Designing for and evaluating the effect of interactive television programming on the comprehension of children, aged 4 to 5.

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This thesis is presented for the degree of Doctor of Philosophy of Murdoch University, 2012
I declare that this thesis is my own account of my research and contains as its main content work which has not been submitted for a degree at any tertiary education institution.

Signed: Hamish McPharlin
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Abstract

Making a television programming genuinely educational for young children is a difficult
endeavour; hampered primarily by the mass audience paradigm of the television
broadcast. The rollout of interactive television services, such as ‘red button’, are a
seemingly natural fit for enhancing the educational impact of children’s television,
through providing the possibility of a reciprocal interaction in line with contemporary
thinking on children’s education. However, to date, there is little evidence of interactive
television applications for children that represent a compelling model of best practice.

This thesis tested the assumption that interactive television can significantly increase
comprehension in young children, ages 4 and 5, when compared to comprehension
results gained from non-interactive programming. This was accomplished in three
phases of primary research; Exploratory, Formative, and Evaluative. In Phase 1, a series
of interviews with children’s interactive television producers were undertaken in the UK
and USA in an attempt to identify the elements of interactive television for children that
amount to best practice. Though there is little academic literature about the affect of
interactive television on children’s learning, this phase attempted to draw insight from
the creators of children’s content in an effort to fill this important gap, and arrive at an
understanding of both iTV best practice and the commercial barriers that hamper this
approach from being realised. The feedback was collated and analysed, and a set of best
practice conventions were produced. The results also found that best practice in
children’s iTV is hampered significantly by the cost of development and transmission of
interactivity, whether by satellite, cable, or broadband.
In Phase 2, this notion of best practice was adopted as the basis for the construction of an ‘interactive construct’; a premise for how a children’s interactive television programme might look if it was built from its inception with interactivity at its core. This construct was evaluated in at a set of preschool classes in Perth, Western Australia. 65 children were exposed to the programme, and data on the performance of the construct was gathered using an attention test, simple observation, and a drawing activity. It was found that the construct was highly engaging for young children, however one particular element was found to hinder their ability to negotiate the construct. The children were observed to be distracted at times when they switched between two simultaneous onscreen activities that bore no relation to each other. The outcome of the study was to recommend that concurrent activities must be contextually related to ensure that interacting participants are not isolated at times that viewers choose to switch streams.

Phase 3 incorporated the insight from Phase 1 and 2 into a final episode of programming for testing. An additional ‘control’ episode was created, in which the interactive elements were removed; leaving a linear programme. Finally, in response to cost concerns raised in Phase 1, an ‘Interactive Stills’ version was created, in which interactivity was in the form of a ‘simple’ execution; forsaking the rich video sequences for still screen images. The hypotheses under investigation were:

1. That the inclusion of interactivity in children’s television programming significantly increases comprehension in children, ages 4 and 5,
2. That the use of ‘simple’ iTV production techniques does not significantly reduce this impact.

199 children ages 4 to 5 from randomly selected schools in Perth, Western Australia, were exposed to the stimulus. Children were randomly assigned to one of the three cells; (1) Control, (2) Interactive Video, and (3) Interactive Stills. Data was gathered using a paper comprehension test, and coding of both attention and engagement with the programming. Statistical analysis found that children exposed to the (2) Interactive Videos stimulus on average scored a statistically significant 23% higher on the comprehension test than those in the Control. It was also found that those in the (3) Interactive Stills sample also performed better than the Control group, and did not demonstrate significantly lower comprehension scores than the Interactive Video group. Children exposed to the Interactive Video did not pay more attention to the programming than the Control group; as such, data indicates that they extracted a higher yield of processing of the programme’s educational outcomes. Behavioural measures indicated that this effect was a result of heightened expectations, and a more intellectual investment in the programming. The study arrived at a set of principles for successful production of interactive children’s programming, and concluded that the incorporation of these principles can successfully increase comprehension of content in children’s television.

It was concluded that this comprehension effect is not contingent upon production values; a critical sticking-point in the widespread rollout of iTV for children. As such,
the use of simple iTV programming, a fundamental cost-saving measure in the commercial children’s programming industry, does not diminish the positive effects seen in this research.
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CHAPTER 1 – Children and Education

1 Introduction

In recent years, the perpetually rapid development of new media technologies has formalised a suite of new television services increasingly enabling audience interactivity.

Bringing a large number of possibilities, and the inevitable throng of acronyms, interactive television services essentially enhance the television viewing experience, the most distinct offering being the addition of choice to the viewer\(^1\). Through using a remote control, a viewer is able to access and control a range of services, including the ability to purchase goods, post messages, access emails, submit information, play games, control on-demand media, vote and, most significantly for this study, manipulate programme content.

Interactive Television, hereafter referred to as ‘iTV’, has been around in various forms for a number of decades (Carey, 1996), and is itself not confined to a particular region, platform, or approach. At present, it occupies a place in the digital television broadcast

\(^1\) For a comprehensive definition of iTV see Chapter 2, sections 1, 2 & 3.
environment, allowing transmission on cable, by satellite, terrestrially, and, most recently, on broadband-delivered platforms. The potential of iTV has been heralded, discounted, and defended since its inception. However, this potential has been considered almost exclusively from a commercial marketing perspective; the addition of choice on the television platform being seen as a key factor in not only immersing and winning over the viewing public, but allowing a consolidation of entertainment, browsing, and purchasing behaviour on the one platform (O'Rorke, 2001).

What has received very little attention, however, is the potential of iTV to provide a powerful vehicle for children’s education (Revelle, 2003). From studies of linear television, the educational community has come to understand that television can be a powerful educator (Huston and Wright, 1994; Clifford, Gunter and McAleer, 1995). The ability to interact and make choices on this rich media platform provides great latitude for possibilities in education. Though linear television has always comprised an element of interactivity through motivating children to sing along, send in a letter, or shout out the answer, iTV is unique in that both the audiovisual experience and the choice are integrated into the one platform (Gawlinski, 2003). The effect of this integration is threefold. First, it provides greater immediacy; when the child clicks a button, the choice is made instantly. This is distinct from sending in a letter to a programme or visiting its website, in which feedback to the sender is delayed. Second, the very young viewers not only make choices, but see the immediate consequence of their decisions. This is distinct from shouting an answer to the screen; in iTV the choice the viewer makes can directly change the way a story unfolds. Third, the choice made creates a unique viewing
This is distinct from sending a vote in to a reality programme; in iTV a choice affects only the viewer’s personal experience, not the entire audience.

This integration of a rich media, audiovisual experience, and the reciprocal exchange of information between viewer and broadcaster, suggests a formula with considerable educative potential, which will be investigated in this and the following chapter. As iTV is still a developing technology with a generally expensive and competitive element to its development, this potential has largely not been pursued. More specifically, the measurable differences between linear and iTV experiences for a young child have not been formally tested. At this stage of iTV deployment, this is an important question for Children’s Television (CTV) developers; it occurs predominantly because development of an expensive new technology without demonstrated proof of its benefits beyond linear television has lead to considerable inertia in this sector of the industry (Revelle, 2003). This thesis will examine the impact of iTV using multi-method research to investigate industry deployment; develop original iTV programming; perform usability tests; and empirically compare iTV effects with a linear equivalent in early childhood programming. In doing so, it will explore both the educational impact of interactive television experienced by a child, and any differences in viewing behaviour that may arise from it.

Interactive television can be delivered in a number of different forms. Although this research will empirically test iTV and linear programming, it is concerned with the most direct counterpart to linear educational television, an iTV form known as synchronous
programming. Synchronous programming is so-called due to the synchronising of the interactive enhancements with the events in the programme during the broadcast. It is the most visually rich and immersive of the iTV models, being presented in a form demonstrating some forms of interactive enhancement (further discussion can be found in Chapter 2, section 5.3). It is possible to present it as either a one-off production or episodic, though the latter is virtually non-existent at present. The enhancements vary both in their production values and their level of integration with the central storyline or theme of the programme. Synchronous programming for early childhood is vastly under-utilised, chiefly because the expense required for its development has not been balanced by an awareness of how such content is created for this audience, the necessity to understand correct interactive design, or belief in its educative capacity. This thesis will also develop and suggest conventions for appropriate iTV programming for this age group through exploration of contemporary educational theory and practical usability tests.

The findings of this study are intended to make three contributions to the field. First, they intend to provide suggestions for an extension of contemporary studies on television viewing behaviour. In doing so, they draw from both traditional television research and computer-based usability experiments in order to explore potential changes associated with television’s evolving landscape. Children’s viewing behaviour is an intensely examined domain. This study compares and contrasts contemporary findings of research into children’s viewing behaviour under iTV conditions. For educators, child psychologists and media developers it will provide both an extensive background of iTV
programming and an analysis of the benefits and drawbacks of using the iTV platform as a tool in the education of young children. Second, for media developers this research provides an empirical exploration of whether iTV is an effective tool for children’s educational programming, articulating a list of principles for producing appropriate content informed by both educational theory and practical testing in this environment. Third, a consideration of its feasibility in terms of production and delivery costs is included, together with a formal analysis of whether effective results can be retained while reducing costs in certain areas.

This chapter is followed by an extensive investigation into iTV in Chapter 2, including an exploration of its various models, delivery platforms and broadcast methods. Current projects and recent advances are explored in order to outline the myriad technological constraints and commercial concerns that hinder iTV production. Finally, educational concepts reviewed in the present chapter are incorporated into a discussion of what iTV can realistically produce and deliver. Then Chapters 3, 4, and 5 respectively outline the development of the hypotheses, research methodology and stimuli of the experiments. Two preliminary studies are then implemented: Chapter 6 presents the results of an interview study with industry practitioners involved in children’s iTV programming; while Chapter 7 records the results of a study testing the usability of the research instrument. The findings of the major study are then reported in Chapter 8, with discussion and conclusions described in the final chapter.
This chapter introduces the research topic, presenting evidence that the structure and design of the iTV platform provides a closer alignment with contemporary approaches to early childhood education than linear television has previously been able to accomplish. It does this through an exploration of current educational theory and an investigation into how this television form has attempted to translate educational methods to the screen. It contends educational methods to be inherently interactive in nature, and as such are more ideally suited to an interactive platform such as iTV. This contrasts with the structurally one-way format of linear television, which mirrors a more didactic educative approach. The chapter concludes that iTV, conceptually, is better able to deliver educational methods onscreen for early childhood viewers. Following a review of the technology of iTV in Chapter 2, this assertion is tested in an experimental setting.

2 Rationale

The efficacy of educational content, as with any content, is the affected by the manner in which it is transmitted and received. Educational subject matter is transmitted in a variety of forms for the early childhood age group, including television, radio, print, toys and devices, computer-based content, and through human interaction in a classroom or at home. In each case, the particular limitations of the platform can affect the impact of the subject matter on the receiver. In the classroom educational content is transmitted using reciprocal human interaction. Three factors influence this exchange: the subject matter to be taught, the teaching style incorporating this content, and the child. Wright and Huston (1983) refer to the latter two factors respectively as the ‘content’ and ‘form’ of the exchange; the implication being that when educational goals are presented on
other platforms, such as television, the ‘form’ in which the educational content can be delivered changes and is shaped by the technical characteristics of the medium. The form of linear television, rather than consisting of the elements of reciprocal human communication, is predominantly a one-way experience. Subsequently, tensions exist in television–based education for children on how best to present styles of contemporary education advocated in the literature (Anderson and Lorch, 1983; Huston and Wright, 1983; Huston and Wright, 1989; Schmitt, Anderson and Collins, 1999; Fisch and Truglio, 2001; Revelle, 2003).

This chapter will outline why contemporary theoretical approaches to childhood education have traditionally struggled to find purchase on the linearly structured mass-media model of broadcast television. This is because education is inherently an interactive pursuit, and by its very nature is a reciprocal exchange between learner and educator. As a review of contemporary approaches in the next section demonstrates, one of the principle features of education is the ongoing assessment of the needs of the learner, and the flexibility to alter teaching patterns to allow these needs to be met. The challenge in bringing educational concepts to the screen, therefore, involves recognising learning to be a dynamic process that is rarely linear. Teachers do not merely disseminate knowledge, they facilitate the gaining of knowledge; structuring learning experiences based on input received from the learners themselves. At this juncture, the form of linear television fails fundamentally to provide a structure which can successfully incorporate learning goals as intended. As is investigated in section 5, developers have brought many educational concepts to the screen. However, this lack of
a structure allowing a reciprocal exchange of information has hampered a complete incorporation of preferred educational techniques. Interactive television, however, does provide this reciprocal functionality. With the use of a two-way data path and the ability of the viewer to provide input using a remote control, the infrastructure exists to allow a closer alignment to an educational experience observed in the one-on-one characteristic of the teacher-student relationship.

3 Concepts in Education

Learning techniques utilised in educational television find their source in contemporary education literature. However, due to differences in structure of television platforms, some of these techniques have met with little success, while others are effectively deployed using the strengths of television to their advantage. This section examines education principles of early childhood that inform children’s educational television. It should be noted that contemporary philosophy in early childhood education is an extremely complex and comprehensive discipline. It is not the role of this thesis to argue for or against various positions in what is inevitably a pluralistic domain. Rather, it highlights relevant current educative concepts that have either been used in children’s television or contain elements ideally suited for its delivery on an iTV platform.

Much of what constitutes contemporary educational theory stems from how educators believe the child acquires new knowledge. For instance, if the child is viewed as merely absorbing knowledge in a systematic fashion with little or no cognitive intervention on their part, then the educational focus transfers to the teacher’s role in the dissemination
of that knowledge. Within this approach, the teacher is seen to convey knowledge systematically; and children’s success is judged by the extent to which they absorb an exact replica of the teacher’s understanding. This view finds its origins in the concept of *tabula rasa*, the ‘blank slate’, of philosopher John Locke’s 17th Century view concerning human reality. This holds that when born, a person’s mind is without history, reference, or substance; it is ready to be filled with knowledge and experience. In educational terms, the child is seen as being either a malleable object capable of being crafted into shape, or an empty vessel capable of being filled with knowledge (Kliebard, 1975b). Examples of this ‘teacher-centric’ line of thinking became prominent in the mid 1900’s, being commonly referred to as a ‘traditional’ teaching approach (Spodek, 1982).

Alternatively, if a child is seen as constructing knowledge based on their own mental schemata then focus may be given to the child’s cognitive processing (Kessler, 1991). Within this approach the teacher may be seen as a facilitator of understanding, wherein the child is considered as actively decoding and interpreting content; the environment playing a significant role in the manner in which this content is constructed (Boethel and Dimock, 1999; Alanen, 2001). Examples of this ‘child-centric’ line of thinking can be seen in the work of Swiss psychologist Jean Piaget, among others, and the introduction of the ‘constructivist’ perspective on childhood education. Just as these approaches influence how a teaching-learning method is structured, so too are they mirrored in the development of educational television content. This is discussed in more detail in sections 4 and 5.
The ‘traditional’ approach incorporates an education method known as ‘instruction-centred’ teaching. This school of thought was common practice in the Post-War 1950’s, wherein the student was considered as “raw material to be transformed into a finished and useful product under the control of a highly skilled technician … The outcome of the production process is carefully plotted in advance according to rigorous design specifications” (Kliebard, 1975b, p. 84). Theorists point to many catalysts being responsible for the prevalence of the traditional teaching model of this period. One such catalyst is the formalisation of the early childhood kindergarten into the western education system. As the kindergarten slowly gained acceptance as a part of early childhood education in America, so too did the expectation that it subscribe, at an early age, to the continuities of the educational process; specifically locking step with the schooling system which had absorbed it (Spodek, 1982). Additionally, manufacturing and production procedures were undergoing massive improvement, thereby providing a model for production that influenced other areas of society, including education. Under this extant mode of thinking, the school was now an assembly line, crafting its students into acceptable and capable citizens. Cubberly (1916) exemplifies the thinking of the time:

“Our schools are in a sense, factories in which the raw products (children) are to be shaped and fashioned into products to meet the various demands of life. The specifications for manufacturing come from the demands of twentieth-century civilisation, and it is the business of the school to build its pupils according to the specifications laid down.” (p.338)
As such, the development of instruction-centred learning was largely influenced by societal forces, rather than formal research into children’s learning patterns.

Alternatively, a child-initiated approach is devoid of such rigidity and objective-setting. Children are seen as actors in, rather than recipients of the learning process. Rather than patterning an exact replica of the disseminator’s knowledge, a child is considered to ‘construct’ knowledge from their own experience, a concept known as ‘constructivism’ (Prout and James, 1990; Golub, 1994; Cairns, 1998; Boethel and Dimock, 1999; Alanen, 2001; Waldron, 2006). This philosophic position contends that a child’s understanding of a concept is influenced by their own mental schemata and life experiences, thus not necessarily being a mirror of the understanding disseminated through the direct instruction of a teacher. This mode of thinking shifts the focus from the teacher to the child’s developmental level (Spodek, 1982; Charlesworth, 1998).

The work of Swiss psychologist Jean Piaget was seminal in the field of developmental psychology. Piaget’s research covered many aspects of human development, but it was his contribution to children’s development that serves to inform this study. Through years of testing and observation of children – even his own – Piaget began to notice patterns of behaviour in children of similar ages. He observed that a child’s method of interacting with the world around them evolves as they develop increasingly sophisticated ways of interpreting their surroundings (Paciorek and Munro, 1999). The child’s world gets larger as their intellect develops in its ability to grasp it. Piaget
theorised that children’s development consisted of the child moving through a series of stages at approximate ages, where successful attainment of one stage allows for development of the next (Spodek, 1982). Piaget concluded that children’s learning is therefore ‘constructed’ through their experiences with their environment and other people (Kessler, 1991). He described the process of *assimilation* and *accommodation* by which this construction takes place. Bruner (1983) explains that assimilation is the process of shaping experience to fit one’s mental schemata; and accommodation means the changing of one’s schemata to fit experience. Therefore, when considering a learning experience in which the child initiates personal learning, the manner in which the environment is shaped accords with what is personally known, and the feedback received from the environment *shapes* what is known.

Piaget’s thinking on progressive stages of development attracted criticism on a number of fronts (Kessler, 1991; Fleer, 1992; Fowell N. and Lawton, 1992). First, Piagetian theory considered early childhood development as moving quite uniformly through set stages, and in the opinion of many investigators, “ignoring, to a large extent, the impact of culture, class, gender, race, or disability on children’s realities” (Waldron, 2006, pp. 85-86). As such, Piagetian theory was regarded by most as too simplistic and not applicable to many situations. Additionally, findings emerged indicating that children can commonly have radically different competencies at similar ages (Weddell, 2003). As a result of this, the social context of children’s experiences came under focus as a major contributor to their understanding, and ushered in new dialogue on how children construct knowledge.
One of the major criticisms of Piaget’s work implied that his method of testing sometimes failed to take into account a socio-cultural perspective. Some of his previous studies were replicated by researchers who found that children responded differently to experiments when these were based within alternative contexts (see Fleer, 1992), enabling theorists advocating the influence of social context on a child’s development to come to the fore (Honebein, Duffy and Fishman, 1993; Duffy and Cunningham, 1996).

In particular, the work of ‘social-constructivists’ such as John Dewey and Lev Vygotsky reached prominence, primarily for promoting the influence of the social environment on children’s learning. Dewey, born in 1859, was a supporter of developmental theory in education, but maintained the critical role of the child’s personal experience and the social context in which this development takes place (Dewey, 1931; Dewey, 1938). For instance, in terms of developmentally based education, Dewey advocated the need for a child-initiated approach to themes and activities. In his undated work, ‘My Pedagogic Creed’, Dewey (nd, p.15) explained: “only by the continual and sympathetic observation of children’s interests can the adult enter into the child’s life and see what it is ready for…”.

Dewey’s writing on the influence of the social environment has emerged as an important contribution to contemporary thinking, and in doing so, has provided a vital realignment of the developmental approach. Again in ‘My Pedagogic Creed’, Dewey (nd, pg.15) states:
“The only true education comes through the stimulation of the child’s powers by the demands of the social situations in which he finds himself. Through these demands he is stimulated to act as a member of a unity, to emerge from his original narrowness of action and feeling.”

In 1896 he put his ideas into practice when he created an experimental school for young children, based at the University of Chicago.

Years later, theorist Vygotsky (1978) refined the social constructivist approach, bringing new clarity to the relationship between instruction and development. He advocated a child’s learning not to be an isolated process whereby a child constructs learning with little or no guidance from the environment or teacher; a position in contrast to the work of Piaget (Thomas, 1992). Rather child’s learning comes about through stimulation of the developmental ability, and challenges to their existing understandings (Fosnot, 1992). He suggested that a child’s understanding derives from the twin processes of understanding at a social level (inter-psychological) and the subsequent internalising on an individual level (intra-psychological) (Vygotsky, 1978; Moll, 1994; van Geert, 1994). Thus, children’s learning was considered to require this social input in order to effect an internalisation. In ‘Thought and Language’, Vygotsky asserted that an educational approach can only be effective when it “marches ahead of development and leads it; it must be aimed not so much at the ripe as at the ripening functions” (Vygotsky, 1986, p. 188). This implied that, not only is there a place for instruction in early childhood education, but also that learning is an ongoing dynamic process (Brooks and Brooks,
Additionally, it acknowledged that children’s developmental abilities may range considerably in a given age group, a concept not directly accounted for in Piaget’s developmental theory. As such, Vygotsky’s position on education was that neither direct instruction nor development are the sole catalysts for a child’s learning; rather, whilst development can occur naturally, instruction, if performed properly, can accelerate development (Smith, 1996). This principle was incorporated into Vygotsky’s theory of the ‘Zone of Proximal Development’ (ZPD) (Smith, 1996; Lubek, 1998; de Vries, 2005). The ZPD was used to explain the process whereby instruction contributes to learning. Vygotsky (1978, p.86) defined the ZPD as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers”.

Vygotsky’s ZPD did not discount developmental theory in general, his position being that instruction should lead development, not match it. A child’s learning occurred when the existing mental schemata were challenged. When it came to the question of either meeting or challenging this learning, (Vygotsky, 1986, p. 189) warned against orientating instruction “towards the child’s weakness rather than his strength”. In teaching practice, implementation of the ZPD involves the teacher as facilitator, posing problems and questions to a child “just a bit beyond what the child knows already, but not so far that the child cannot learn when provided appropriate guidance” (Harris and Pressley, 1991, p. 392). In this way, the child moves to a higher level of understanding than had they not received the input (de Vries, 2005). This naturally requires skill from
the teacher, and is commonly incorporated into a teaching device known as ‘scaffolding’ (Bruner, 1985; Schifter, 1996). Scaffolding, also known as ‘guided participation’, involves the practitioner building upon children’s play by asking questions, suggesting scenarios, and providing suggestions and help for a child who encounters difficulties in lessons or play (Bruner, 1985; Berk and Winslet, 1995). A feature of scaffolding is that the teacher’s role in the experience lessens as the child gains competence in the exercise. Concepts such as scaffolding pose challenges for educational television programming.

Contemporary teaching involves a predominantly interactive approach, where feedback from the child is important in the assessment of their educational needs, and the ongoing restructuring of what must remain a flexible approach based on these needs. Much of how these concepts are incorporated into television programming is based on whether children are considered an active or passive audience.

4 Children as Active or Passive Viewers

The implications of the concepts mentioned in the previous section provide unique challenges for children’s educational television. A major assumption of educational theory holds that children cognitively process concepts in an educational setting; thus successful translation to the television platform relies on children processing programming content in a similarly active way (Anderson and Lorch, 1983). Adherence to either of these conventions directly influences the manner in which this programming is structured.
Contemporary education theory holds that children are active learners, thereby influencing the degree to which educative concepts are incorporated into programming. In theory, a television programme can be designed for an ‘active’ or ‘passive’ audience. For instance, the notion that children passively absorb information on television favours a direct-instruction programming method, which assumes that a child’s learning is entirely contingent upon the systematic dissemination of information. The programme, therefore, would seek to provide instruction beyond the child’s developmental level in order to advance the understanding of the viewer. Content would be academically-based, didactic, and challenging; questions posed to the audience would have only one answer; concepts would be taught systematically without specific reference to their social context; and both pace and level of difficulty would increase as time passed. In this way, educational concepts on television could reflect a direct-instruction method of learning, catering to a passive audience.

While this approach, the equivalent of traditional teaching methods, is ideally designed for a linear platform such as television, research has frequently demonstrated that children are active viewers of television (Collins, 1979; Collins, 1982; Anderson and Lorch, 1983; Wright and Huston, 1983). Programming based on an active audience model assumes that children actively process the content. The viewing audience therefore interprets programming according to their own life experiences - a constructivist approach.
An active model may approach programming in a number of different ways. For instance, programmers may adopt a Piaget-inspired developmental learning approach. Assuming that childhood development moves through progressive stages, the level of difficulty, pace, and subject matter would be standardised according to pre-defined age groups. This approach would seek to provide programming that does not challenge the viewer beyond their developmental level. Difficult terms would be made explicit and events would be predominantly entertaining and presented in social contexts. As children construct their own understandings, specific concepts would not be taught; rather programming would portray ideas, events, and themes designed to motivate children, expanding their knowledge by seeking out further information. The programme would have a specific target audience with the intention of developing content designed to meet the capacity of this audience directly, and avoid approaches that confuse or isolate. This approach might utilise the constructivist theory advocated by Piaget in which the level of programming difficulty is designed to target a developmental level. However this can be problematic because it carries an underlying assumption that audiences are a predominantly homogenous group, in which age neatly corresponds to a stage in development.

Programming based on an assumption of active viewing may also adopt the educational approaches advocated by Vygotsky, which assume that a child’s level of development is not a function of age nor based on predefined criteria. Thus levels of difficulty addressed in programming would be designed to “march ahead” of children’s understanding. On a mass-media platform, this ‘interactive’ approach to television inspired education
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requires feedback from the viewer in order to function adequately. Classroom-based learning and teaching allows a two-way interaction between educator and child, a feature not traditionally available to television programming. As a one-way medium, the design of television appears to present a largely non-interactive approach, rendering difficult the prospect of including the input of both child and educator in equal measure. As such, the incorporation of contemporary teaching approaches onto the television platform is fraught with difficulty. The following section provides an assessment of these concepts, and evaluates the process of incorporating them into the linear television model.

5 Education and the Television Platform

The reciprocal interaction between the teacher and child is a fundamental part of a successful learning experience (Kessler, 1991; Boethel and Dimock, 1999; Alanen, 2001). One reason for this is that it allows the teacher to assess a child’s progress continuously, and moderate any elements if so required. This opportunity to respond to feedback in real time is not a feature of linear television, whose one-way transmission method has required programmers to seek other methods of inculcating educational experiences. To enable an understanding of iTV’s role in children’s educational programming, it is important to investigate ways that CTV has attempted to bring some of the principles of learning through social interaction to the screen.

Due to the heterogeneous nature of a television viewing audience, perhaps CTV’s most fundamental restriction is not being able to tailor its message to a particular viewer’s
level of ability. While one child may understand a certain concept, another one may require further explanation. CTV instead commonly presents content at varying difficulty levels to capture the understanding of a wider audience (Aletha and Wright, 1998). This presents an unusual problem; one particular educative segment may directly meet one child’s cognitive abilities, completely exceed another’s, and slightly challenge a third. The programme, therefore, is unable to provide a distinction between a developmentally focused learning experience or one that challenges a child’s developmental state; thereby stimulating the ZPD. For this to occur, filtering of the audience would be required so that an appropriate difficulty level could be presented. A ZPD effect may be achieved, more or less, however, with a process called ‘layering’ (Bickham, Wright and Huston, 2001). In this method, different levels of complexity are presented on one subject with the aim of slightly exceeding each child’s understanding at least once. The additional benefit of this method is that, theoretically, repeated viewings will retain the interest of viewers as they begin to understand more and more of the subject matter.

The principle of scaffolding in a learning context (Bruner, 1985) poses similar difficulty for those endeavouring to implement this principle in a television environment. A fundamental element of scaffolding comprises the systematic reduction of the support of the educator as the child develops in its ability to master the concept (Revelle, 2003). As the primary platform of learning in CTV is onscreen, this is a difficult proposition. Generating interest in a subject or theme for a child, and motivating it to investigate further when the programme is concluded may be considered a rudimentary form of
scaffolding; but it certainly does not contain the finesse of gentle support reduction one would normally expect in a face-to-face setting.

Creating a constructivist learning environment in CTV is problematic, primarily because such a circumstance contains elements of flexibility and exploration for the child; both of which are challenging prospects for television. This type of learning normally involves the child’s ability to manipulate objects, make decisions, and have a measure of autonomy in their learning at certain points (Revelle, 2003). CTV has been known to incorporate this by including the child’s physical space as part of the learning experience. An activity involving a child doing craft in front of the television is an example of a constructivist learning experience included in a linear television programme. Aside from the ability to manipulate objects, the linear television experience is able to embody social constructivist principles in another sense. As it is a rich-media device, concepts are able to be integrated into social contexts and deliver holistic, rather than didactic learning experiences. For example, one programme may present the concept of counting to 10 using a traditional approach by going through a sequence from 1 to 10; perhaps using puppets or animation as a visual aid. However, another may incorporate this concept into a real to life context involving a character baking a cake. In the course of mixing the ingredients, the character counts out eggs. Counting out some eggs, and then perhaps noticing how many are left in the carton, enables children to understand numbers in a social context in which they are familiar. In this way the child then understands not only how to accomplish the task, but why and in what cases counting would be an important skill to have. This approach can be used for
numerous tasks such as helping children make sense of emotions, social skills, and relating to adults or younger children. In addition it can introduce themes and topics that may excite them, all with the intention of stimulating imaginative, educative play. If used properly, the television platform, with its ability to depict limitless scenes, characters, and locations, is able to provide a diverse range of social contexts for learning far more effectively than in a classroom setting.

However, broadcast television remains a one-way transmission path, which severely limits the abilities of the programme to provide appropriate content to its specialised audience. These necessary components of learning have found more support in computer-based learning, in which a two-way interaction is better supported by the platform. The concept of scaffolding, therefore, is able to be implemented far more effectively in this interactive platform. In a computer learning experience, support can slowly ‘fade’ to give increasing autonomy to the user (Jackson, Krajcik and Solowey, 1998). Herrington and Standen (2000) describe a successful incorporation of social constructivist learning in a computer-based statistics learning module for university students. Rather than systematically teaching and testing students on the various

Figure 1: Using social constructivist principles in computer-based learning (from Herrington and Standen, 2000)
statistical analyses, the programme was altered to reflect a bank situation; the student being a ‘new employee’ (Figure 1). Meetings with the bank manager gave the new employee their tasks for the day, and the students then set about figuring out problems. Meetings involved discussions about the nature of the task at hand, with students being challenged to choose from a range of questions to ask. At hand was a mobile phone to call other colleagues for help, as well as files to consult in a cabinet. Students could then export their data to a statistical package and complete the assignment. In this way, rather than being given columns of data to decipher, participants were taken through a genuine, socially-grounded task. As students gained more familiarity with the programme, they could progressively reduce their use of support devices such as the scaffolding effect of a mobile phone.

For the early childhood audience, examples of scaffolding can be seen in interactive products designed by the Sesame Workshop. In their computer-based products, children face increasing levels of difficulty. However the key to this, explains Revelle (2003), is understanding that the concept of ‘increasing difficulty’ is not necessarily a mere increase in pace, or demands on motor skills. Rather, an increase in difficulty gradually introduces greater demands on higher-order thinking. For instance, a low difficulty question might test a child’s recall of a song, but a greater difficulty level would require her to explain what the song is about. This hierarchy exemplifies Bloom’s Taxonomy of Learning Objectives (Bloom, 1956). This theory holds that cognition is “cumulatively hierarchical”, in that its application requires understanding, which in turn requires recall (Furst, 1981). An educational concept can therefore be aimed at each level of this
hierarchy to manipulate the cognitive demands of the learning experience (see Figure 2). In children’s learning, for instance, an initial task might involve remembering the words to a poem (recall); an intermediate level task might involve explaining the meaning of the poem’s theme (understanding); and finally, a higher order task might require drawing a picture illustrating the theme in a different context (application). In the Sesame Workshop example, the use of this taxonomy means that learning becomes a progressive dynamic in which children’s increased ability is a reflection of their understanding, and not merely their familiarity with the activity.

Additionally, scaffolding is incorporated through the use of ‘hint structures’, in which hints are offered at times of difficulty, rather than the over simplification of labelling an answer ‘wrong’. An initial hint provides marginal assistance, with subsequent difficulty which might be encountered provoking greater assistance. Hints also ‘fade’ as a child’s abilities improve; a vital element of the scaffolding method.

These techniques illustrate the power that a two-way platform can bring to learning, through a reciprocal interaction with the learner. Television has traditionally been unable
to incorporate these to any great effect. Though the television platform provides a high quality, rich viewing experience, with a variety of paces, scenes, and cinematic devices to drive its teaching efforts, it is hampered by the mass media model, in which each viewer receives uniform content and has little opportunity to respond, make choices, or explore. The incorporation of the interactivity into CTV transmission holds exciting prospects for successful delivery of interactive learning methods on television.

6 Conclusion

Interactive television’s position as an ideal educational vehicle for contemporary educative goals is, at this stage, largely theoretical. This research represents an attempt to explore this opportunity further, and to discover both whether the achievement of educative goals are enhanced by its use; viewing behaviour being modified as a result. Additionally, iTV is still a developing platform, and learning how to wrest compelling content from its processes requires an understanding of its myriad technological limitations. Chapter 2 reviews the technology of iTV, with an investigation into broadcast methods, iTV models, and technological limitations. It also provides evidence of innovative ways that have enabled content developers to overcome some of these limitations and provide compelling interactive content for children. It concludes by revisiting the concepts introduced above by discussing the benefits of using an interactive platform, usability issues that can hinder its impact, and the potential of iTV to be more closely aligned with educational goals.
CHAPTER 2 – Interactive Television and Children

1 Introduction

As early as the 1970’s, people have been experimenting with a variety of new technologies designed to provide interactivity for television services; often referred to as interactive television (iTV). With its promise of the emotional engagement of television, and the individualised interactivity – and trackability - of the internet, iTV was originally considered the ‘perfect medium’ (Kaplan, 1992; Weinscheck, 1993). What this new technology offered - for both viewers and programmers - was a more dynamic, active model of television that offered a way for someone to not only receive individualised programming or to interact with the content that they receive, but to ‘shout back at the world’ (Waters, 1977, p. 107); a reference to the potential of iTV to bring an increased level of reciprocal dialogue and empowerment to the individual in a digital community.

Thirty years on and, while interactive television has not yet reached the level of supremacy foreseen by its jubilant heralds (Kim, 2001; Walley, 2006), it is nevertheless a strong, rapidly expanding technology, whose place in the world of communications is
still evolving. The world’s leading media companies are in the process of switching their broadcast services from an analogue to a digital signal, and as this is progressively rolled out in different markets, viewers will increasingly have access to digital interactive services. At the same time, the rapid growth of broadband internet in the home is paving the way for a much more powerful set of delivery options for getting interactivity onto a consumer TV set.

Interactive television is a part of a technological convergence that is developing around the world (Buckingham, 2003). In a time when viewers can access a music video on their mobile phone, watch TV on demand through an internet-connected television, or send an SMS from their computer, technological developments are blurring boundaries between devices and platforms. iTV blurs the boundaries between broadcast television services and computer technology by allowing compressed, digital data to be broadcast along with the programming. This means that a programme can feature extra enhancements such as multiple angles or extra content, or it can provide control; such as influencing the direction of a narrative, choosing what you want to watch, or purchasing products.

A technology that encourages active participation opens the door for interesting possibilities in children’s educational content. When it comes to education, the idea of placing control of the learning experience in the hands of the preschool child is a concept that finds its source in contemporary views of education (Revelle, 2003). Children’s television has always sought to provide a level of interactivity. Mr Squiggle
(ABC TV, 1959 - 1999) encourages children to send in designs for him to draw with; Sesame Street (PBS, 1969 - present) characters address questions and comments directly to the viewer; presenters on Play School (ABC TV, 1966 - present) instruct children to fetch egg cartons for craft time; and The Wiggles (ABC TV, 1991 – present) invite the child to sing and dance along with them. What interactive television provides is a platform that allows a two-way interaction between the child and their viewing experience; a platform where they can use their remote control to participate in a quiz; seeing their score in real time on the screen, or they can decide which direction a character should go; influencing the turn of events in the narrative. While children have, in a sense, always interacted with their television, iTV allows the child to not only interact but to observe the effect of their interaction.

Studies have demonstrated that, despite ideas that television has a detrimental effect on children’s learning; its capacity to be a powerful device is a question of content rather than form; specifically its ability to broadcast a rich, immersive experience to a mass audience (Fisch, 2005). In an American longitudinal study of 570 adolescents, Anderson and colleagues concluded that the educational impact of television was measured by content of programming, rather than exposure (Anderson, Huston, Schmitt, Linebarger and Wright, 2001). This thesis argues, similarly, that the power of interactive television lies not in the mere administering of interactivity, but in the ability of the programmer to make this interactivity an inherent, natural, and vital part of the execution and the learning goals.
In order to assess the potential of interactive television to educate the early childhood audience, it is necessary to start with both an understanding of iTV technology and an understanding of how interactive media – via broadcast or otherwise – has been used to educate children. This is primarily because interactive television is often an inflexible, costly medium, and success in leveraging its potential requires a deep understanding of how to draw compelling and appropriate content from its processes. This chapter explores the technology of interactive television including transmission formats, execution styles, and advances in the way it is created. It then examines the uses of interactive media for preschool children, and investigates the ways in which interactive television can be used as an educational tool.

2 Background

Interactive Television has been deployed in different ways around the world, with the result that countries not only use differing terminologies, but deploy interactive services in different ways and with different results. This thesis will primarily concentrate on the technology, terms, and examples of interactive television activity in the United Kingdom. This is for two reasons: Firstly, the UK has one of the fastest rates of takeup of digital television. While the U.S. has a larger television market overall, in Q1 of 2010, 92.1% of UK homes had digital television (OFCOM, 2010), a digital takeup that has outstripped the US over the preceding years (OFCOM, 2008).
Secondly, the United Kingdom also currently has one of the most active interactive television industries in the world (Quillenan, 2005). The speed of digital takeup, and large subscriber bases of powerful pay platform operators such as Sky has given the UK a decade of experience and innovation in interactive television. The BBC’s red button services attracted 12 million views per week through 2010, showcasing interactivity for, among others, the World Cup, Wimbledon, and the Glastonbury festival (Wright, 2010). UK channels CBeebies and CBBC have maintained a consistent presence for many years on the BBC interactive portal with children’s games, stories and activities. Companies such as Disney UK and Nickelodeon have produced and offer consistent interactive content for children, and a number of innovative iTV programmes for children have been created. Through this scale of deployment since 2000, UK content producers have not only seen the effect of their iTV work over time, but have been able to consider the economics of interactive development, and what constitutes ‘success’. The UK has reached a maturation of the process of developing interactive services that enables it to provide numerous practical insights, findings, and advances in technology, making it an ideal point of investigation for this thesis.

3 Defining Interactive Television

It has been the advent of iTV itself that has forced many companies and regulators to rethink their ideas about the use of the word ‘interactive’. For example, in 2002 the Canadian Radio-Television and Telecommunications Commission discovered that, in an investigation into their own growing iTV industry, ‘it is difficult to define interactivity
because the term can be used to describe aspects of many rapidly evolving products and services’ (CRTC, 2002, p. 2). Indeed, the concept of ‘interactivity’, while increasingly used in reference to interactive television, has been a part of the media environment for many decades. From shopping on the internet, phoning in to a talk show, writing away for more information, to perhaps even tapping your foot to a music video, producers have always attempted to make television more interactive (Gawlinski, 2003).

However, developments in technology have resulted in the development of broadcast television that allows the user to control their viewing environment; and the term ‘interactive television’ has been adopted. Therefore, in order to define iTV’s contribution to the television environment, it is necessary to define how television historically has sought interactivity. Linear television’s level of interactivity can generally be seen as comprising two forms. Firstly, the programme can cause the viewer to react in some way, by perhaps dancing along to a song, answering questions on paper in a televised IQ test, or shouting out an answer to a quiz. The latter activity was defined in the mid-fifties as ‘parasocial interaction’, and referred to the practice of viewers engaging in dialogue with a television broadcast (Horton and Wohl, 1956). Secondly, the viewer can use a form of media to interact; perhaps texting a vote on their mobile phone, commenting on an online forum, filling out a brochure, or phoning in to pledge a donation. The distinction between these two activities is that the latter involves the sender receiving some form of immediate response.
So while interactive television involves both of these forms of activity it cannot claim to be defined by them, as they have traditionally been a part of the television experience.

To illustrate this; many point to the 1953 as the birth of interactive television with the launch of *Winky Dink and You* (Carey, 1996; Bukowska, 2001; CBS News, 2002; Gawlinski, 2003; O’Modhrain and Oakley, 2003; Smith, 2003; Schwalb, 2004; Lu, 2005). The CBS children’s programme, hosted by Jack Barry, invited children to participate in the programme by purchasing a clear plastic overlay and using it to help get Winky out of trouble. For example, to help Winky get off an island, children would be encouraged to use the overlay on the screen to draw a bridge for him to escape (Figure 3). While the child did not directly affect the course of events in the show, or change them in any way, the act of participation and the *illusion* of cause and effect was enough to represent interactivity.

This is a point of contention, though, for differing ideas persist about what actually constitutes interactivity. For instance, Srivastava (2002) defines interactivity as control over content. When it comes to traditional television viewing he argues that, in the sense that you cannot make choices that impact on your viewing of a show beyond the changing of a channel, linear television is a passive medium (Srivastava, 2002, p. 79). Gawlinski defines interactive television as anything that ‘lets the television viewer and the [producers] engage in a dialogue’ (2003, p. 5). However,
just how tangible and immediate you view this dialogue to be can inform how interactive the experience really is. For instance, author Julian Dibbell contends that broadcasters receive feedback from viewers via other channels, such as ratings and letters to the editor, rather than via the TV (Dibbell, 2000), and that these also constitute return paths; albeit slower and more fragmented ones.

Dibbell (2000) also states that interaction occurs in the mind of the participant, regardless of the return path. This is an interesting proposition, for, as is investigated later in this chapter, sometimes iTV itself only gives the appearance of interactivity. Ironically, in the case of switching between synchronous video streams, the reality of the interactivity as it is currently deployed through broadcast signals, is effectively sometimes little more that a channel-switch itself. This begs the question; is the site of interactivity in the lounge room or in the production studio? Or more importantly; like Winky Dink and You, is it enough that the experience just appears interactive?

It is perhaps because of these complexities that few can agree where to draw the line when it comes to defining interactive television (Stienstra, 2001; Lu, 2005). It is useful, then, to distinguish between an interactive experience, such as Winky Dink and You, and interactivity as a technological platform. The issue is further compounded by the fact that different markets and countries use different terms to describe interactive products and features. One particular example is the different uses of the terms ‘interactive television’ and ‘enhanced television’. For instance, iTV is an umbrella term that is defined as any use of broadcast television that involves active participation from the
viewer. This can include such activities as choosing your location for a weather report on a news service or voting on a reality television programme. However, the term ‘interactive television’ is also used to describe a subset of this umbrella term (Krause, 2003). In this case it describes interactivity that involves using the return path (also known as a ‘back channel’) via the set top box. It is therefore distinguished from ‘enhanced’ television, which defines television services that provide enhancements to an existing show, such as extra content, that do not make use of the back channel. There are many ways to consider interactive television, and regardless of these differences in perspective around the world one thing is clear; iTV is simultaneously a more dynamic platform for participation than previous iterations, and its form of interactivity is a convergence of the myriad paths of communication between the viewer and the broadcaster.

In the UK market, interactive television appeared to originally be conceived as a convenience/customisation mechanism more than an educational one. By allowing viewers to use their remote control to see the weather in their location, to see a different Wimbledon tennis court, to send in a vote to a reality show, to subscribe to a new TV package, to read more about a product; all of these enhancements provided a more customisable and engaging experience for the viewer. The reasoning behind these enhancements was also an economical one; content producers could pay a little more to enhance their existing programme and hopefully make some incremental revenue by doing so. This vision would have been essential in selling the idea of interactive TV to the industry, but what was largely overlooked in the process was the educational
potential of such a technology; the ability to take that engagement and turn it into learning.

4 The Technology

In order to realise the capacity of iTV services to provide good quality interactive programming for children, it is necessary to understand the technology upon which these services are delivered. For, as will become clear later in this chapter, a solid understanding of how iTV works can allow a content creator to use the limitations and capabilities of the technology to their advantage. The result can be content that provides both a rich and intuitive user-experience for the child, as well as minimising the restrictions and costs frequently associated with its delivery.

This section will explore the technology behind interactive television. It begins with an explanation of how digital television works and its comparison to analogue transmission. It then discusses the various digital platforms on which interactive services are delivered, with an exploration of the particular requirements and restrictions of each of these platforms.

What will become apparent is that while in a technological sense iTV is a relatively new and evolving addition to the market, the reality is that it is arriving on the back of significantly consolidated television and communications industries (Kim, 2001). The impact of this is that the realisation of the potential of iTV to become a powerful
medium for early childhood education will be a gradual process, as these industries work to develop the capacity for delivering appropriate and powerful children’s content. Later in this chapter, however, we investigate recent advances in content programming that exemplify, even at this early stage, the potential of iTV.

### 4.1 Digital Television

Digital television is a method of transmitting a broadcast signal – in the form of television, radio, communications, or data – that has significant advantages over analogue transmission. For the consumer, digitally-delivered television offers three main benefits; clearer picture, superior sound, and the functionality to deliver interactive services. Broadcasts occur along the electromagnetic radio-frequency spectrum (RF). RF spectrum is measured in Hertz (Hz), which describes the number of times an electromagnetic wave vibrates in a given second. RF encompasses the range of spectrum between 3 Kilohertz (kHz) and 300 Gigahertz (GHz). A typical use of the spectrum has terrestrial television allocated between 400 and 800 MHz, with mobile phones operating on 900, 1,800 and 1,900 MHz, and wireless data on 2.4 and 5 GHz (European Commission, 2005).

Both analogue and digital signals are broadcast on the RF spectrum, and as such, an expansion of digital services usage requires the scaling back of analogue services. With analogue television signals, the quality of the picture and sound is entirely dependent upon the strength of the broadcast signal. A weak signal causes weak interpretation of the picture and audio, resulting in signal noise and flickering of the program.
Digital transmission is deployed differently in that the wave of information is instead interpreted as a binary system of zeros and ones (Government Accountability Office, 2005). The effect of this is that digital signals theoretically do not suffer from such symptoms as television noise. Since the receiver only needs to distinguish between a one and a zero, it either can receive the signal or it can’t. This means that a digital signal can be transmitted more efficiently across distances (Gawlinski, 2003). In practice, however, digital signals are susceptible to noise. At times of missing data during broadcast a digital signal gets interpolated, resulting in misplaced pixels onscreen.

Due to its design, digital television is a more attractive choice for government. This is for two reasons. First, the nature of a binary system means that it requires less space on the spectrum to be broadcast, and secondly, digital information can be compressed (Gawlinski, 2003). Because of these efficiencies a digital signal uses approximately one fifth of the spectrum than is taken up by analogue (NERA, 1997). This allows the government to sell off more parts per unit of spectrum. Using existing compression techniques such as MPEG2, a compression standard created by the Moving Picture Experts Group, digital signals are able to be stripped of information that is either not required or not noticeable to the senses. Through this method, more channels and communication services are able to be allocated space on the existing radio frequency than before (OFCOM, 1997). In late 2005 it was discovered that moving all of America’s analogue services to digital would free up 108 megahertz of radio spectrum (Government Accountability Office, 2005). Since a normal analogue channel is typically
allocated 6 MHz of spectrum (ePanorama, 2005); this is the equivalent of freeing up to 18 analogue channels; or almost 90 standard-definition digital channels. Additionally, a digital signal operates as a single frequency network (SFN). An analogue signal uses repeaters to transmit a signal across distances; each requiring their own frequency. As a result, one analogue signal can take up, for instance, 25 frequencies. Alternatively, a digital signal can be transmitted using only one or two frequencies; a valuable proposition in this era of rapid technological development.

Currently, most countries have allocated a combination of both digital and analogue services to their radio spectrum, with the allocation of larger amounts of spectrum enabling more powerful digital services, including broadcasts in high-definition, multiple camera angles, or interactive television. Spectrum is a valuable resource, however, with radio programs, television shows, mobile phone operators, health services, navigation services, and the military all using its valuable bandwidth. As such, it has become increasingly important to keep a country’s spectrum allocation efficient and compact.

The advantages in efficiency posed by digital transmission not only allow for a more robust broadcast stream, they also currently allow room for the embedding of data; the instructions that allow for interactive television. Through transmitting packets of data along with video and audio, broadcasters are able to offer an array of enhanced and interactive services to go along with their programming.
4.2 The Transmission Process

The idea of broadcasting data along with audio and visual information was around before digital television came about. In the 1970’s it was discovered that it is possible to send data via the analogue transmission stream by taking advantage of the way in which the transmission process displays the image (DeCarmo, 2003). With broadcast television two consecutive fields of information, one for the odd lines and one for the even lines, are ‘painted’ onto the screen in a process known as interlacing. PAL colour systems paint 625 horizontal lines at a rate of 25 times per second, while NTSC paints 525 lines at a rate of 30 times per second. An interval occurs between the time it takes for a line to finish scanning and a new line to begin. This was termed the ‘blanking interval’, with two intervals being identified; the ‘horizontal blanking interval’ – which describes the interval between the finish of a horizontal line and the start of a new one – and the ‘vertical blanking interval’ (VBI) – which describes the interval between the end of a frame at bottom right, and the start of a new frame at top left (Boston, 2000).

It was discovered that it is possible fit data into these intervals; most notably the VBI due to its larger capacity. While colour phase information and other bits of data necessary to the signal are commonly sent in the VBI, around 30 percent remains unused (Boston, 2000). In 1990, the U.S. government saw an opportunity for this gap. The ‘Television Decoder Circuitry act’ stated that all television broadcasts much transmit captions for the hearing impaired, using the VBI as a carrier (Srivastava, 2002). This enabled the opening to a data path into the home via an analogue broadcast, and has
since seen common usage in closed captioning (which has been allocated ‘line 21’ of the VBI) and Teletext services (Schwalb, 2004).

An advantage of the VBI for interactive television is that since the data is transmitted in spaces between the audio and video, it is intrinsically synched to the timing of the broadcast. It can therefore be used for embedding triggers and other data for programs that rely on effectively synching the enhancement with what is happening on the screen. A disadvantage of the VBI for interactive television is that it can only carry a relatively small amount of data (DeCarmo, 2003; Gawliński, 2003). Digital television, however, encodes the entire transmission signal, including the audio, visuals and instructions, into digital data. This means that there is opportunity to change the method of encoding and transmitting the signal in a way that will maximise the use of the bandwidth, as long as the receiving device is equipped to translate it. Different transmission methods deal with data in different ways, and the choice of method depends upon both the demands of the particular interactive service being broadcast and the characteristics of the broadcast platform that is being used.
Figure 4 outlines the four platforms that support a digital broadcast; terrestrial, cable, satellite, and DSL (broadband). Terrestrial transmission is delivered in the same way as an analogue signal; over the air via the RF frequency. Cable delivers its signal via a combination of optical-fibre and coaxial cabling to the home. Satellite broadcasts its signal using micro-waves, which are beamed from an orbiting satellite and are picked up by an installed satellite dish at the viewer end. Internet Protocol Television (IPTV) uses the most recent avenue for television broadcast; broadband. IPTV sends the broadcast signal along traditional copper telephone wires using the standard broadband internet standard, DSL (Digital Subscriber Line).
The commonality between these platforms is that all of their digital signals require processing at the receiver end. This can be accomplished internally by a digital television however the most common method is via a small device that plugs into the television, known as a digital set top box (STB). The initial function of an STB is to convert the digital signal into analogue for a standard non-digital television to display. However, the STB has since also proved to be useful as a device for graphics processing, data caching, and high-end interactivity.

Regardless of the platform that the set top box is associated with, the essence of the transmission process remains largely the same. The transmission process for digital television packages up the data, audio, and video into a signal, and then broadcasts it via a carrier wave using modulation; much like analogue transmission. This process, known as multiplexing, divides up the content into sections called ‘transport packets’, and transmits them one by one via the broadcast stream (ATSC, 2005). A file of transport packets is commonly called a multiplexed file (‘mux’). Transport packets are commonly 188 bytes in size, with 184 bytes being made up of data, and an extra four bytes to hold information such as a PID (‘packet identifier’), a unique identifier that lets the STB know what to do with each transport packet. The set top box is then able decode the signal (‘demux’) in order to sort out the data; separating the different assets, sending the audio and video off for display, and executing interactive enhancements if required (Boston, 2000).
Set top boxes are designed to suit the platform that they are receiving data from, and in
order to do this they are provisioned with custom designed software known as
middleware. Middleware processes the broadcast data and executes its functions. Set top
boxes come with inbuilt interfaces and programs of varying capacity and the middleware
acts as an intermediary between the data and the interface on which the data will be
presented. Middleware is composed of small programs called application programming
interfaces (API’s). API’s perform a multitude of functions; from executing a command
by the user’s remote control to blocking channels that the user has not paid for (known
as Conditional Access).

API’s are useful as they execute commands locally using their own inbuilt instructions;
saving the broadcaster from transmitting application instructions along with every piece
of transmitted data. As API’s are designed around the standards of the manufacturers as
well as the broadcasters, they also help to provide a measure of interoperability between
different makes and models of set top box (ETSI, 2004). Different set top boxes can
come equipped with any number of API’s, though it is the platform operator that will
decide based on what suits their needs as a media broadcaster, the memory demands of
the STB, and which API’s support the functionality for their particular platform. Some
platforms develop their own proprietary software, such as Homechoice, and others
implement an ‘off the shelf’ solution. BT Vision uses Microsoft software called
Mediaroom, that can also be seen in other markets, such as on the T-Home platform in
Germany. The characteristics of all of these platforms can be divided up into those that
feature one-way transmission; terrestrial and satellite, and those that feature two-way transmission; cable and broadband.

4.2.1 One-Way Transmission

One-way transmission paths such as satellite and terrestrial are so-called because the transmission itself does not provide a way for any data to return to the broadcaster. However, this can be overcome in two ways. First, creating an alternative return path via a dialup or broadband connection to the STB. Whenever a viewer interacts by voting, filling out a form, or requesting information, the STB can send the request back to the broadcaster as a data packet. Second, they can encourage the use of other media, such as sending a vote via SMS, or dialling a phone number to participate in a poll.

Over the last decade, satellite has also demonstrated digital television’s capacity to provide interactivity without the use of a return path. The nature of multiplexing allows a large amount of data to be sent to the STB, including multiple audio or video streams as well as complex software instructions. If the STB is provisioned with software to execute commands provided by the signal then the middleware can be instructed to execute only certain packets of data; withholding other packets until they are requested by the user. In this way a one-way transmission signal is able to represent multiple screens at the viewer’s request without the viewer using the return path to obtain it. Instead, all of the possible information is sent to the set top box of the viewer, whose actions decide which bits of information are displayed. Further functionality can be gained through using the local storage of the PVR feature (‘Personal Video Recorder’).
Additional to allowing scheduled recording and time-shifting of live broadcasts, the PVR allows interactive data to be pre-loaded locally; enabling greater interactive functionality for the one-way transmission platform.

### 4.2.2 Two-Way Transmission

Two-way transmission formats such as cable and broadband are physically connected to the television in the home, and so are capable of providing both downstream and upstream data. This path most commonly opens the door for Video On Demand, as high quality video can then be streamed to the box ‘on demand’. However, it also enables the television service to provide interactivity in the programming that can allow the viewer to send responses directly back via the transmission path; allowing for votes to be lodged, enquiries to be made, forms to be filled out, and audience activity to be monitored.

As two-way allows for the use of return path, this means that much of the experience can be controlled at the ‘head-end’, providing only the data and video required on request from the viewer. The implication of this method is that the STB does not necessarily have to be very powerful, as all the process is done prior to arriving. Set top boxes with low processing power – and who rely on the processing power of the head-end – are known as ‘thin’ boxes (and sometimes ‘dumb boxes’), while STB’s with inbuilt interfaces and rendering and caching abilities are known as ‘thick’ boxes. Most programmers will cater for both of these requirements – depending on the needs of the broadcast – using either a ‘declarative’ or ‘procedural’ transmission method.
A declarative application environment allows for enhancements to be transmitted in a mark-up language (such as HTML), leaving the set top box to render the graphics and process the application according to inbuilt software, such as a browser. In contrast, a procedural environment bundles the application along with its assets and instructions, leaving little for the STB to process using inbuilt software (Whitaker, 2004). Procedural environments have been used frequently in the U.S. cable industry, as the two-way transmission platform means that much of the processing was done at the head-end, with requests coming from thin boxes at the consumer end (Halle, 2003). The current standards in use on digital platforms use a combination of both of these environments to execute their processes.

### 4.3 Digital Broadcast Platforms

Table 1 outlines the current subscriber bases for the major platforms in the US and UK markets. The United States has had an extremely established cable television market for many decades, and as such has eight major cable companies now rolling out digital services; operating alongside America’s biggest satellite service ‘DirecTV’. Recent figures show that approximately 31 million Americans receive satellite-delivered television, while a further 65 million subscribe to cable. In the United Kingdom, however, the situation is a little different. The cable industry is currently wholly operated by Virgin Media, with over 3.5 million households. Satellite TV is dominated by Sky, a News Corp company, with around 9 million households, and approximately 10 million UK homes receive free to air digital TV via Freeview.
Table 1: USA AND UK Digital TV Subscriber Levels in 2008/2009

For the deployment of any interactive service, each of these platforms has specific limitations and capabilities that are important to bear in mind. This has commonly lead to a situation where an interactive program has had to be made a number of times to be compatible with each platform. It has also been the case that a program may have to be deployed without certain interactive features on a particular platform in order to cope with the demands or limitations of the medium (Rees, 2004). The next section will give a brief outline of the four current digital platforms and the methods they employ to deliver interactive services.
4.3.1 Digital Terrestrial Transmission (DTT)

![Diagram of UHF Broadcast, Carrier Wave, Set top box, and Television]

**Figure 5: Digital Terrestrial Transmission**

Digital Terrestrial transmission is the direct digital equivalent of commonly-available analogue broadcast television. As it only requires a one-off purchase of a set top box and a suitable antenna to access the free-to-air digital channels, DTT is currently a compelling choice for digital viewing. DTT uses UHF radio spectrum, with a digital channel typically taking up 6 to 8 MHz of bandwidth and broadcasting between 8 and 24 mbps (megabits per second) of data. In the UK and most of Europe, DTT predominantly uses a middleware known as MHEG (‘Multimedia and Hypermedia Experts Group’). While MHEG supports data carousel transmission, it has little support for a return path. The implication of this is that interactive features such as voting commonly need to get pushed to other devices, such as mobile phones or the internet. As free-to-air profits derive from renting spectrum to broadcasters, there are significant cost pressures when it comes to development of STB hardware. Freeview in the UK initially deployed cost-effective thin boxes to significantly penetrate the market, with the result that any interactivity requires predominantly procedural-based programming (Jones, 2005c). As
such, interactive programming is limited to a very rudimentary execution, yielding limitations to the creative aspect of the programming.

### 4.3.2 Digital Cable Transmission (DCT)

Cable television was introduced in the United States in 1948 as a solution to poor terrestrial reception in certain parts of the country (NCTA, 2005). Its two-way direct transmission method over optical fibre enables cable companies to offer true Video On Demand services and potentially superfast broadband beyond the limits of DSL-based broadband.

Cable operators, predominantly bearing the costs of the STB, have traditionally offered low-cost thin set top boxes as part of a subscriber bundling deal; leaving most of the data processing for the head-end (Halle, 2003). However, developments in open standards – standards that promise interoperability across other platforms – require the use of considerable processing power for set top boxes (Sparrell, 2004, April). While traditional cable STB’s are ill-equipped to handle these new developments, thin boxes
have thus far accomplished two things for the industry; the low start-up costs have allowed for rapid penetration (most notably in the U.S.), and the head-end based control method has allowed the use of one of cable’s most powerful offerings; Video on Demand.

These cable boxes typically are only capable of operating one application at a time. With procedural programming, an application and its instructions are both loaded to the box from a request to the head-end. When the viewer navigates to another site, the data is discarded to allow processing of the new site. The implication of this is that thin DCT boxes are incapable of performing complex or multiple functions. One common drawback of this method is that the head-end is susceptible to request ‘spikes’ at times of high usage, which has the potential to significantly affect loading duration for interactive applications and VOD at peak times.

With the rollout of new software standards, future development of the cable box increasingly incorporates a ‘software stack’ containing inbuilt API’s to support graphical interfaces, multiple software standards, code libraries, and a Java runtime environment (Sparrell, 2004, April). This will not only promote compatibility across other platforms, but will allow a more extended use of a declarative programming environment; saving the bandwidth usually reserved for sending programming instructions to thin boxes, and allowing for more sophisticated and visually-rich interactive applications.
4.3.3 Digital Satellite Transmission (DST)

DST delivers its microwave signal via orbiting satellites to achieve a large broadcast footprint on the landscape; delivering both free-to-air and pay propositions. This has enabled pay platform operator Sky in the UK to provide digital satellite services, including full interactive television, to over 10 million households (Sillars, 2010), and DIRECTV in the US to more than 19 million in 2010 (DIRECTV, 2010). Using OpenTV middleware, Sky offers support for sophisticated interactive advertising and programming, an Electronic Programme Guide (EPG), as well as an interactive portal known as ‘Sky Active’.

Using a data carousel, Sky is able to transmit all of their services via the broadcast feed. Over the last 10 years they have incorporated a rudimentary return path via a dialup connection through the telephone line. Since this return path attracts local telephone call charges, it has not been used excessively. In the case of a typical interactive ad, Sky will commonly multiplex all of the assets and content into the broadcast stream, only activating the return path to request a brochure or submit a vote at the cost of a telephone call.

Figure 7: Digital Satellite Transmission
One very practical limitation of this return path, not shared by DSL or DCT, is that it ties up the use of the telephone line for the viewer at times that the return path is being used (DMA, 2003).

A dialup return path is highly restrictive, ruling out the possibility of on-demand services such as VOD (Datamonitor, 2005). This limitation is being removed, however, as satellite platform operators begin to introduce a broadband connection to the set top box. In late 2005, Sky purchased broadband service provider Easynet; now known as Sky Broadband. Using DSL as a high-speed return path not only allows Sky to offer a ‘triple-play’ package to consumers (telephone, TV, and broadband), Sky is also using this as an opportunity to plug the Sky broadband router into the back of Sky set top boxes; allowing video on demand services to be provided to the television set, outside the one way transmission afforded by the satellite. (Inform ITV, 2005a).

While Video On Demand is perhaps the key driver behind this strategy, a broadband connection does reinvigorate the interactive television space. As we shall see in this chapter, interactive television via broadcast and dialup is heavily limited to what it can do. Modules of data sent over broadcast via a data carousel are commonly 64kb in size. When interacting with an advertisement, assets such as pictures and audio are included in the mux file, which is sent via the carrier stream alongside the video broadcast. All of these assets, once loaded, will reside in active memory until required for use. STB’s commonly have trouble caching large assets, such as long audio clips for play on-demand. Programs and advertisements are subsequently limited to a few short audio
clips, with audio file length commonly clipped to 60 seconds (D. Smallshaw, personal communication, 12th March, 2005). The introduction of broadband allows the potential for much larger assets to be included. Instead of including them in the mux file via broadcast, these larger assets can be provided on request via DSL. This saves valuable satellite bandwidth, and also allows a scenario where a consumer can watch an advertisement for a new album, click through to the Sky Active portal, and then listen to whole tracks of an album, or watch a movie, all on demand and served by the DSL return path. Without the broadband return path, this type of consumer experience would be impossible.

4.3.4 Internet Protocol Television (IPTV)

Broadcast television via DSL, known as IPTV (‘Internet Protocol Television’), is the most recently introduced digital platform. With a powerful two-way transmission path driven by internet standards, IPTV is ‘the single biggest topic in the digital television industry today’ (Datamonitor, 2005, p. 5). This claim is based on the flexibility of deployment that comes with an IP-delivered system; bolstered by the fact that many
pioneers in IPTV are telecommunications companies (‘Telcos’). The reason for this is that Telcos are predominantly the owners of the telephones wires coming into the home that support high-speed internet (Forrester, 2004). In this position they can take advantage of their unique offering of mobile and home services, coupled with a two-way path based on worldwide internet standards. As such, while DST and DCT may develop a ‘triple-play’ option of internet, telephony, and television, Telco’s that offer television are in a unique position to offer ‘quad play’; by offering their mobile phone services as well (Hawley, 2004).

IPTV’s functional equivalent, and thus their most likely competitor, is DCT; the other direct broadcast line into the home. As such, both compete on two-way transmission’s key services such as VOD. As satellite and terrestrial rely on a one-way delivery mechanism, Video-on-Demand is frequently little more than a time-shifted programme service, featuring multiples airings of the programme at intervals in a services that is commonly referred to as ‘near VOD’. Cable and IPTV have had a key advantage in this area, as their customers are able to deliberately request a programme and have it play at their time of choosing. This offers many exciting possibilities for future programming formats, particularly for children; allowing not only the option to choose multiple episodes featuring their favourite character, but to repeat segments of programming.

IPTV is also gaining popularity due to its relative convenience in high-density areas. In European countries significant proportions of the population are concentrated in inner-city apartments, causing problems with connection to some broadcast platforms. To
receive a satellite signal in France, for instance, one must ensure a south-facing
apartment and find an area of wall clear of signal obstructions that is not already
festooned with dishes. As such, pay TV in parts of Europe sometime has as little as 3%
penetration of the population (Forrester, 2004). DCT, on the other hand, is limited to
cabled areas, and dependent upon landlord approval and installation. Using the existing
telephony cabling directly into the household, IPTV is able to circumvent these
restrictions. Urbanised areas of France have seen a recent boom in subscriber levels to
IPTV services, with French regulator ARCEP announcing 11.4 million IPTV subscribers
in March 2011 (TeleGeography, 2011).

One limitation of IPTV, however, is that it is subject to attenuation; the loss of signal
strength over distance. The signal strength is dependent upon the proximity of the home
to the local telephone exchange, so while there is a minimal effect in inner city, IPTV
provisioning is limited in less built-up areas where homes are further from their
exchanges (Cable-Satellite, 2004b). The IPTV industry is set to deal with this in three
ways. First, ‘fibre to the cabinet’ (FTTC) infrastructure can increase speeds to the home;
currently up to 40Mbps; significantly increasing a service provider’s range. Secondly,
adoption of new compression standards allows more services to be piped per unit of
bandwidth. MPEG4 is a new standard of compression enabling, among other things,
superior compression rates to the current broadcast standard MPEG2.

Thirdly, the future installation of optical fibre cabling in residential areas allows a
further increase in bandwidth carriage beyond the traditional copper-wire telephony
cables. The FCC in America has taken a step towards this by allowing the installation of optical fibre networking by Telco’s without the requirement to share the lines with resellers; competitors who use the same infrastructure (Reeder, 2005).

While these four platforms are inherently in competition, development in technology and services has seen a convergence of many facets of their respective structures. More recent years have seen the advent of ‘hybrid’ boxes that add broadband to either terrestrial or satellite. Boxes that carry terrestrial and broadband include BT Vision in the UK, and the original Homechoice fully IPTV box, now branded TalktalkTV, has been redesigned to also carry Freeview via an introduced terrestrial input. Most recently, Sky has added broadband to their satellite transmission, to supplement their 500 satellite delivered channels with a video on demand service.

### 4.4 Measurement and Accountability

The need for advertisers and programmers to provide robust measures of feedback such as ratings, impressions, dwell time, click through rates (CTR) and completion rates has seen an increase in the use of reliable measurement media such as internet advertising and direct mail (Butcher, 2005). This has occurred alongside what has consistently been a general scepticism in the ability of panel-derived television ratings to provide genuine measures of audience participation (Walley, 2004). Since its inception, one of iTV’s major drawbacks has been its lack of measurability (Jones, 2005a). As it is delivered via a multitude of transmission platforms, and to viewers with set top boxes of varying ages and capacities, there exists limited opportunities to measure the behaviour of interactive
viewers. Indeed, with the amount of data available for online media, the knowledge of who has interacted – and for what duration – is important for the widespread use of interactive services and the justification for spending the extra budget that is usually required.

The challenge lies in the ability of the industry to develop infrastructure to deliver the measurement. BARB, the UK’s television ratings organisation, uses its panel of 5,100 homes to collect certain information about interactive programming and advertising. Most television transmissions are embedded with SI (service information) codes that inform the set top box about its services and how to tune to them (Brooks, 2004). Using SI codes as a tag, BARB can identify interactive ads or programs, and therefore provide ratings information during the airing of an interactive ad (Garland, 2002; Brooks, 2004). This process, however, cannot provide information on audience participation inside the interactive space.

Audience response is, of course, measurable. If 15,000 viewers click to order a pizza from Domino’s red button application, then this can be tracked. The challenge, therefore, is discovering how to measure those who interact and engage with the experience, without purchasing something. In interactive programming, this is all important, as it would commonly be your key measure of success.

Zip Television went some way to solving this limitation in 2004 with the introduction of a new measurement application, ‘i-Count’. When clicking through to the interactive
space, one in a thousand of viewers’ set top boxes were programmed to log the interaction by dialling a toll free number. From this, the broadcaster was able to obtain a sample of their audience, as well as measure the time and channel of the interaction (Howell, 2004; Howell, 2005). In November, 2004 the interactive advertisement for ‘Bridget Jones; The Edge of Reason’ was the first to use the ‘i-Count’ application (Figure 9).

A limitation to this method is that it is the advertiser or programme that foots the bill for the calls. Another limitation is that the nature of the programming only allows one-off measurements of programmes or campaigns. There exists a need for more in depth measurement of interactive activity on a long-term basis.

Interestingly, the platforms with the best capacity for interactive television measurement are not using it. Both cable and IPTV technology, with the direct return path, can provide real-time measurement of activity. However it is Sky in the UK, a satellite service, who is most active in the interactive television space. The strongest step towards red button measurement has come from Sky’s advertising arm, Sky Media. Using a

Figure 9: Bridget Jones 'The Edge of Reason'; the first ad to use ZipTV’s 'i-Count' tracker.
similar model to BARB’s TV viewing panel, Sky Media currently has 33,000 homes around the UK equipped with special set top box software that provides a nightly download across the return path of any red button activity in the previous 24 hour period (Sky-Media, 2005b). Sky has aligned a proportion of their panel with the TNS Worldpanel; a consumer tracking system run by TNS. Through monitoring both consumer’s red button activity, and their purchasing patterns, Sky is able to provide extremely detailed feedback on the effect of its interactive advertising.

Like BARB measurement, the Sky View system also uses embedded SI codes as a reference point, meaning that the boxes can only track ads that are similarly tagged. However, they can measure changes in audio and video within the SI interval, and so can track usage within an interactive experience such as a DAL (Dedicated Advertiser Location). With this technology, Sky View records three critical measures; the number of viewers who click into the interactive space; the length of time they spend in there, and the amount of people who subsequently return (Hawking, 2004).

While cable has potential for comprehensive measurement, its limited use of interactive advertising has meant that it remains largely under-utilised (Anderson, 2001). This limitation of deployment is due to a number of factors (Jones, 2005c). Firstly, cable companies have traditionally preferred to concentrate on developing services for which their platform has a key advantage, such as high definition and VOD (Adams, 2003; Datamonitor, 2005). Secondly, the move from analogue to digital requires a large-scale upgrade of legacy set top boxes, which comes with significant costs; especially in the
U.S. where cable television has been around since the 1940’s. Currently in the United States there are still more than 45 million customers using analogue set top boxes (Yao, 2005, October 25); and this is despite a 50 billion dollar investment into cable distribution networks to support the digital changeover (Swedlow, 2001; Birkmaier, 2002). For these reasons capacity for measurement has been limited, however the adoption of new standards such as OCAP and MHP-C over time may allow cable to offer a more comprehensive suite of interactive services in the future, along with appropriate measures to support them.

Therefore, the sphere of interactive television programming is not well supported by measurability, and may not be for some time to come. Sky’s new broadband delivered service has the potential to rollout real-time measurement. As the key delivery platform for interactive television in the UK it is most likely, when the time comes, to be the one to provide it.

5 Interactive Television Models

While the term ‘interactive television’ has been adopted to describe broadcast television enhancements, interactivity has been a consistent part of television usage for many years. This has been induced by the belief that an active participant is an engaged and alert participant; and therefore someone more likely to remember and understand the content of the programme or advertising message (O'Modhrain and Oakley, 2003; Lu, 2005). This has seen the development of many forms of interactivity, from using SMS
votes and phoning in opinions on a chat show, to working up a sweat watching an aerobics programme. Usage of the Vertical Blanking Interval (VBI) has also seen forms of interactive television using analogue transmission. For instance, in 1972, the BBC used the VBI to broadcast Ceefax, an up-to-date information service; and in 1996, U.K. viewers could play along with game shows using gaming services pioneered by Two Way TV (Weapon7, 2002).

The convergence of media such as mobile phones and the internet has seen interactive television involve other platforms and methods of interaction. 2-Screen TV was trialled in the nineties as a form of interactivity, using the Internet to send auxiliary content to support a programme on television. It was discovered in the United States that when a company advertised a website on television they would often get an immediate bandwidth spike on their website, which indicated that people were simultaneously on the internet at the time of the advertising message. Subsequent research revealed that at times up to 40 percent of the audience were online while watching (Birkmaier, 2002). 2-Screen TV capitalises on this trend by offering extra online content to support scheduled programming. For example, U.S. satellite provider DirecTV provides extra scores and stats to support the broadcasting of NFL games (Figure 10). American network TNT offers behind-the-scenes facts and trivia on

Figure 10: Live NFL scores delivered on 2-Screen TV. © DirecTV, 2005
their website to support the airing of blockbuster movies. As the movie plays out on television, the trivia updates on the screen in synchrony with the events in the movie (Figure 11).

Modern interactive television takes advantage of technological innovation to converge all of these types of interactions onto the one vehicle; the television screen. This section investigates the current models of interactivity that are commonly used, and is followed by an exploration of how content providers use these models of interactive television to create compelling content.

The risk with the development of models is that interactive television practice can become predominantly techno-centric; allowing the model itself to influence the programming. Ideally this relationship should work in reverse, however the quite specific limitations of interactive television authoring puts pressure on creativity to conform to its parameters (Kim, 2001). While this section explores the most common models, it is important to note that it is quite often the degree to which one breaks out of these models that determines compelling content. Some of these models have been created out of paradigms lifted from our traditional television and internet experiences, and some have been created out of maximising use of the technology available to the creator. Conformance to a content
model does, however, allow a familiar environment for the viewer in order to facilitate their understanding of the experience. In these formative stages of interactive television practice creating an intuitive experience for a largely unfamiliar audience is a key factor. However the aim of a truly successful interactive experience is always to marry the content with the user experience to such a degree that they should not be considered separate entities; regardless of existing models (Sky Interactive, 2005).

5.1 Impulse Response

The advertising world’s simplest interactive advertising model is known as the ‘impulse response’ ad. This model comes in the form of a basic screen overlay during the linear broadcast, enabling the viewer to access more information, or send information back to the broadcaster via the return path. In efforts to present a familiar experience to viewers, impulse response ads usually follow a standardised process. Standardisation is in the interest of the platform, so Sky’s ‘Blackbox Designer’ has been offered to advertising agencies to create impulse-response ads in-house (Gooby, 2002; Howell, 2003; Netimperative, 2004, 9th August). During the linear broadcast of the advertisement, the prompt to press the red button is known as a ‘trigger’. Usually in the form of a red icon, pressing the trigger initiates the impulse-response overlay.

Advertisers can differ in how this overlay is presented, but its general function is to either refer the viewer to an advertiser location in the platform’s portal (see section 5.3), or to collect impulse response information. This can be achieved by answering up to nine ‘filtering’ questions to qualify the consumer (IDS, 2005a), as well as prompting the
viewer to fill out information to be sent via the return path. In this way viewers can request a brochure, book a test drive, order a pizza, or request a sample of a product. As the impulse response model does not take the viewers away from the broadcast, it is an unobtrusive medium. Its simplified execution also only requires a modest amount of processing power by the set top box.

5.2 Enhanced Television

Enhanced television is so called because it is designed to enhance the experience of an existing programme. It commonly involves an invitation to enter the interactive space by clicking the ‘red’ button on your remote control. Enhanced television does not necessarily involve a return path; instead allowing the viewer to access extra information on the program, or participate in an event. Enhanced television applications are designed often around news (Figure 12), sports and other programmes requiring more information than is commonly displayed at one time. An enhanced news program will allow the viewer to access other articles of text while the main news programme plays; perhaps checking stocks, local weather information or world news. Enhanced news services on Sky are delivered via satellite, and so the enhanced content is part of the data carousel, enabling sky programmers to update information and add it to the carousel periodically. Enhancements also suit situations involving lots of small data that

cannot possibly all be reported by the channel. Examples include checking local electorate results in an interactive election special, or searching for the Olympic medal count of a particular country.

Another form of enhanced television involves viewer access to extra content via processes such as audio and video switching. Audio switching can allow for broadcasting in multiple languages, or perhaps allowing the viewer to tune in on remarks from their preferred commentators. Video-switching enhancements can give viewer access to extra footage or angles beyond the primary stream. For instance, the BBC’s coverage of Wimbledon allows viewers to choose which tennis court they would like to watch. This is accomplished by increasing bandwidth requirements during the coverage to allow broadcasting of multiple video streams over the air. The application was programmed to switch between these streams due to requests from the remote. It is interesting to note that, due to the sophistication of this interactive coverage, certain platforms were not able to support all of the included features. So in the case of Wimbledon, the BBC needed to repurpose their application to suit the requirements of each platform (D. Smallshaw, personal communication, 12 March, 2005). One such restriction is that on digital terrestrial, Freeview’s MHEG middleware can only support certain picture-in-picture arrangements. So while Sky’s
coverage displayed the all-courts mosaic screen, when Wimbledon was introduced to DTT, you did not see this mosaic.

As well as allowing access to more comprehensive information and visual control, enhanced television services also allow the viewer to participate in events. For instance, the BBC’s yearly national IQ test ‘Test the Nation’ was re-launched in 2002 featuring enhanced audience participation (Figure 13). During the course of the show, viewers were given the opportunity to answer the questions from their home. At the end the application added their scores, allowing the viewers to compare their scores to the participants on the program. Programmes such as this rely heavily on the enhanced content appearing at the correct time during the show. This synchronisation is usually accomplished by embedding ‘triggers’ into the mux file, to let the application know to start displaying the extra content. With most video or audio, however, it is a little more delicate. This is because the asset is too large to be embedded in the mux file, and is not able to be downloaded to the STB. Instead it is streamed in the broadcast, with the interactive application working around it in certain ways, by perhaps displaying it as a picture-in-picture, or arranging multiple streams in a mosaic as in the Wimbledon example. In order to synchronise the extra video footage it is instead necessary to cue the footage to play at a given time. With programs that can possibly run over time this can be a challenge, however software is gradually getting powerful enough to handle the timing. Enhanced television programs that make use of synchronising their enhanced content in this way are often referred to as ‘synchronous’ programs.
In some cases, the use of the return path is also used in enhanced television. Enhancements that involve the return path can allow viewers to submit messages to participants in a programme, or perhaps vote for a song or favourite character. In section 7.4 we investigate the 2004 ‘Kids Awards’, a televised awards night produced by Disney Channel UK. The enhanced programme allowed children to answer questions on the screen throughout the program. At the end of the programme they had the option to submit their score via the return path for a chance to win a prize. Another example is reality show Big Brother (Figure 15). During the airing in 2002 in the UK, Channel 4 gave viewers the choice to pick which room they’d like to see with their remote control. Other enhanced content came in the form of updates on the latest happenings in the Big Brother house, and background information on the participants. Along with this, Channel 4 also enabled interaction via the return path, giving viewers the option to put down their mobile phones and vote directly for their favourite housemate onscreen.

5.3 Walled Garden Services

One of the unique features of the Big Brother scenario mentioned above is that events in the Big Brother house were continuing beyond the borders of the scheduled programming. This necessitated services that could be constantly available for viewers.
to return to; such as streaming video of the different rooms in the house. The need for ‘always on’ content is a common element of this programming, and as such, platforms reserve some of their bandwidth for a special interactive portal known as a ‘walled garden’.

Walled gardens receive their name from the fact that they are not ‘open’ services that will allow a viewer to navigate anywhere, but instead offer content and services in a controlled environment. Depending upon what platform the service resides, and what technology they have available, walled gardens can differ in their look and feel, as well as their name. Platform operators sometimes refer to these service as ‘24/7’ services, in reference to their ‘24 hours a day, 7 days a week’ availability. Sky has branded its 24/7 service; calling it ‘Sky Active’.

Services in a walled garden can range from shopping, banking and games, to content specifically related to scheduled programming, such as reality shows, the Olympics, or an election. While walled garden portals host many services that are accessible via the portal menu, they are sometimes also accessible via a broadcast channel.

For instance, a particular advertisement may feature an interactive call-to-action that invites a viewer to click the red button to access more information on the product. When the viewer clicks the button, they are directed off the main channel onto a part of the...
portal reserved for visitors of that particular advertisement. These types of services are known as DAL’s (‘Dedicated Advertiser Locations’; Figure 16). They can range from very sophisticated affairs to simple one-page text screens known as Microsites. In 2005, Nokia became the first major brand to avoid linear television advertising entirely in favour of a dedicated advertiser location, to promote the release of a new mobile phone (Jones, 2005d).

Games are also a popular part of a walled garden service. Some channels host their own walled gardens services; providing free and pay-to-play games 24 hours a day. Some channels that do this are Nickelodeon, Jetix, Disney, and BBC children’s channels CBBC, and CBeebies. Figure 17 shows a game for preschool children based on the television programme Postman Pat; available on the CBeebies portal. Using the coloured buttons, children can help Pat put the correct envelopes onto the corresponding stacks. Some games require the participant to pay to play them, while other companies such as Nickelodeon and the BBC provide free-to-play games as an incentive to stay with the channel. Some games are even presented as an overlay on the top of the channel feed, so that the participant can play the game while still watching a programme.

The benefit of a walled garden service is that it is a constantly available portal of data storage for the platform, and can be used in
innovative ways. Well executed DAL’s can move seamlessly between the channel and the portal without it becoming obvious that the viewer is in a different space. Regardless of the source of the data, whether it is coming via a broadcast channel or a 24/7 service, the user experience can be managed so that their expectations of the experience remain constant. This can be achieved through customising the DAL to achieve uniformity of execution; such as maintaining the same audio and presentation of the original advertisement, and delivering on the expectations that the advertisement generated.

6 The Uses of iTV

While iTV has a commercial profile as a marketing device that promises to turn a ‘viewer into a consumer’ (Simmons, 2000; Weapon7, 2002; IDS, 2005b), its uses offer a broader reach for advertisers and programmers alike. The following section investigates some of the main uses of interactive television, with a view to understanding why, with often high costs, bewildering technologies and uncertain business models, companies have produced iTV content.

6.1 Competition

One of the main driving forces behind technology development is competition. Despite the fact that both content producers and audience bases around the world often approach new technologies cautiously, the steady march of progress serves to entice industry players to keep pace with the ever advancing market. For instance, small media
companies often develop an interactive or enhanced service to differentiate their product offering from more established companies.

Interactive television can also be used as a customer retention device. For example, a particular programme might offer viewers the chance to click the red button at the end of the programme to access extra content. Advertising studies have also found that enhancements to a thirty second advertisement can lead to a viewer spending up to three minutes exploring additional interactive content (Anderson, 2001). For television programming, retention is demonstrated by the viewer staying with the channel at a juncture where they might have normally switched to another channel. In this way, interactivity television is sometimes not intended as a direct revenue model, but provides value to the media company through additional engagement (Swedlow, 2005, 21st March). The BBC’s interactive spy-drama *Spooks* offered UK viewers the chance to test their skills as an MI5 secret agent in the enhancements developed for their third season; which aired in 2004 (McClelland, 2005). Viewers could participate in missions to test their mettle in stake outs and other training modules, all delivered on an alternative video stream that was synchronised to initiate at the end of the linear programme. In this way, the BBC was able to provide a high level of engagement at the close of the programme that held viewers onto the BBC1 channel for an extended period of time, as well as providing an appropriate and immersive supplement to the linear programming.
6.2 Reusing Content

A reality of broadcasting is that media companies commonly possess a significant archive of material that no longer gets used. These media companies can ‘repurpose and readapt their assets’ using interactive television models (Varan in Goff, 2003), in order to add value to new programming or to provide an incentive for viewers to linger on the channel. This has traditionally been a practice of DVD producers, who have capitalised on the extra space and non-linear accessibility of a DVD disc to include on-set photos, behind the scenes featurettes, and original trailers and promotional spots. The expansion of consumer broadband has intensified this, as producers look to shoot more footage and cut more exclusive content for use on social networks and their website. This content often proves similarly suitable for iTV, where viewers can ‘click-through’ to additional content.

For instance, in 2004 the BBC children’s channel CBeebies launched a service on Sky’s 24/7 portal as part of their ‘Sing a Song Week’, which featured a looping broadcast of the favourite CBeebies children’s songs as voted by the viewers (R. Shallcross, personal communication, 6th July, 2004). All of the material came out of BBC’s programme archive, and the service was continuously available for viewers to access for the week, without charges. The benefit of this for the BBC was that they were able to extend the mileage of their previously used content, while inducing their audience to revisit and engage with the BBC’s interactive portal. Other than the bandwidth costs of renting a 24/7 channel, this value-added service was able to be launched with almost no production costs. A discussion of looping audio can be found in section 7.2. Another by-
product of the service was that, since the featured songs were voted in by the audience, it contributed to community-building by allowing an opportunity for children to influence content on the channel.

Late 2004 also saw the launch of an iTV-supported Disney Kids Awards; an ‘Oscar’s night’ for children’s programming in the UK. This programme was in the form of an enhanced TV application, allowing viewers to access ‘behind the scenes’ content at key points in the show (a full discussion of the features of this programme is included in section 7.4). Disney chose to televise the linear version of the program on the 18th and 19th of September, 2004, and then re-broadcast the interactive version on the 24th and 27th of September, and the 2nd of October (Broadcastpapers, 2005). Children were able to revisit the programme multiple times, with the added incentive of interactive features and competitions. The live awards ceremony was able to gain additional exposure and relevance as a result of interactive television.

6.3 Additional Touch-Point

Many programmes already have a measure of interactivity. Big Brother viewers vote for their favourite housemate via SMS, American Idol fans discuss the show on Idol’s internet forums, listeners vote online for their favourite song to be played on national radio stations, and donations to Australian charity appeal Telethon are via phone calls made straight through to the live studio. Programmes such as these rely on maximising access to their services via as many touch-points as possible, in order to maximise the number of votes, polls, opinions, or pledges that they receive.
The concept of touch-points is very familiar in marketing circles as an element of a field known as *Integrated Marketing Communication (IMC)*. It is used to describe the practice of using as many different media channels as possible to reach the consumer, with the idea that your message can achieve a broader reach, and break through the advertising clutter (Ehsan, 2001). Using interactive television as an additional touch-point to, for instance, the Internet, is a useful proposition as it has the potential to reach those who are not online, and provide a TV-centric experience to those that find it preferable.

In 2002 reality TV programme *Big Brother* added voting via iTV to their traditional SMS and phone call methods (Figure 18). Viewers were able to access the *Big Brother* portal and submit votes for their favourite housemate using the return path.

By the end of the series, 12 million viewers had voted via phone, 5.4 million via SMS, and 5.2 million via iTV. The important thing to note is that iTV services were not introduced to replace the other touch points. Instead they were used to augment the entire voting service, enabling viewers who did not vote via phone or SMS to also participate.
Government services also find great benefit in using iTV as an additional touch-point. 

London’s transport authority TfL (Transport for London) began a trial of interactive services in early 2005. TfL introduced a service on Sky Active (Figure 19) that enabled viewers to do such things as get updated travel information as well as access the TfL Journey Planner, Live Travel News and a Licensed Taxi and Private Hire Vehicle search facility, all via the 24/7 service on their television screen.

The most significant element of this trial was that the choice to release an iTV service was motivated by a desire to provide travel information for people without an internet connection. Marketing director Chris Townsend commented: "Interactive TV is an increasingly important part of everyday life and represents a cost-effective new gateway that further strengthens TfL’s proposition to provide the latest travel information to our customers, anywhere, anytime," (Cited in Swedlow, 2005, 2nd February). TfL already provides travel information via a data connection on mobile phones. By including iTV, they were able increase their channels of communication with their customer base; tapping into potential users who didn’t have the necessary means to access the services elsewhere.

Figure 19: TFL’s interactive service on Sky © TFL, 2005
7 Recent Advances

Despite the large scale of interactive television deployment in certain markets around the world, this chapter has shown that iTV production carries its complement of constraints that can hamper its development. Many of these are largely due to two factors. Firstly, due to the different television transmission standards, there is a need to produce interactive programming that is flexible enough to not only work on all available platforms, but can also accommodate the differing capacities of multiple platforms (Srivastava, 2002). For instance, Sky’s satellite platform has the capacity to resize and move your application’s picture-in-picture around the screen, allowing the developer to shrink, move, or stretch it to accommodate their production needs. Digital terrestrial’s software restrictions, however, will only allow the PIP to sit at top-left or bottom-left of the screen (as discussed in section 5.2). For a pay channel like Disney UK, whose interactive services are only on pay platforms such as Sky, this added functionality has allowed them to broadcast their children’s application ‘Disney Active’ in 2004-2005 sporting a curved PIP to display the channel feed (Figure 20). However for content providers broadcasting across platforms, the variation in platform capacity means that content is often

Figure 20: Disney Active's curved picture in picture. © Walt Disney International 2004
designed for the lowest common denominator (BroadbandBananas, 2004b).

The second factor contributing to restrictions in iTV is the multiplicity of technologies at the consumer end. In mature digital television markets there are often vast numbers of legacy set top boxes in household use at any one time, which introduces the danger of creating content that could crash boxes with older technology. In 2003, Freeview discovered that of the 1.4 million set top boxes tuning into their digital terrestrial service, 800,000 were old boxes from the previous DTT broadcaster ITV Digital, which collapsed in March, 2002 (BBC News, 2002). The impact of these contributing factors is that producers often need to reduce the sophistication of the interactive experience to accommodate legacy boxes and platforms with different capacities.

However, it seems that the many technical constraints facing interactive television development has facilitated innovative advances in the way interactive services are produced (Swedlow, 2005, 4th March). The UK media industry has overcome a myriad technical limitations to provide high production values and intuitive interfaces to the viewing audience. These innovations have allowed companies to produce interactive children’s content at times when it might normally be prohibitive. They make this work by diminishing bandwidth requirements, start up costs, and usability issues that can commonly temper interactive production.
7.1 Recycling Applications

Designing an interactive experience for television, whether it is a synchronous hard-scheduled programme or a walled garden, requires the building of the ‘application’; the program that will run the interactivity. Depending upon its complexity, an application can take as long as six months to develop (Rees, 2004). If the application is intended as a synchronous addition to a broadcast programme, this can cause problems during the production cycle. Considering that a normal production timeline for broadcast television is commonly 12 weeks, this poses problems for producers intending to create ongoing interactive content to support programmes (R. Markham, personal communication, 5th July, 2004). To rebuild applications for each episode of a programme – or even for different programmes with similar needs – is impractical. As a result, one of the more common innovations in interactive television has been to reuse and recycle applications. An application can either be reused for a series of episodes, or it can be repurposed and used for different programmes altogether.

Interactive quiz show ‘Anorak!’ is an example of a program that requires continuous content updates. Instead of rebuilding the application each time a new episode was released, creators Two Way TV designed it as a template; leaving fields that could be updated without any reprogramming required. They were then able to update the new quiz questions for each episode into the same application (Figure 22). In this way one application was able to be used for the life of the program, saving both time and money. The capacity to build an application that can be used for the life of the series is a critical factor in its viability.
Repurposing applications for use in other programmes is another way to save on production costs, as well as avoiding clashes with the traditional production timeline. Improvements in development have allowed programmers to ‘reskin’ their application; using the same basic template, but putting different images and text over the top. Figure 21 shows three releases from America’s largest satellite platform DirecTV in 2005. These applications were all designed as a portal for a suite of news, sports, and children’s content, and one of the features was that they each showed six simultaneous channel feeds on the one screen (Swedlow, 2005, 24th January). Instead of designing custom-made applications for what are quite similar portals, DirecTV was able to create one template, and then re-skin the application for each purpose, significantly reducing their costs.
The BBC has also demonstrated effective use of repurposing applications with their well-known interactive documentary *Walking with Beasts™*. This application switched between four separate channels to allow viewers the option of accessing behind the scenes footage, extra facts and trivia, and alternative audio commentary to support the main feed. The programming that supported the full-screen video switching was actually appropriated from the interactive application for *Wimbledon 2001*, which shared similar video-switching characteristics to swap between tennis courts (M2, 2001). The BBC was able to strip the *Wimbledon* application of features such as scores and stats in order to use if for *Walking with Beasts™* (Gorel in Gawlinski, 2003).

### 7.2 The Illusion of On-Demand

One of the main limitations of sending data via a terrestrial or satellite broadcast stream is that the size of the assets, and therefore the quality or complexity of the application, is determined strictly by the ability of the set top box to process them. Video and audio can be at full quality if transmitted via broadcast, however if they are embedded in the data then they have to be fully downloaded onto the set top box before they are played. While children’s interactive games only required short clips for sound effects and musical stings, programmes that require bigger audio or video files are unable to supply them via the data stream. As set top boxes have very modest processing power, and programmers commonly have to develop for the ‘lowest common denominator’ anyway, this severely limits the size of audio and video assets that can be used, which in turn affects the quality and execution of the experience (Markham in BroadbandBananas, 2004b).
Therefore the challenge often lies in the ability of the developer to create the *appearance* of providing on-demand media, without having the actual processing power to do so.

Content producers have developed simple ways of overcoming these limitations. One particular approach is to loop the audio and video files on the broadcast stream. This serves two purposes. Firstly, because it is streaming data, there is very little delay when the viewer requests the audio or video file since it is arriving via the broadcast stream and routing straight through to the screen. Secondly, since the information is not arriving via the data stream, the STB is not required to demux the media file in order to play it. This means that the audio or video file can be much larger. This comes with limitations, however, as looping video or audio in a walled garden portal still attracts bandwidth costs as their usage is commonly regulated by the platform. For instance, UK platform Sky allows a maximum of sixty seconds length for a looping audio file on its 24/7 service (S. Gauld, personal communication, 6\(^{th}\) July, 2004). Another drawback with this method, though, is that it is not synchronised to the broadcast and so part of the creative development involves making allowances for the looping nature of the media. A children’s television programme might find this method useful by using a portal to store looping songs and videos for children to access during the episode. An example of the BBC using this approach can be found in section 6.2.

In early 2005 record label EMI released an interactive advertisement for an album from UK band *The Chemical Brothers* that has used this technique (Figure 23) (Langford, 2005, 18th January; Swedlow, 2005, 30th March). The advertisement allowed the viewer
to click the red button to listen to five separate tracks from the new album. Using STB processing this would have been impossible, as the five audio files would have been too large. However, when the viewer clicked the red button, the application directed the viewer to a DAL on the Sky 24/7 portal in which the five tracks were playing on loop (Swedlow, 2005, 7th July). The viewer could then select and listen to any of the five tracks. The interactivity, therefore, was little more than a switch of audio streams, which kept processing delays to a minimum.

This method creates an illusion of on-demand, as it allows the viewer to play the songs on request by ‘tuning’ into them. And despite the fact that the viewer is directed to an interactive portal, the experience can still have a consistent look and feel. The challenge to a developer is to ensure that the transition from synchronous broadcast to portal is seamless, and doesn’t detract from the experience. The danger in this method is that some video or audio may not be suited to a loop, and will only confuse the viewer if they access it mid-way through the broadcast.

Developments in cable and DSL transmission have the potential to diminish this issue. As users are able to directly request data via the two-way transmission path, true queuing of audio and video assets for interactive programming is possible.
7.3 Shrinking Applications

In discussions of the limitations of interactive television production, restrictions on bandwidth consistently emerge as an issue. While excessive use of bandwidth attracts high costs from a platform end, it is most visible to the consumer in the effect that it has on their set top box. When a data carousel or digital head-end is transmitting the application to the STB, it needs to receive the media assets before it can display them. The impact of this is that, while content developers are commonly trying to create a rich media experience with high production values, the reality is that the more audio or graphics-heavy the application, the longer it takes to load.

This has also been an issue associated with internet use, perhaps even more-so due to the vast range of browsers, plug-ins and internet speeds that are used to access online content by a worldwide audience. The Sesame Street website has used well-known character ‘The Count’ to encourage children to count along as the page loads; putting an interesting spin on the restriction (Figure 24).

The high expectations associated with television broadcasting means that there exists little latitude for cumbersome loading times and other difficulties (Smith and Webster,
2005; Inform ITV, 2005c). In 2005 the BBC has announced efforts to diminish load times to their BBCi service to 6 seconds across all platforms (BBC New Media, 2005), while the SSSL (Sky Subscriber Services Limited) has enforced guidelines ensuring all load times on the Sky platform remain under 30 seconds (Khwaja, personal communication, 9th November, 2005). As such, there exists a need for innovations in maintaining high production values while minimising the size of applications.

The BBC’s Walking with Beasts™ again provides a good example of an application that overcame this problem. While this particular documentary featured four video channels, with multiple audio streams, and picture-in-picture of the main stream, the reality of the architecture was very different. Normally, the navigation bar, the graphics, and the embedded picture-in-picture would all have been included in the application data, making it very bandwidth-heavy. However in Walking with Beasts™ all of these elements where ‘burned’ directly onto the broadcast stream. This means that while a viewer thought that they were watching picture-in-picture – such as in Figure 25 – the video streams, as well as the navigation bar and all other interactive enhancements were actually all embedded into the video broadcast, instead of being included as a graphical overlay.

Figure 25: Burning enhancements onto the video stream on Walking with Beasts™. © BBC, 2001.
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The effect was a dramatically reduced application size, and therefore load time. The application was primarily only a video-switcher, and as such was only 46kB in size (Gorel in Gawlinski, 2003, p. 84). While the BBC made sure that the streams had a visual consistency to create a seamless interactive experience, the reduced data demands also worked to ensure a smooth transition between streams.

However, a limitation of this method is that since all of the assets are embedded, there is no flexibility in changing or adjusting the interactive elements after post-production, simply because they are burned into the video. It is, however, useful for ongoing synchronous programming, as it provides lower bandwidth costs, less programming requirements, and the embedded nature allows the programmer to design the interactive elements in any way that they choose; free from the restrictions of the set top box. For example, where the DTT platform can commonly only handle basic picture-in-picture (PIP) formats, embedded PIP can be presented in a multitude of different ways, regardless of this limitation; completely sidestepping this restriction. This innovation allows not only the leveraging of high production values from a technology that is only modestly-equipped to support it, but can also supply consistently high level these production values across the platforms, regardless of their different capacities.

7.4 Shrinking Bandwidth

While reducing the application size of Walking with Beasts can relieve the strain on the set top box at the viewer end, it does not necessarily solve the problem of bandwidth at the broadcast end. This is because extra video feeds take up the equivalent of an extra
channel, and the impact of adding an extra video stream or camera angle can effectively double your bandwidth requirements (Quillinan, 2005).

This issue was approached by Disney UK in 2004 for the airing of their annual children’s awards spectacular ‘The 2004 Kids Awards; Buried Treasure’ (Inform ITV, 2004). For the first time, children were not only able to watch the awards ceremony but also participate in the synchronous live-action broadcast (Figure 26). At intervals during the show viewers were prompted to answer questions by a presenter who appeared in a picture-in-picture window on the top left corner (Figure 27). By answering the questions correctly, viewers were given access to behind the scenes footage. The viewer’s score was included on the top right hand side of screen, and participants had the option of submitting their score at the end for a change to win a prize.

One of the features of Buried Treasure was that a pirate theme was used throughout the program. The interactive element was also consistent with this theme, with the interactive score being referred to as ‘booty, the countdown timer being represented by a pile of gold coins, and the presenter appearing in a picture-in-picture that was ringed with fire. Due to traditional limitations, a standard picture-in-picture of this nature would
have been impossible. Instead, Disney embedded it directly into the broadcast in the same way as Walking with Beasts™ did for its picture-in-picture. The result of this was not only that the picture-in-picture was impressively wreathed in flames, but despite the scoring mechanism, the graphical overlays, and the return path mechanism at the end, the entire Buried Treasure application was only 400kB in size (Markham, personal communication, 1st June, 2005).

The trade off with this arrangement was that the broadcast now included not only the application but two full-screen video feeds; the main broadcast, and the alternative ‘behind the scenes’ feed. This meant that the bandwidth requirements were essentially double that of the linear programme, and to combat this Disney partnered with software developer Ensequence to investigate reducing the data load of the video streams (Broadcastpapers, 2005).

The resulting application used an innovative ‘pan and scan’ method of delivering the video. Instead of purchasing the bandwidth for two video streams, Ensequence compressed the two streams side-by-side into one channel and programmed the application to ‘focus’ in on one or other of the streams (Figure 28). The application was...
programmed to stretch both of the feeds to full screen when requested, creating the
effect of two full screen channels switching between each other. It was
discovered that the level of compression of the video streams,
while acceptable at full screen,
demonstrated artefacts and frame-flicker at times of high camera movement. By increasing bandwidth allocation to the
channel by a slight amount, the video stream was able to be broadcast at a lower
compression rate, and this problem was resolved. Another practical upshot of this
method is that, since the application is only focusing and refocusing onto the same video
stream, the video switch is an instantaneous and seamless execution, which further
enhanced the quality of the experience for the child viewer.

What is also interesting to note is that the verbal instructions provided by the presenter
to the interacting home viewer served as a very powerful prompter. This required the
production team to put time aside to script, record and edit these video segments before
the interactive programming began; making sure that they were consistent with the look
and feel of the programme. The implication of this is that powerfully integrated
interactive programming for children requires thought and preparation at the pre-
production stage, a theme that will emerge often in this thesis.
8 iTV for Children

As children’s familiarity with media such as television begins at such a young age, the impact of media on their development is significant (Anderson, Huston et al., 2001; Cohen, 2002; Rosenberg and Santa Barbara, 2002). In reference to the impact of media usage preceding formal schooling, Neil Postman observed that television is fast becoming ‘the first curriculum’ (1994), with many studies suggesting that the high production values and flexibility make television a powerful, but largely untapped, instrument for children’s education (Ball and Bogatz, 1972; Watkins, Huston-Stein and Wright, 1981; Pearl, Bourhilet and Lazar, 1982; Wright and Huston, 1983; Howard and Roberts, 2002). In the U.S. and Canada, studies have frequently observed that children spend more hours watching television and using interactive media than attending school (Comstock, Chaffee, Katzman, McCombs and Roberts, 1978; Huston and Wright, 1982; Wright and Huston, 1983; Liebert and Sprafkin, 1989; Zoglin, 1990; Davis, 1993; Kotz and Story, 1994; Wartella, O'Keefe and Scantlin, 2000; Livingstone and Bovill, 2001; Cohen, 2002; Rosenberg and Santa Barbara, 2002; Buckingham, 2003; Eberhart-Phillips, 2003). As such, there exists an enormous responsibility for advertisers and programmers alike to appreciate the power that media has on young minds, and to produce appropriate content accordingly.

While there is no shortage of research on the effects of media on children, surprisingly, there is a dearth of research on how interactive media can be used to educate children (Strommen, Revelle, Medoff and Razavi, 1996; Cordes and Miller, 2000; Montgomery, 2000; Wartella, O'Keefe et al., 2000; Wartella, Lee and Caplovitz, 2002; Gilutz, 2003).
This is even more pronounced when it comes to research concerning interactive television. The limited research that is undertaken is predominantly done so internally by media companies, and commonly involves usability testing with internet interfaces, as well as new products and templates (see King and Alloway, 1992; Strommen, 1992; Strommen, Revelle et al., 1996). This lack of research has, at times, been exacerbated by a conviction that iTV is merely the internet merged with television; propagating scepticism in its ability to deliver a powerful convergence of internet technology and television that is not merely the sum of its parts (See Stewart, 1999; Doyle, 2001; Kim, 2001; Livaditi, Vassilopoulou, Lougos and Chorianopoulos, 2003). The restrictions of the iTV platform have contributed to the view that while it is possible to bring internet technology and television together in a technological sense, the merging of the passive and immersive culture of television with the active, reciprocal culture of the internet is fraught with difficulty. The implication of this is that, in many cases, children’s interactive programming is developed relatively unsupported by educational goals (Revelle, 2003). It is the position of this thesis that children’s interactive television is indeed worthy of research, from both a perspective of usability and performance of educational outcomes. The educational potential of interactive television from even a theoretical perspective suggests a platform that can provide a level of alignment to educational goals previously inaccessible to linear television transmission.

8.1 Key Benefits

One of the key benefits of interactive television is that it provides safety and security for young children. Even standard digital television has the security of homogeneity of
programming on each channel; so that a parent can trust that when they set their child
down to watch Playhouse Disney, or CBeebies, no inappropriate content will appear.

While interactive television is commonly built upon internet architecture, it does not
allow free-roaming of the World Wide Web, restricting all of its content to what has
been provided by the platform operator. The most common example of this is walled
garden services mentioned in Section 5.3; so named because of the walled-off nature of
the contained content. The means that children’s content is protected from interference,
and children are unable to stumble onto inappropriate content.

Another key benefit is iTV’s ability to structure programming in ways that allows for
greater comprehensibility for the early childhood audience. Research suggests that
children selectively attend to media that they find comprehensible (Anderson, 1998;
Close, 2004; Roberts and Howard, 2004). One of the ways that iTV is able to deliver a
comprehensible experience is through the ability to provide repetition. Research
suggests that repeated viewing of television content increases a child’s capacity to
comprehend it (Sell, Ray and Lovelace, 1995; Crawley, Anderson, Wilder, Williams and
Santomero, 1999; Bickham, Wright et al., 2001; Palmer and Fisch, 2001; Knight, 2003,
June 25th June). The ability to repeat content has long been the crown of the video
industry, with children able to rewind and repeat favourite segments (Mares, 1998;
Kantor, 2005, September). Repetition of content helps children to develop their
comprehension, and consolidates their grasp of concepts being presented (Fisch and
Truglio, 2001; Calvert, Strong and Gallagher, 2005). The internet has also been able to
provide this level of interactivity. In Figure 29, Bear from Disney’s *Bear in the Big Blue House* invites children to click to repeat the program’s title song with him on the programme’s homepage. On the iTV platform, repetition can be provided in a number of ways. In section 6.2 we used the example of CBeebies demonstrating basic looping of content with ‘Sing a Song’ week. Repetition involving a viewer interaction from the child can firstly be provided by allowing the child to repeat pages of content on a 24/7 portal. With synchronous programming, repetition can be provided by hard-scheduling an alternative video stream to repeat selected content if the child presses the button. For instance, the theme song in the Bear in the Big Blue House could be residing on a second stream that is synched to play at the end of the program. The child would then be able to press the red button to hear the song again. Costs could perhaps even be saved by using the *pan and scan* method of video compression, as discussed in section 7.4.

Finally, iTV provides the key benefit of granting control of content to the viewer. Though control is considered to be empowering to the child (Carey, Tryee and Alexander, 2002; Lloyd, Roeth and Stone, 2003), its effect has not yet been specifically measured in iTV programming. However, some studies have been conducted on the effects of control in a computer-based environment. An American study by Calvert and
colleagues tested the effect of giving children control in a children’s online Blue’s Clues storybook entitled *Blue is My Name* (Calvert, Strong et al., 2005). Fifty-three children between the ages of 4 and 5 were tested on their attention and comprehension under two conditions; being in control of the mouse, and having an adult control the mouse. In the experimental group the child could control the experience by clicking to turn the page and roll over certain assets while an adult read out the text. In the control group, the child could only watch as the adult read and also performed the functions. Children who had control were found to exhibit higher levels of attention, however their comprehension of the events and learning outcomes in the story were no higher than the control group. The conclusion of the study was that control can increase a child’s engagement with the activity, but not their comprehension (Calvert, Strong et al., 2005). Though computer-based and iTV programming share characteristics, the studies performed in this thesis intend to determine whether control only influences engagement on the iTV platform, or further enhances a child’s understanding of the content being presented.

### 8.2 Usability Issues for Children

Usability testing for children’s interactive media, most significantly interactive television, is a relatively unexplored subject area (Markopoulos and Bekker, 2002; Nielsen, 2002, 14th April; Barendregt and Bekker, 2005). One of the common misconceptions in usability testing for children is that it is cross-compatible with usability testing for adults (Revelle, 2003; Demming, 2004). Research done specifically for children has found that contrary to this, children have quite unique usability issues
that are not applicable to the more wide-ranging and comprehensive literature on usability testing for adults (Strommen and Frome, 1993; Strommen, Revelle et al., 1996).

While there currently exists no formal performance criteria for children’s usability with iTV, the following section outlines some general usability issues with a view to understanding how children approach the iTV experience.

### 8.2.1 Navigation

Interactive television navigation, for children, using a set top box remote, is via either the up, down, left, and right cursor keys, as well as the ‘select’ button, and the four coloured buttons; red, green, yellow, and blue. The coloured buttons are a compelling navigational device for the child audience to interact with, as they provide a useful and identifiable marker for children with little or no understanding of formal navigational conventions. As such, they are used frequently in the development of children’s iTV content, as we have seen in the previous section.

The four coloured buttons in iTV represent a strong navigational device, as they allow the user to directly link to a choice or button on the screen, without necessarily having to navigate to your choice via cursor keys (Figure 30). A study in interactive

![Figure 30: The coloured buttons on a Sky remote. © BSkyB](image)
media navigation has found that the coloured buttons method of interactivity is an effective and accurate navigational device for early childhood. Revelle and Medoff (2002) conducted a study with three and four year olds, comparing the usability of cursor keys to direct-linking keys. The research instrument used in their study was implemented on a Playstation game console, and consisted of choosing a number of options on the screen. One sample group were tested in their use of the cursor keys on the console’s gaming pad, and so were required to scroll up and down the options on the screen; pressing ‘enter’ to select the option. The other group was tested on the four shaped buttons on the right hand side of the gaming pad. Each shaped button corresponded directly to each of the four options on the screen, meaning that choosing the option for the participant was a ‘one-press’ action. The results demonstrated not only that children as young as three are capable of using navigational devices in interactive media, but that the one-button press method was both an effective and appropriate method of navigation for young children; a finding that was later confirmed in a followup study (Revelle and Medoff, 2003).

With the buttons on the iTV remote control performing the same functions as the shaped buttons in the console study, it can be inferred that assigning navigation to the coloured buttons in children’s iTV programming is the most appropriate and effective navigational device.
8.2.2 Verbal Cues

When designing navigation for children’s interactive television, one of the most fundamental considerations is that the viewing audience is likely to be unable to read. The implication of this is that if the child is watching without the aid of a parent or competent peer, cues for interaction need to be represented graphically or, most ideally, verbally onscreen.

Graphically represented navigation for children has been seen in the BBC’s CBeebies webpage (http://www.bbc.co.uk/cbeebies/characters/). Instead of providing text links to the various programmes and activities, the CBeebies page provides an image-based launchpad through each of its well-known television characters. Children who are pre-reading are then able to access content by clicking on characters that are familiar to them; consistent with findings stating that children identify strongly with onscreen characters (Signorielli, 1990). Talktalk TV present their children’s EPG, Scamp, using the same method. Scamp utilises the two-way transmission aspect of IPTV with animation based navigation icons, to enable the pre-reading child audience to navigate (See Figure 31).

Verbal navigation necessarily involves a presenter or character inviting the child viewer to ‘press the button’ in order to interact. Verbal cues were used effectively in Disney UK’s 2004 Kids Awards; Buried Treasure (as discussed in section 7.4). During the program, the presenters would appear shortly before an interactive segment, reminding the audience that an interaction was coming up. While Kids Awards was pitched at a
junior youth audience, the use of verbal cues is of even more critical importance to the early childhood audience. Studies have demonstrated that when it comes to any type of interactive media, children require navigational cues that are clear and simple (Schneider, 1987; Nielson, 2002, 14th April).

As examples of current iTV programming demonstrated in section 8.3, the use of verbal cues is rarely incorporated into children’s programming to date. This is often due both to many iTV programmes being intended for a child accompanied by a parent, and the costs associated with the adding these extra features. However, the ability to provide verbal instruction and other audio is a considerable strength of iTV over other forms of interactive media such as the internet. Revelle, Strommen and Medoff have observed that due to the differing download times on children’s computers, programmers rely more heavily on graphics and text to provide information and instruction, rather than using download-heavy sound files to provide verbal instruction (2001). Another reason for the lack of verbal cues in programming is that a common practice has been to develop interactive enhancements for a program after the program has been created (Lu, 2005), and a significant implication of this is that developers commonly have few extra assets available to put into interactive services.
The issue of considering interactive television development at the programme development stage is a recurring counsel in this thesis. As the interactive television industry develops – perhaps through the assistance of new broadband-delivered TV platform technology – development planning will necessarily include consideration of iTV content, giving rise to not only assets such as verbal cues, but a method of iTV production where all of the interactive features are designed to enhance and deliver the educational goal, instead of the other way around (Bukowska, 2001; Carey, Tryee et al., 2002; Lu, 2005; Swedlow, 2006, 1st March).

8.3 Alignment with Educational Practice

Linear television programming has sought to provide educational content to children for many years. As a teaching medium it has the ability to provide high production values, control of pace and sequence of content, the ability to source and display content from all around the world, as well as combining live action, animation and music. These strengths have allowed linear television to provide a rich and immersive experience for children, proving it to be a powerful vehicle for children’s education (Children's Television Workshop, 1991; Anderson, Huston et al., 2001; Fisch and Truglio, 2001; Askov, Johnston, Petty and Young, 2003). However, television is limited in the fact that it is based on a one-way transmission method (Askov, Johnston et al., 2003). This has two implications. Firstly, television struggles to provide a cumulative method of scheduling cumulatively educational content as it has no way of ensuring the same repeat audience (Palmer and Fisch, 2001). Secondly, there is a lack of reciprocal communication between the programme and the child, diminishing the power of the
programme to specifically meet the child’s needs. The presence of these features on the iTV platform suggests a promising alignment with current approaches to early childhood education. This final section draws learning from Chapter 1 on these approaches, and investigates ways in which iTV has attempted to translate them to the screen in a more effective way than is possible on a linear platform. This section endeavours to explain that although iTV is designed for communicating these goals effectively, current efforts are falling vastly short of the true potential of iTV.

As we have seen earlier in this chapter, television has consistently incorporated an interactive element into early childhood programming. Children’s television commonly uses devices to create these interactive experiences, such as addressing the child directly and providing scenarios and activities that the child can emulate in their own space. Convergences in technology have also seen SMS-voting, onscreen messaging and other forms of communication utilised in an attempt to add interactivity to linear television.

However, the one-way communication model is at odds with contemporary ideas of children’s learning in two respects. First, while the child is able, to a certain extent, to interact with the program, they are unable to see the effect of their interaction on the screen. As we have seen in Chapter 1, social constructivist views of education acknowledge that the child’s interaction with their environment contributes to learning. This is a missing link in one-way transmission, as the child is unable to effect real change in their onscreen environment. While this does not rule out the interaction that they are able to implement in their own personal space, such as singing along with a
television presenter, interaction is diminished in impact because it is still distinctly separated into two planes; the world of the screen and the world of the child’s personal space.

Secondly, television transmission is unable to tailor the pace, interest, or difficulty level of the content to the specific needs of the child (Palmer and Fisch, 2001). Instead, television can only present its content “at varying levels of difficulty in the hope that at least some of it will be appropriate to the viewer.” (Aletha and Wright, 1998). Also, when a child is reading a book or using a computer programme, they can always slow down if the content becomes incomprehensible (Fisch, 2004). With linear television, pace is determined by the broadcast, and the implication of this is that linear television cannot guarantee that it will always operate at the same pace or learning level as its audience, nor present its educative goals ‘framed’ within content that the child will necessarily have an affinity with.

The ability to provide a two-way transmission method equips interactive media with educative potential for children’s content. This is principally because the pace, content, and time of transmission all have the potential to be delivered in a customised manner to the user. What this introduces for the participant is a basic emulation of the teacher-student relationship (Calvert, Strong et al., 2005). Consider an interactive, educational application where the presenter turns to the child audience and says ‘click the red button at any time if this is too hard’. If a child clicks the button, new enhanced content appears on the screen to help the child along with the educational content. What this has done is
mimic one of the dynamics of an educator-child interaction. A teacher in a kindergarten is able to determine if a child is struggling with a concept or game that they are participating in, and is able to adjust his or her methods accordingly. One-way television is able to received feedback via other paths of communication such as SMS or Internet, such as on Big Brother, but the content adjustment is uniform for the entire viewing audience, and is not tailored for the individual. A two-way transmission platform has this capacity; the capacity to broadcast a signal, receive immediate feedback, and adjust the broadcast content to suit each individual (Strain, 1998; Crawford, 2000; Bukowska, 2001). Wartella et al (2002) and Luckin (2001) advocate that this platform allows for the implementation of Vygotsky’s Zone of Proximal Development. Discussed in Chapter 1, this terms refers to the difference between the level of development a child can reach in isolation and when collaborating with a more competent peer. Luckin suggests that, in interactive media, the media itself can play the role of a peer; promoting a dialogue whereby it can adjust content and difficulty according to the needs of the participant, and providing a platform that has the ability to scaffold the learning for the child (Luckin, 2001).

Popular 1950’s children programme Winky Dink and You, which is commonly touted as the first ever interactive television show, attempted to provide the illusion of two-way transmission. Children who had purchased the Winky Dink and You kit could place the included translucent overlay onto the screen and draw bridges, ladders and ropes to get Winky out of trouble.
Yet despite being considered quite *avant garde* at the time, the incorporation of the interactive segments was not in line with contemporary educational theory. While child-initiated theory emphasises flexibility of method to accommodate the interests of the child, Winky Dink and You was inflexible in its execution. For instance, the child may be asked to draw a bridge for Winky Dink to escape an island and get onto the mainland. A delay is included so that the child has time to draw the bridge, with Winky even providing a lightly traced line on the screen so that the child can get it just right. This method of instruction left very little flexibility for the child, who was restricted to merely tracing along the line to complete the exercise. Under contemporary approaches, a more developmentally focused methodology would have instead asked the child participant to think of any way that Winky Dink could escape the island. However, while this method attempted to provide a two-way appearance of cause and effect, the reality was that Winky Dink would escape from the island regardless of whether the child drew a bridge, or indeed participated at all. While one-way transmission models such as this are commonly touted as possessing interactivity, Holmquist (1996) draws a distinction between true interactivity and ‘interpretation’; where the interactivity does not actually affect the narrative stream but only occurs in the mind of the participant. He argues that true interactivity takes place between the viewer and the narrative and, most importantly, effects a change in the representation of the narrative. Thus, Winky Dink’s interaction was interpretive as it was not able to respond to the actions of the individual viewer; a distinguishing feature of interactive TV.
While interactive television has the potential to provide strong alignment to educational goals, there exist few robust examples of this in the market place. The factors preventing this potential from being realised, such as high bandwidth and development costs, are discussed in Chapter 3, in which interviews are conducted with key professionals in children’s interactive programming. Despite this, in terms of educational practice, iTV has the ability to provide for specific educational goals in the following ways.

Firstly, the advent of interactive media has seen research into how it can successfully provide a constructivist model for children’s learning (Jonassen, Peck, Wilson and Pfeiffer, 1998; Boethel and Dimock, 1999; Herrington and Standen, 2000; Revelle, 2003). As is discussed in Chapter 1, the constructivist theory states that children can effectively construct knowledge when they actively participate in a tangible and relevant learning experience (Kafai and Resnick, 1995). Revelle also explains that, in interactive media, constructivism means to ‘support children in figuring things out for themselves, and in learning how to find the answers, rather than just learning what the answers are’ (2003, p. 3). The role of the programme in this exchange, she explains, is to ‘ensure that the exploration is structured and systematic’ (Revelle, 2003, p. 3).

In ‘Halloween’, a Sesame Street interactive game that features Elmo available in the U.S., children use the navigation keys on their remote to help Elmo get dressed for Halloween. This has the effect of providing an experience where the child is not rushed to find a right or wrong answer. This is a strong element of constructivist theory, as it allows ‘an opportunity to explore rich environments in an open-ended way to see what
happens’ (Revelle, 2003, p. 3). Tenets of social construction are also seen in the 
*CBeebies* interactive television games, which are available on the BBC digital TV portal. As the portal has a selection of about twenty games and interactive stories on rotation throughout the week, the child is able to initiate their own learning through their choice of activity; indicative of a child-centered approach to programming. In *Bill and Ben* (Figure 32) the child participates in hide-and-seek by searching for Bill and Ben’s friends under flower pots. By pressing the four coloured buttons, the child is able to lift each of the four displayed pots and search for the hiding character. Through remembering who was under which pot the child is able to complete the game more easily. The programme also includes sound bites to notify the child of successful or unsuccessful attempts. As in the Halloween game, the child is able to participate at their own pace.

Nickelodeon interactive game *Scavenger Hunt*, featuring Dora the Explorer, also provides this; though based around an enhanced synchronous application (Figure 33). In the programme, the child helps Dora by using the cursor keys to click on objects when they are appear in the show. For instance, in Figure 33, Dora comes across some red boots in a chest. If the child navigates to the boots on the interactive toolbar and presses ‘select’, a congratulatory audio cue is played. Through
allowing the enhanced app to run synchronously with the linear program, and relating
the game to the events in the programme, the application is building an appetite for
participation. The thinking behind this practice is that the child may be positioned to feel
that their choices will have a bearing on the unfolding events in the narrative. The more
that they concentrate on the program, the more success they’ll have in their interaction,
and the more they’ll help the characters that they care about.

The CBeebies game for *The Tweenies* allows children to follow
an interactive narrative storybook
(Figure 34). By clicking the
coloured buttons, the children are
able to choose which character
participates in the story. This fulfills
notions of a child-centred approach
that sees children as identifying with learning goals when the content is presented in a
way that is of interest to them, and that they can have a measure of control over. In this
case the children are able to choose their favourite character to take them through the
story. As we shall discuss later in this study, children identify strongly with their
favourite characters, enabling interactive media to use this as a catalyst for learning in
many cases.
‘Noddy’s Interactive Storybook’ is a text and graphics-based storybook (Figure 35). It is designed so that the parent sits with the child and reads the text while the child views the images. The child presses the ‘select’ key to turn the page of the book. This enables the child to control the pace of their own learning. Younger children who are having more trouble keeping up with the story will be able to slow down their experience of the events.

This activity also allows for another tenet of educational practice to be utilized. Throughout the program, the parent is able to sit in and participate with the child, helping them through the experience. In this way, the parent is able to provide scaffolding opportunities throughout the story, by asking them questions about the events as they unfold. Scaffolding of learning, as we have seen in the opening chapter, refers to ‘support provided so that the learner can
engage in activities that would otherwise be beyond their abilities’ (Jackson, Krajcik et al., 1998).

Scaffolding incorporates elements of Vygotsky’s Zone of Proximal Development (Vygotsky, 1986), as it causes the child to progress beyond their normal developmental level.

While in Noddy, the scaffolding comes from the parent, iTV can also allow the broadcast platform itself to scaffold the learning experience. In the Cbeebies game Bob the Builder (Figure 36), the child viewer uses the coloured button keys to select mechanical parts in order to help Bob assemble a truck. The application is able to scaffold in two ways. Firstly, when the viewer hesitates during the interaction, the application activates pre-stored audio that encourages the viewer to ‘have another go’. Secondly, the game is divided into levels of difficulty, which the child is able to control. The levels of difficulty go from exploring the building of a truck by choosing parts, up to committing to memory what Bob’s truck looks like, and then choosing all of the parts for him to build it again. As well as providing a real-life scenario in which to frame the learning-goal, this application is in line with Vygotskian theory of instruction leading development (Vygotsky, 1986). It accomplishes this by
progressively scaling up the difficulty of the game ahead of the participant’s
developmental level.

From progressively ramping up difficulty in games, to providing flexible activities that allow children to explore, these efforts have achieved a certain level of efficacy. However, the reality is that the majority of current iTV efforts are repurposed internet-based programming, and indeed when considering the above examples it becomes immediately obvious that many of these programmes could just as easily be delivered on the internet as iTV. As such, the programmes exhibit quite rudimentary production values, and the educational structures incorporated into them are of limited scope and quite limited impact. For example, the lack of audio in Noddy’s Interactive Storybook (Figure 35) means that the programme requires the presence of a parent, and also lacks the more immersive environment that background music and diegetic effects would generate. The still screens used in Bill and Ben’s ‘Hide and Seek’ game (Figure 32) mean that the child views very little eye-catching motion to further draw them into the activity. The cartoon-like imagery in Bob the Builder’s ‘Build a Truck’ game (Figure 36) means that attempts to ground the exercise in a social setting are hindered by a lack of live action programming in which the activity could be more closely connected to the real world. The text-based narrative in ‘Storytime with the Tweenies’ (Figure 34) means that children are unable to follow the story without the help of a parent; restricting them from considering the meanings behind the story or constructing their understanding in an independent manner.
Chapter 2  
Interactive Television and Children

If iTV programming could just as easily be delivered on the internet then what is the point of using iTV at all? As discussed in the previous chapter (section 6), while the advantage of iTV over linear television is two-way transmission, the advantage of iTV over internet is the high production and engagement value of linear television. All of the restrictions mentioned in the previous paragraph are related to production values, and it is this lack of audio and live action that hinders current efforts from being absorbing as well as educational. As we have seen in this chapter, the considerable cost of iTV programming has meant that these production values are often kept to a minimum. There are examples of rich media use of iTV, such as the Disney Kids Awards (section 7.4), though their frequency for early childhood viewing is few and far between; and such programming with an agenda to educate is practically non-existent. However, it is realistically the combination of internet and television features that not only gives iTV its potential, but distinguishes it from these platforms. Through an investigation of the power of rich media production values and two-way interactivity, this thesis aims to demonstrate the true potential of iTV in early childhood education.

9 Conclusion

This chapter has demonstrated the wide variety of capabilities of different television platforms, whether delivered by satellite, terrestrial, cable, or broadband. The capacity of different set top boxes can be wildly divergent; meaning the reality of any given TV market is that some TV set top boxes can deliver certain functionality that others cannot. It is also important to note from this chapter that interactive television is a very flexible
concept. As time passes, technology advances, audience habits accommodate new
behaviours, and the concept of interactive television moves in new directions. Pay
platforms themselves are locked in a perennial struggle for subscribers; and so
innovation continually moves forward. To refer to interactive television as ‘red button’,
for instance, is to ignore the progression of interactive television functionality as time
passes. This has a particular implication for research. For the purposes of this study, it
must be noted that research into children’s iTV that focuses on one particular platform
or technology level may move into obsolescence as quickly as the technology it was
based upon. Research into how interactive television services can best serve the
childhood audience must acknowledge this limitation, and so these principles might
need be relatively platform agnostic. It is the concept of interactivity on television that is
of interest, not the immediate technological structure of how the experience was
delivered.

As such, development of the research rationale should accordingly be based on notions
of ‘best practice’ in the children’s television domain. However, as the latter parts of this
chapter have also suggested, principles of television interactivity are not readily
available in literature, as iTV has not reached a critical mass of usage, and its potential
for the childhood audience has not been realised. These principles must be sought
elsewhere; the focus of the next chapter.
CHAPTER 3 – Phase 1 (Exploratory) – Industry Study

1 Introduction

In developing a conceptual framework for children’s interactive television research, there are certain assumptions or principles upon which it must be based. For instance, one cannot seek to test the difference between an interactive and linear representation of children’s television content unless one knows, and therefore avoids, any known usability issues associated with children’s interactive interfaces. Similarly, one cannot base findings on the use of a prototype that could not possibly be replicated in the commercial world using a reasonable production budget. Usability problems, cost prohibitive production techniques, the levels of permission granted by parents to their viewing children; all of these issues require clarification before new research can be undertaken.

Additionally, as outlined in the conclusion of the previous chapter, efforts to remain platform and technology ‘agnostic’ require a strong foundation of cross-platform, cross-technology principles on how interactive television is to be presented to children. For instance, if we assume that a child’s visual and navigational needs for an interactive
interface are different than an adults, then what principles are to be applied to interface development for children? Clearly, these principles must be defined.

As we have seen in the previous chapter, the nascent nature of children’s interactive television means that these questions point to relatively unexplored terrain. As Chapter 2, section 8.3 suggests, while interactive television may hold tremendous potential for children’s education, through the forces of technology, marketing, and policy, this is currently a potential unrealised. As technological innovations enhance viewer’s connections with their televisions, this potential will become increasingly tangible; further emphasising the need to draw research design away from a techno-centric debate, and towards more holistic notions of interactive television practice.

In the academic world, there remains no strong body of opinion on the use of interactive television in children’s education. Though studies into children’s interactivity in other domains are in greater abundance (most notably the Internet), the focus on interactive television, as we have seen in the previous chapter, has remained largely in the realm of advertising. As such, to provide a foundation for this thesis, I have turned to the work of practicing industry participants who are creating and evaluating interactive television programming for children. This is an important step to take, as this currently amounts to a significant gap in academic discourse on the subject.

The development and design principles behind the Disney Kids Awards (Chapter 2, section 7.4), the numerous applications on the CBeebies portal (Chapter 2, section 8.3),
and trials conducted by the Sesame Workshop (Chapter 2, section 8.3) all involve development of interactive principles; principles largely undocumented. Some of these principles may have been appropriated from other platforms, such as online, and some may have been constructed as a bespoke solution to problems or issues arisen during development. An industry review can determine the source of any principles, and bring synthesis and standardisation to what is undoubtedly scattered and non-standardised innovation.

An industry review can additionally provide insight into four broad areas. First, information on research conducted in-house may suggest new directions concerning children’s use of current iTV technologies. Findings may shed light on children’s proficiency with an interactive remote, the success of certain interactive formats, and children’s interactive viewing habits. Second, the interviews may provide information on technical breakthroughs and setbacks that have come to light as interactive technologies develop. Each of these findings would affect the research design of this study, and the direction of the research question.

Third, exploratory research into media companies introduces the concerns of a commercial element to the study. Due to the often expensive nature of iTV production, this can impact the design in certain ways. By including an exploration into cost and restrictive technology’s bearing on current projects, their impact on this research, and the direction of interactive content for children in general, can be taken into account. For instance, if an industry study demonstrates that the children’s television industry is likely
to hesitate to bring compelling iTV productions to market in the face of high costs, then this directly affects the development of any prototype content upon which this research may be based. It is of little value if this study proves how to best serve children’s interactive television if it can only do so on the basis of an unlimited production budget.

Finally, and perhaps most importantly, this study seeks to provide a synthesis of ‘best practice’ in children’s interactive television design for educative content. Though the concept of ‘best practice’ in CiTV programming is certainly a long way from being an academically debated and formalised body of knowledge, this study seeks to bring together and synthesize a body of intelligence from the scattered and isolated sites of CiTV production around the world. These sites include TV broadcasters, children’s production companies and television research agencies that have experience in interactive television innovation. Though the bringing together of intelligence from these sources cannot claim to generate a definitive standard of ‘best practice’, it can at least identify a practical perspective of ‘best practice’ as it stands at this point in its evolution. At the very least, this practical perspective can provide a working model upon which research in this thesis can be based; a template for correct design and execution of educative goals, and pre-emptive identification of design and execution pitfalls which can thus be avoided. In consideration of the dearth in academic support of this industry sector, this chapter aims to provide a much needed academic investigation of a developing area.
In fulfilling these requirements, the following study requires an investigation into the following aspects of CiTV design:

- Usability testing of iTV for children
- Market insight into the directions of iTV
- Opinions on the future of children’s iTV programming.
- Hindrances to quality iTV content deployment, and ways that these are being overcome.
- How readily children’s usage of iTV programming aligns with current knowledge on children’s learning with digital media and broadcasting.

By conducting exploratory research into this area, two outcomes may be achieved; the formulation of the research question may be informed by industry insight and concerns, and notions of best practice in children’s iTV development may inform the development of the research stimulus.

2 Methodology

2.1 Research Design

This study was conducted using semi-structured interviews with professionals involved in children’s iTV production. The sought results comprised data on issues associated with iTV production for children’s media. The purpose of using interviewing as the method, therefore, was to draw a number of issues and insights from a group of
children’s media industry practitioners. This suggested a qualitative methodology that would give rich and varied data on issues, opinions, and perspectives; acknowledging that different interviews may produce remarkably different results. A semi-structured interview with open-ended questions was therefore an appropriate technique as it gives the flexibility required to adjust or alter the questions to best exploit the particular expertise of each participant (Aberbach and Rockman, 2002). At these formative stages of the greater study, this technique is useful for providing exploratory data for experiments seeking an ‘insider perspective’ on an industry topic (Leech, 2002, p. 665).

The most important consideration, therefore, is the appropriateness of the participants chosen for the interview. This study required participants from a quite specific pool of expertise; that of professionals working in children’s interactive television production. Practitioners needed to be in an executive, managerial, or producing role in order to have sufficient insight into industry practice necessary for the interview. The sampling technique, therefore, needed to take into account the modest size of the subject population. For this reason, a purposive sampling technique was employed, in which participants were chosen for their specific expertise in the subject area. Purposive sampling is appropriate in sampling populations in which a predominantly homogeneous sample is sought; in this case, the expertise and experience of the participant in children’s interactive television (Patton, 1990).
2.2 Participants

The recruitment process for this phase first involved an identification of organisations involved in any combination of interactive television production, interactive television research, and children’s media. This generated a list of approximately fifteen companies. Companies were contact through email and telephone, inviting personnel involved in interactive research, new media, or children’s programming to participate in a face-to-face interview concerning their work. This request generated the following 7 respondents who were confirmed as the participants in the study. Participants were four males and three females; all in senior, professional positions directly involved in some aspect of children’s interactive media such as production, management, or research. Participants are displayed by position, and in the order that they were interviewed.

- Paul Marcum, Interactive Media Group Head, Sesame Workshop, NY.
- Robert Markham, Executive Producer in New Media, Disney UK, London
- David Chudleigh, New Media Senior Coordinator, Disney UK, London
- Rebecca Shallcross, Interactive Executive, CBBC, BBC, London
- Stephanie Gauld, Interactive Editor, CBeebies, BBC, London
- Diane Smallshaw, Interactive Producer, BBC, London
- Nigel Walley, Founder/CEO, Decipher, London

The following briefly outlines the position and responsibilities of the interview participants at the time of the interview, as well as the context in which they worked.
Paul Marcum was the Interactive Media Group Head of the Sesame Workshop, a nonprofit organisation based in New York, most notably responsible for Sesame Street. Since the interview, Marcum has moved to Yahoo.com (Swedlow, 2005, November 21). His responsibilities comprised maintaining an interactive presence for the Sesame Workshop on a number of fronts. These include web-based interactivity including ‘sesamestreet.com’, CD-ROM gaming (though to a declining extent), mobile content, and more recently iTV. His department had been developing interactive prototypes since the mid-nineties, with a view to ultimate inclusion in Sesame Street, however had not at the time deployed an interactive application.

Robert Markham, an executive producer, and David Chudleigh, a senior coordinator, both worked in the new media department of Disney Channel in London. Disney Channel operates a number of prominent children’s channels on digital pay TV platforms. These include ‘Disney Channel’; aimed at ages 8 through 11, Disney XD; showcasing predominantly cartoon series, and ‘Playhouse Disney’; aimed at years 6 and under. Disney has produced numerous interactive applications and content in the UK. However, while the Playhouse Disney channel continued to be considered, it had not had interactive content created specifically for its young audience. As part of an iTV production team Markham and Chudleigh produced the UK’s first interactive application for children in 2001, and continued to produce interactive content such as Star Ticket Active – a ‘Pop Idol’ for young children – and the Disney Kids Awards in 2004; a programme that pioneered some advanced methods in iTV production (see Chapter 2, section 7.4). Disney UK also receives a considerable amount of content from
Disney in the United States, and the team has been involved in investigating how to incorporate into this content more localised iTV enhancements.

Rebecca Shallcross, an interactive executive, Stephanie Gauld, an interactive editor, and Diane Smallshaw, an interactive producer, all worked in children’s media at the BBC in London. Their efforts were directed towards BBC’s two main children’s channels, CBBC and CBeebies, as well as their associated websites. Shallcross oversaw a team that produced children’s new media content for CBBC, including interactive television, mobile and online. Gauld was responsible for all editorial content on the interactive platforms, which included online and iTV. They had produced numerous interactive television applications, the majority of which reside on BBC’s 24/7 portal (examples can be found in Chapter 2, section 8.3). Diane Smallshaw worked as a producer on interactive projects for both CBBC and CBeebies. This involved developing ideas from their inception to commission, as well as producing successfully commissioned projects.

Nigel Walley was the CEO and founder of Decipher, a media strategy consultancy company. His London based team specialised in conducting new media research on usability, audience behaviour, and business models for media platforms, broadcasters and advertisers. Decipher was involved in studies for a wide range of audience types, including early childhood, with their client list including Nickelodeon, Disney, and the Cartoon Network. Walley’s field of practice was in the research side of children’s new media, with experience including children’s audience behaviour, investigations into the
use of new technologies such as PVR’s, EPGS and VOD, as well as the concerns of industry.

2.3 Materials

Materials used for this study included a digital voice recorder, headphones, a PC, and Adobe Audition software, for transcription purposes.

2.4 Procedure

The study was conducted as a semi-structured interview. Interviews took place at the convenience of the participant. All interviews were conducted face-to-face at their place of work.

As the participants varied in their expertise and job description, questions were flexible to accommodate this, and were based around the participant’s feedback during the interview and their prior experience. However, all participants were asked about what interactive television work they are involved in, usability issues that they have encountered in their experience with children’s iTV, the state of the industry, and their outlook for the future. The questions that formed a basis for these interviews were:

- What interactive children’s television programming are you involved in?
- What issues have you found in your research related to the transition from linear television to interactive television for children?
Has your team/department found it easy to add interactivity to existing linear shows, without losing impact, or necessary to build interactive shows from scratch?

What issues have you found in your research related to interactive television’s ability to educate?

What do you see as key future trends in the children’s ITV field?

What is the impact on costs associated with the move to ITV, and what is the economic model through which this will be viable in the future?

Interviews were recorded using a digital voice recorder. Interviews lasted an average of 46 minutes. If certain intended questions were beyond the scope of the participant’s expertise, these questions were not asked, with more relevant questions asked in their place. Subsequent to the interview, voice recordings were transcribed on a PC using Adobe Audition, and a transcription of the interview was forwarded to each participant. Key trends and subjects were identified in the transcriptions, and the results of this exploratory phase were compiled into essay format.

3 Results

3.1 Industry Perspective

One of the most significant preliminary enquiries in this study was the prevailing perception of interactive television’s potential to educate, entertain and engage the early childhood audience. Regardless of what iTV content had been produced by the company
in question, this reflected a more personal judgement of the capacity of iTV; a judgement which would most likely arise from a combination of practical experience, forward looking estimations, and awareness of commercial agenda. This proved an important preliminary question as it served to set the tone of the topic, as well as give insight into the level of, and reason for, commercial interest in interactive television for children.

All of the interviewees expressed a positive view of interactive television, though a general undertone was that technology and production costs were a major hindrance to it reaching its potential at these formative stages. These hindrances will be discussed later. This belief in iTV for children stemmed frequently from an awareness of children’s increasing technological literacy in recent years. Marcum of the Sesame Workshop comments:

“There’s a great phrase out there, which is ‘kids are native to new technology; parents are immigrants’, which is a great line and we certainly believe that to be true”.

What the participants had discovered in a majority of cases is that a child’s expectation of all media is that it is primarily interactive. From being able to choose content on the web, to rewinding a favourite song on a video, children were used to being in control of content. What interactive television offers, then, is an inevitable fulfilment of
expectations that they had developed using other media. Shallcross of the BBC comments:

“A child naturally shouts out at the television…Very rarely is a child completely passive. So I think that you’re missing a trick if you don’t tap into that, because they have a willingness; they’re always wanting to learn, they’re always wanting to try new things, they’re always wanting to develop and take part… We’re looking at ways that we can push that even more. I think children become used to interacting with things on the web, and actually being able to print something out; take a certificate away, take an achievement record away with them. We’re looking at ways that we can make that more obvious on interactive television because they get used to the fact of ‘where’s my truck? I built it, why can’t I have it?’ Again it’s getting that sense of achievement, so that they actually feel that they can go away and feel that they’ve achieved something.”

Gauld also comments that iTV is a natural step for children’s content, simply due to the interactive nature of most children’s media:

“With this age group you only have to watch a four year old watching The Tweenies, for example, and it’s interactive. They’re dancing and they’re singing and the child might be moving in front of the TV, and it’s only really if the preschool child is quite tired that they actually use TV in that ‘sit back and entertain me’ kind of way. With a preschooler it really is more of an interactive activity.”
This notion is also supported by Nigel Walley’s testing experience in children’s new media usage. In young children, a simplistic understanding of media infrastructure has mean that the line between what you can and can’t control on television and digital media platforms is becoming increasingly blurred:

“In their lives they’ve got a DVD Player, a VHS player, they might have VOD or a PVR depending on the household you’re dealing with. It’s only the live broadcast channels that don’t have any of that nice functionality, so they can’t understand why you can’t do some of those things. If you’re watching an episode of The Wiggles on BBC, why can’t I just rewind it and do all the stuff I can when I watch the other Wiggles? And you then get into a debate. ‘Well actually this is a live broadcast channel’; a ten year old wouldn’t understand what the hell you’re talking about!”

The existence of interactivity in children’s linear television is, to Gauld, intrinsically related to flexible structures of learning in line with contemporary ideas of teaching, such as a constructivist approach:

“I think with certain programs, you can have very didactic programs that are very good and very helpful, but very didactic. So throughout one program you might learn the word *por favor*, for example, and it will go round a whole story which really helps children to learn one word, and it’s very, very didactic. Whereas you might have some programs which are all about imaginative play; maybe they’re doing
finger puppets, and it’s all about interaction with finger puppets. So children can then go off afterwards and they can then play, so really the program doesn’t stop with the linear program. The program really carries on afterwards, and it’s very interactive.”

For this reason Gauld supports the use of iTV with children’s learning, as it allows an extension of the flexibility believed to be a fundamental part of a child’s learning:

“Any way of enhancing a learning experience for a child, or just a pleasurable experience – you can’t really separate the two – but I think any way of enhancing the experience which they get on a linear program is good.”

Walley also sees iTV as providing a much more engaging platform for children:

“Interactive content around programming; we think one of the big roles of that is actually about improving the engagement with the consumer, improving the consumer’s overall enjoyment with the content”. Markham of Disney UK agrees that interactive television holds great promise for the children’s market “because it engages kids first and foremost”. However, as Chapter 2 has demonstrated, cost and technology have hindered a wider and more comprehensive deployment of children’s iTV content. In a commercial sense, this can lead to reluctance in media platforms to initiate iTV content; preferring to observe how the market and the early pioneers react before joining in. However in this case, Markham comments that when it comes to iTV, the significance of the new medium requires experience and development at this stage to equip a company, and its audience, for the future:
“It’s pointless actually saying ‘we’re not going to invest in this now’, because we won’t have the learnings for when it is mass market. If you educate the kids now, to say ‘this is what enhanced is’, they understand it, they feel confident with it. They’re going to be your next generation of teenagers and adults to actually fully embrace enhanced TV.”

Marcum of the Sesame Workshop agrees, commenting not only on the years of iTV research that the Sesame Workshop have conducted, but his conviction in the impending wide scale deployment of iTV content for children:

“With interactive TV, we’ve been looking at it for probably ten years at this point along with many other companies, and spend a lot of time doing prototyping and demos featuring a number of different middleware and hardware platforms…we look at those platforms as ways of connecting with kids and we want to be there, when the platform is adopted by children, with great content for them.”

Though the participants concede that iTV holds significant benefits for children in an educational and engagement sense, they also see long term commercial benefits for adopting and promoting this technology. This is an important consideration, for having a robust revenue model or proposition for a new technology is regularly the primary catalyst for its adoption. Through his experience with the concerns of the media
industry, Walley has observed that the introduction of iTV as a new media format can hold benefits for early adopters:

“The minor channels are very interested in how they can use this new media to broaden their reach into a market that is still, over here, dominated by some of the big, main channels…they’re really interested in how they can use new media to get under the skin of the kid’s audience in different ways, and break down the dominance that the big networks have got.”

Through providing supplementary content to a programme, either by supporting a programme with an enhanced TV application, or directing the audience to a 24/7 portal, iTV is able to extend children’s engagement with a programme, and therefore a channel. This, as Chudleigh confirms, is a significant win for companies looking for improved audience retention:

“One of the main reasons we’re doing enhanced TV is that they’re not entirely satisfied with what is on the TV channel and they want to just ‘dip out’ for a few minutes. So they’ve got the remote in their hand; they can either change channel or they can go to your enhanced TV service. So you can still keep them in the world of the channel. If they are a fan of Bob the Builder, and if you’ve got some enhanced Bob the Builder content – then when Bob the Builder finishes you can keep them on the channel, or you can use it to promote the next Bob the Builder episode.”
Shallcross agrees, commenting that the provision of interactive content also allows for audiences to continue an experience after a programme has finished. As we investigate in section 7, this can sometimes cause problems from a creative standpoint, as production teams sometimes proves hesitant when faced with the proposition of creating content that may not be seen. However, Shallcross argues that by providing this extra content, it is possible for one channel to cater to two audiences at once:

“There is a debate; ‘should we be taking children away from the service that we are providing on the television? Does that make sense to do that?’ Dick and Dom, for example, the application that we’re going to be producing…which has the stream switcher; the narrative application that will be available through the program. It will also be available for about an hour off the back of the program once the program’s finished. Clearly we still have programming going on after that program, so in a way we’re taking them away from other shows. But the other shows that follow Dick and Dom are for a slightly older audience. It means that at that point, the kids who are really big fans of Dick and Dom can potentially turn over to the [interactive] channel. So we are still, in a way, keeping some audience that we may lose at that point with our channel, with Dick and Dom, because they can keep on the experience of Dick and Dom, interact with it, and participate in it. There are occasions when we would not consider doing that because we would want to keep children with the channel. If they decided not to stay with the channel they would go elsewhere anyway, but it’s about offering the choice at the right times when we feel it’s relevant…”
In doing so, the programme is giving the child audience the control to choose their own content preferences. This is an interesting concept. In a media setting that frequently sees channels and advertisers trying to provide content for a core segment in a hit-and-miss environment, an audience being able to select their own appropriate televised content goes beyond mere segmentation; it is a dynamic process that allows an audience to, in a sense, self-qualify. Aside from its benefits to industry at this early stage, the participants indicated that another positive feature of iTV was that parents also find it a safer environment than the web; an issue discussed in Chapter 2, section 8.1. Shallcross comments that parents “class it as being safer because there’s not as much choice, and it’s more of…a ‘walled garden’ environment where kids will be able to access the stuff that is suited to them.” Marcum agrees: “I think that at the end of the day parents are very scared of PC’s. There’s a lot of stuff that can go wrong with a PC. Very little goes wrong with TV, even if it’s digital, and I think that’s a reassuring thing for parents of young kids."

A company that has a particularly robust perception of interactive TV safety is IPTV platform TalkTalk TV. In 2004, when Talktalk’, they released the ‘Mini-Mote’, a children’s only remote control designed for television content safety (Videonetworks, 2004). Large, durable, and easy to handle, a significant feature of the remote was that it would only allow children’s channels to be displayed when channel-surfing. In this way, parents had additional peace-of-mind when it came to inappropriate content.
Smallshaw has also noticed that this perception extends into purchasing behaviour for adults, who feel more comfortable sending encrypted information via iTV rather than the web. In her experience, the long standing relationship of a channel or platform with its audience is a lot more tangible and accountable than an anonymous web-purchasing experience:

“It’s interesting, the security thing, because I worked on the ‘Children in Need’ service last year and the user research from that [was] ‘why would you want to donate via interactive TV? Well it’s a lot safer than the internet’. They have this perception that it’s safer but of course all they’re doing is sending information. It dials up a modem and goes over the same route. It all has to be encrypted just as your internet donation does, which, for good or for bad they just don’t think of it as using telecommunication to get their donation information across.”

Smallshaw has also discovered that perception plays in important role in the deployment of interactivity as well. While the technology that deliver interactivity frequently hinders the development of compelling content and concepts, as we have seen in Chapter 2, a programme’s management of audience perception can be used to great effect to deliver robust interactive experiences in a cost effective manner. In a yearly national quiz program by the BBC, ‘Test the Nation’, iTV advances allowed participation via iTV in the UK. Though there is no return path to the broadcaster, Smallshaw discovered in testing that planting a scoring algorithm locally into the set top box gives a sufficient
interactive experience, where participants feel connected and involved in the programme:

“What was really interesting with the ‘Test the Nation’ service…was, if you asked people on the grid: ‘did you feel that you were getting a response from the program or they were communicating to you?’…they really felt that this was interactive. As in, that they were getting that personal response. But they didn’t use the return path at all, they didn’t make any connection; it was all done in the application. But they felt they were being personally communicated to by being given their IQ or their score, or whatever the quiz happened to be… Actually you can have the perception of interactivity and communication much more successfully without having to use a return path.”

When considering a technology such as iTV, this is a positive finding. As we have seen in Chapter 2, companies are developing content in an environment of multiple transmission platforms, numerous middleware standards, rising bandwidth costs, and uncertainty over who is equipped with a return path. Simplicity is often the key in capturing as large an audience as possible, and if well-designed programs are capable of creating a perception of community building and full service interactivity without the use of functionality such as a return path, front of box algorithms, or on demand content, then this can only serve to benefit both production and the quality of experience for participants. We have seen a prominent example of this concept in the BBC’s Walking with Beasts™ (Chapter 2, section 7.3). Using ‘burned on’ interactivity to create the
illusion of multiple screens and picture in picture, the reality of the interactivity was little more than a channel change. However, with careful timing and control of creative delivery, *Walking with Beasts™* was a comprehensive interactive experience for its audience.

Evidence provided by the interviewees demonstrate the positive and productive approach that the media industry has taken to iTV content, though their efforts are in the face of considerable technological and creative hindrances; a topic discussed in more detail in section 3.5. With new technology adoption, however, there is also the danger of becoming overly optimistic and reliant on its promises, rather than taking a more pragmatic approach to its deployment. However Gauld demonstrates awareness that, although iTV has theoretical and practical benefits, there are times when it is not appropriate (Ali and Lamont, 2000; Lamont, 2003). One particular genre that she identifies as not suited in some cases is drama. She identifies that programmes are watched for their power of catharsis or escapism can lose their effect when control is handed to the viewer:

“I think the conclusive evidence is that actually people don’t want to choose all kinds of endings of dramas. They want to get what they’re given. I only experienced that myself on a DVD; “24”. On the DVD of the first series it gives you an option at the end to have the ‘nice’ ending where she doesn’t die. I thought that was going to be really nice, I don’t really want her to die. But I felt really cheated; I was really
surprised at my emotion. It could be either, and I don’t know what the ending is and
it felt really inconclusive, and it was no longer a story.”

Smallshaw also demonstrates this pragmatic approach to the use of iTV. She comments
that when it comes to choosing which children’s programmes should incorporate
interactivity “it’s similar to the types of programs for adults that are best suited to
interactive TV really; I don’t think there’s that much of a difference. And that is, the
programs where you’re in that frame of mind already, where you’re willing to engage or
to shout out or to have questions and be provoked in some way. I think if it’s a program
where you’re just wanting your mind to be taken away for half an hour or 20 minutes
and you’re completely engaged in the narrative and you don’t want to be thinking about
any other distractions in the room almost - let alone pressing buttons on your remote
control - I think I’d want to leave those ones well alone”.

This approach to interactivity engenders a development process that is more focused on
whether interactivity suits the program, rather than the other way around. Instead of a
development team producing interactive content for the sake of it, the idea and its
outcomes are first devised, with iTV one of a myriad of options considered in efforts to
decide which production route will present the outcomes at their greatest effect. As we
shall see in section 3.5.5, acquiescence to this approach has, in the BBC’s case,
necessitated a departmental restructuring that promises a more effective development
process.
Chapter 3

This section has demonstrated that iTV is considered a positive and legitimate addition to children’s television media. This is further strengthened by parents’ perceived safety of television in relation to the internet. The implication of this is that iTV is likely to continue to develop more comprehensive content. The perspective of the participants was that interactivity is a natural step for young children, who’s considerable technological literacy might allow them to embrace iTV formatting with little difficulty. The participant’s experience with how children really have responded to iTV programming is the subject of section 3.3. While the participants consider iTV a promising format for children’s media, their perspective on how iTV can contribute to children’s learning is of particular importance.

3.2 iTV and Childhood Education

Though media companies have been incorporating children’s television learning outcomes on a linear platform for many years, the previous section has demonstrated that interactivity has been a part of the children’s media agenda prior to iTV. For this reason, ideas on how to incorporate children’s learning into this new interactive platform have likely been sourced from existing processes; both from linear television and interactivity online. However, where the degree of interactivity for television was traditionally as much as a one-way linear transmission path would allow – and for internet, as much as existing bandwidth and computing power would allow – iTV provides two-way interactivity on a much larger scale. Marcum also believes that a key advantage of television is its place in the activity of the home: “It’s oftentimes not in the centre of the household activity. These are very young kids who like being around mum
and dad...and to be able to have the TV be an interactive centre, as it is already the centre of linear family entertainment.”

Marcum also sees iTV as a long overdue producer of activities for children that have not found a revenue model in other digital formats:

“The preschool market has pretty much been ignored by console manufacturers. There’s not the shelf space, there’s no retail opportunity to sell video games. We’ve tried, everyone’s tried, but you don’t see any competitive releases in the preschool stakes for Playstation or X-Box at this point. So if their older siblings are playing games on TV, and they want to play games on TV, then we think we’ve found a very easy way for them to do it.”

Smallshaw believes that one of the primary offerings of iTV to the children’s market is a more practical and hands-on learning experience; the fundamental basis of which is grounded in an active model of television viewing:

“I do think [interactive television] is one way in which you can potentially make that experience more rewarding. It doesn’t have to be overtly educational…but they can take part in a way that requires more of their minds than just sitting there and consuming; letting it wash over them. And I really believe that has to be a good thing.”
Where linear television always sought to provide a measure of interactivity, Smallshaw believes that iTV can provide an instant and reciprocal dialogue that not only allows children to participate, but to see the effect of their interaction:

“I think there are quite a few programs where they do set out to stimulate the children’s mind and engage them, often they’re asking them questions with the presenter face to face with the camera saying ‘do you remember, how many apples has Tom got’ or ‘there are spelling bee competitions and quizzes coming up for CBBC’, and that sort of thing. And I think we could provide a mechanism where rather than just shouting out or thinking ‘oh, I could have done that’ they can actually say ‘yeah I could do that, I could do better’ and have a go at home and take part…. I believe educational materials, they have to engage you like that; you have to be taking part and practising.”

Gauld believes that this increased level of control of the content leads to greater empowerment for the child, consistent with Carey, Tryee, and Alexander (2002); and Lloyd, Roeth and Stone (2003):

“I think anything which gains attention like that is really good. Empowering little children is really good…It’s like when they first learn to say ‘no’. It’s just testing their inner power. They are an independent.”
She also contends that a major contribution of iTV to children’s learning may just be the simple action of cause and effect: “On the subject of cause and effect, I was thinking about the telephone, the remote control, the computer keyboard, things like Leapfrog. Why are things like that so appealing? Is it because they’ve got buttons; is it buttons intrinsically in themselves which are appealing? Or is it the fact that…their learning experience is ‘cause and effect’, and by pressing a button there is an immediate cause and effect between what they’re doing.”

Along with the advent of iTV, studies have reported on the benefits of interactive television for providing a constructivist learning approach, by providing this highly empowering, reciprocal experience (Jonassen, Peck et al., 1998; Boethel and Dimock, 1999; Herrington and Standen, 2000; Revelle, 2003). The question of whether this dynamic generates greater memorability or understanding of the content in an iTV setting is the subject of the final phase of study. However, as we have investigated in this thesis, many media companies are already creating educational content for children (Chapter 2, section 8.3), using tenets derived from experiences in linear television and online. Shallcross comments on the way that the BBC approaches the issue of educational content delivery in its iTV efforts:

“The services that we offer, particularly on 24/7 – with the games and stories – all those have early learning goals underlying. We treat those in the same way as we treat anything we produce online, anything we produce on television, in terms of what we’re trying to achieve with those programs. All our preschool programs have
those objectives. Obviously we’re an entertainment service, but we’re about learning through play; that’s one of the lines of CBBC. So it’s all the time, and for CBBC it’s about finding out things for fun. So it’s about developing your skills, developing your knowledge base, and all those have had a great deal of thought put behind them in terms of what they deliver… We’re always thinking ‘What will they gain from it? What will they learn from it? How will they develop from using this?’ Whether that’s their motor skills or whether it’s something about the way their memory works. Whether it’s their recognition – whether it’s colour recognition, shape recognition – numeracy, literacy, letters, numbers, and using the brands which they love to get them interested in doing those things, and learning without even realising it.”

In terms of what iTV can offer childhood learning, the participants gave a strong indication that the benefit of interactive television is in its ability to create a more participatory environment. This in turn can facilitate the introduction of constructivist learning styles, where programmes can introduce control of content and experimentation to a child’s viewing experience. The existence of many 24/7 and synchronous programmes, which have been deployed based on these tenets, has further reinforced the need for formal studies in children’s usage of iTV. Phase 3 can therefore significantly contribute to notions of interactive television’s capacity to fulfil educational and usability goals that, at this point, have little more than theoretical validity. Internal usability studies, however, have been able to provide practical insights not yet covered by literature into how children interpret and handle interactive television.
3.3 *Children’s ITV usability*

Practical experience is, at this formative stage in iTV’s life cycle, a particularly significant contribution to this investigation. What literature has not yet covered in children’s usage of iTV content, internal investigation and testing has provided for in the commercial sector. Findings of this nature can also inform this study in two ways. First, they can be used in the design of the research instrument; itself an interactive television programme that relies heavily on a conceptual sense of appropriate delivery. Second, findings into how children respond to iTV content can perhaps aid in interpreting viewing behaviours observed in the latter phases of study. By understanding issues associated with iTV audience behaviour, the behaviour of the children under test conditions can perhaps better be understood, in order that any inferences made concerning the effect of iTV content on children is firmly based in both a theoretical and practical sphere of understanding.

Three areas of particular interest and concern were highlighted in discussion with the respondents. First, the question of how children use iTV functionality. This encompasses the capacity for early childhood to grapple with the basic motor functions of the iTV format, such as usage of the remote control and general competence and understanding of the iTV interfaces. Second, competence with the navigational elements of iTV such as negotiating menus, understanding directions, and their capacity to get where they want to go. It also includes questions of children’s usage behaviour; how they respond to certain elements, what their preferences are, and how it differs from our conceptions of
adult behaviour. Finally, something that has emerged as a significant factor in children’s usage of iTV content is their parents. This section concludes with a look at how the parental influence has shaped both how children use iTV content, and how this has influenced designing for the early childhood audience.

### 3.3.1 Interactive Devices

Usability issues concerning iTV revolve primarily around children’s competency with the remote control. Studies mentioned in Chapter 2 have confirmed that children as young as three are capable of using a remote control (Revelle and Medoff, 2003). In Sesame Street’s ten year history of iTV design and testing, Marcum comments that “as a group we’ve designed [on] pretty much every interactive platform that has come around. So we know what works and we know, generally, what the best way to design the interface for the input controller is.”

Though the Sesame Workshop hasn’t conducted significant research into the use of the coloured buttons as an interactive input device, they have made inroads into children’s usage of interactivity using the interactive cursor keys, such as up, down, left, right, and select. Marcum comments: “I think we can accomplish what we need to do using a standard remote…We’ve actually done a few studies, casually, with remote control usage on this thing….And you talk to somebody who actually has a three or four or five year old kid in the house and they look at you like you’re insane, like ‘you didn’t need to test that; I could have told you that. My kid can use a remote control’’. That’s something that is quite important for us to do it, and to make sure that the design that we’re using,
which is the arrow keys and the ‘okay’ or ‘select’ button actually are usable.” Though Marcum is aware of research pointing to the age of three as the beginning of remote control competency, he comments: “I’m optimistic, let’s put it that way, that when we’ve finished with research that we’ll know that kids as young as two are able to use this thing.”

In the UK, the prevalence of VOD and PVR development has created a lot of interest in children’s usability of the ubiquitous Sky remote control (see Chapter 2, section 8.2.1). Walley contends that though children are capable of associating the coloured buttons, it is sometimes the physical product itself that can cause problems: “We do find that the kids find the normal [Sky] remote controls big and heavy. So remote control issues seem to be an issue.”

When it comes to their understanding of how to use an interactive remote, however, Walley concedes that children often display competent use of the device and its functions. The success, he has found, derives principally from their exploratory behavioural patterns when it comes to an iTV interface:

“They’re quite happy to explore the buttons, and have a little play and see what happens. That seems to be a thing on all technologies though; adults will stare at the technology, trying to work out what to do, and kids will just press it and see what happens. That’s a different perspective. You see that in the remote controls.”
Ian Shepherd, Managing Director of Sky Interactive, also comments on the tendency of adults to use interactive services in a purely utilitarian regard: “When you use a traditional text-based menu to access interactive services, you tend to know where the service you're interested in is located and you tend to go straight to it. You never really absorb anything else that's going on” (Swedlow, 2005, 13th January).

Walley indicates that in a moment of disorientation where an adult might hesitate in using the remote control, a child will continue to navigate and interact with the television. This, he maintains, derives from a difference in usage behaviour. Where an adult has been found to use iTV in a functional way – as a vehicle to facilitate transport to pre-chosen content – to a child the navigation itself is part of the experience, and in many ways the destination. Therefore, usage of an EPG or an enhanced service is part of their exploration of the medium, and can allow a certain level of immunity from technical frustration. Walley also discovered that this was consistent with children’s usage behaviour of other aspects of iTV navigation; an issue discussed in more detail in section 3.3.2.

Shallcross also maintains that children’s usage of iTV content is greatly facilitated by their exploratory usage behaviour, however contends that children’s familiarity with interactive navigation from other media also plays a significant part. This, she comments, relies heavily on creating simple and familiar navigational devices. However, when they are developed properly, Shallcross remarks that they prove extremely usable and successful in children’s testing:
“When we do user-testing, particularly with interactive TV in the past, the parents have sat there and said ‘How do they know how to do that? I’ve never taught them to do that!’ We try to develop all the services so it is really intuitive. Playing an online game; we may not even have any instructions. It would just be really obvious to the child about how they would actually move forward, and take part. The colour keys, as you say, are the easiest way to do that, because they see them on the bottom [of the screen], and they see them on [the remote]. You can just hand them this and they would work out how to actually use the game.”

While enhanced television applications commonly rely heavily on the cursor and selection keys, Shallcross identified that the coloured buttons provide an immediately familiar and intuitive navigational tool for children. The colours themselves provide a recognisable reference for children not familiar with convention navigation techniques. Another significant contribution that the coloured buttons make to interactive usability is that they employ a direct-linking method of interaction. In experiments reported in Chapter 2, section 8.2.1, by Revelle and Medoff (2002; 2003), allowing children to interact via a direct-click selection was found to be significantly easier and more accurate than allowing them to ‘choose’ and ‘select’.

3.3.2 Navigation

Children’s use of the navigation extends beyond merely their proficiency with using interactive remote controls; it involves their ability to understand and interpret prevailing
iTV and linear conventions that adults may take for granted. One of the elements that Walley cautions on, therefore, is the tendency to assume adult data is also applicable to children; a concept consistent with research identifying children’s usability issues as being fundamentally irreconcilable with adult usability research (Strommen and Frome, 1993; Strommen, Revelle et al., 1996). One of the most significant differences that Walley has discovered in VOD testing is that children exhibit very different behaviour when presented with incomprehensibility:

“Some of the work that we’ve been doing around Video on Demand has shown that when you move out of the non-linear environment, adults have a much stronger need to have a sense of ‘home’ on the TV. When you get lost; you’re three layers down in the VOD menu looking for a program - you’ve gone left and right, you suddenly can’t remember where you are – adults really feel the need to have a big ‘home’ button on here. Whereas kids don’t seem to have that same need to have that locator space on the EPG. Most people use this as their kind of ‘if anything goes wrong, I’ll get myself back to here, and I’ll start again.’ So that’s been quite interesting. Kids don’t have that same need to have that kind of anchor point. They would go off and delve.”

This finding raises a critical tenet concerning iTV behaviour; children do not largely find difficulties with an iTV interface a deterrent. In Walley’s experience this is at odds with adult behaviour, which is more reliant on things such as the ‘home’ button to avoid disorientation. For children, however, the process of navigation itself is of value, a
concept ideally suited to the proposition of iTV as a learning platform for children. The implication of this is that concerns about children feeling isolated by new technology and unfamiliar concepts may be largely unfounded. Gauld recounts a testing experience from the BBC’s internal iTV research that provided strong evidence for her that children are indeed undaunted by unfamiliar iTV formats.

“We only tested on two children to begin with, a four year old boy, and a three year old girl. It was a Bob the Builder ‘build-your-truck’ Interactive TV game. The children hadn’t used digital TV at all. We had a computer in the corner with CBeebies online on it, and we navigated to the Bob the Builder game on the TV using the Sky control. We went through it with the boy, and he played it a few times. Then we went through it with the girl, and she played it a couple of times. After playing it two or three times they were bored. But then the interesting thing is that they both wandered back at certain times to the TV, so we just watched them without interfering at all. The little boy went back, he picked up the right remote control straight away from the table, and he navigated to the game. Then the three year old girl, after he’d finished, she copied what he was doing. But she picked up the wrong remote control to begin with, pressed lots of buttons, and just didn’t seem fazed by the fact that they weren’t working. So we just let her press buttons. She finally found the remote control that worked and also started playing the game.

“So that is just incredible. It is at the age of three that they can cognitively make that leap between what they do to something affecting what happens somewhere else. But
the thing we took out of that was their fearlessness. To me and to his parents it’s quite complex, but to the girl, she wasn’t fazed at all; it was just fun buttons to press, and so she was just picking up all the remote controls and trying it until it worked. And with her it was trial and error until it worked.”

Walley contends that this viewing behaviour can once again be attributed to a child’s exploratory perception of navigational iTV elements. He maintains that while adult research reflects a more utilitarian usage of iTV navigation, children’s exploratory usage behaviour allows the navigation to function as part of their viewing experience:

“…they’re not quite so fixed on getting to where they’re going. With adults they know what they want… they try to get it or they come out and go back in again. Whereas kids are much more willing, they don’t have such strong affiliations to programming. They don’t have to watch that episode… if they bump into a Scooby-Doo program, they’ll start watching that. …it’s much more of a tool for adults. But the process and just the exploration is quite fun for kids.”

This once again strengthens the notion that iTV is ideally placed as a learning vehicle for children. These observations suggest that a programme that has appropriately incorporated navigational devices into learning outcomes will provide significant value for an early childhood user. In summary, industry perspectives suggest that children’s viewing patterns differ from adults in two significant ways. First, they interpret navigational elements in a much less utilitarian way. This is manifested in more
exploratory usage patterns, as well as less of a loyalty to episode continuity. Second, children are much less isolated by difficulty. They are less deterred by mistakes and disorientation, and are more comfortable exploring and discovering in the iTV experience.

### 3.3.3 Parental Influence

Children’s usability testing has inevitably involved discovering how a parent’s perception and understanding of iTV functionality affects a child’s experience. Many times these insights do not come about as a result of direct testing procedure but are, as Walley puts it: “one of those things you learn; a peripheral outcome to the results”.

Participants in these interviews indicated that these outcomes have had a direct effect on the manner and style in which iTV has developed since its beginnings.

Problems sometimes arise, Chudleigh finds, when parents are unfamiliar with the interactive service: “Some parents, because they don’t understand where they are with the enhanced TV service, find the experience stressful. The service may say ‘To play the Bob the Builder game press red’. They press it and then the parent doesn’t know where they are, the kid wants to try the hardest level first, not the easiest level, and they inevitably can’t do it; the parent could find the experience stressful, and the kid wouldn’t really know what they were doing.”

Another unforseen issue that Disney has discovered has been that the Sky remote (a considerable amount of UK interactive content is delivered via the Sky platform) is sometimes out of bounds for early childhood users. Chudleigh explains that when it
comes to parents, Disney research has noticed that “they use the TV passively; because they are going to put the kid in front, then they put it on the channel and put the remote - which costs 20 pounds - up on the mantelpiece. Now, the reason they are going to do that is because the kid is going to chew it, and has a high chance of breaking it. Lots of people go out there and make these kid remotes. But the parent wants to have a lot of control; either from a ‘buying a remote’ perspective, or for the educational purposes of the kid, to make sure that they don’t wander on to some of the other channels that are on there, in the EPG.”

This can have a considerable impact on children’s programming, in that it severely limits the interactive access for childhood audience members. As well as expensive remotes and appropriate content, the BBC has also found that the proliferation of ‘red-button’ advertising and activities have meant that parent’s consider cost to be a considerable factor. As return path functionality is frequently associated with payment, whether through ‘pay-to-play’ games, voting on Big Brother, or 24/7 shopping channels, a parent’s common perception of any kind of interactivity on television, Shallcross explains, is that it costs money:

“As it stands amongst the parents, there’s negative perception around the red button. Some parents say to children ‘whatever you do, don’t press the red button,’ because their automatic thought is that when you press that red button you’re being charged. And that is clearly not the case. Until you participate, either by vote which requires a return path, or by comment or whatever, you’re not participating until that
Gauld agrees, commenting that the BBC’s public-funded status has allowed all of their children’s interactive services to be free; something that they have had to fight to bring to the public’s realisation:

“Parents seem to be frightened that they’re going to have to pay, even when they don’t on our service. And we don’t have the return path on CBeebies; we just don’t use it because the children are too young. So if we’re encouraging three, four, five, or six year olds to use it, we don’t want them to incur any costs, even though there would be interstitial pages and ‘ask parents’ pages. We still wouldn’t use it; we just don’t think it’s worth it.”

As Walley explains, the tension between parental and commercial interests when it comes to the childhood audience has been a syndrome of the UK industry; and one that has considerably shaped the way that iTV is deployed for the early childhood audience: “TV companies are terrified of being seen to use interactivity as a way of gouging more money out of the kids market. They’ve all fallen foul of it in the last couple of years. There’s been a backlash by parents; parents stopping their kids from using the interactive services.”
Chapter 3

Companies have discovered that one of the problems parents have with the return path is that the household has no way of knowing their iTV return path costs until the end of the month. As a result, Shallcross explains, alternative return paths have been relatively more successful for the older childhood audiences:

“Instead of using return-path to comment and send in questions and things like that,…we give them a phone number that they can use, we give them a text number that they can use, and they can also use email both before and during the event. So we don’t need to actually use the return path, because children are more likely to actually use their text on their phone, or send an email, than they would press the red button and actually type in that way…they are so much more likely to use their mobile phones, because that’s what they use every day to communicate and interact. And also then the costs can be controlled much better because most kids are on ‘Pay-As-You-Go’ tariffs. It’s their choice to do that, and the parents often say ‘you’ve got a card for a month. If you run out on that card, you aren’t getting any more’. So the children have to manage it themselves…”

Though this is a successful model for older children, as it also allows the parent to educate their child on money management, the fact that early childhood viewers rarely have mobile phones or the freedom to purchase has meant that return path functionality, whether free or otherwise, is largely not used. This move, however, has left educational content for children little affected. Programmes, as we have seen, have instead focused on providing control, choice, and immersion; fortuitously, features that have been found
to provide great educational value with little need for a return path. Parents, themselves, have also emerged as having a significant part to play in this model of children’s interactive programming. Though the BBC currently has a considerable amount of content for the early childhood audience available on their 24/7 service (Chapter 2, section 8.3), Shallcross comments that the vast majority of their services are intended for an accompanying parent to provide assistance: “The CBeebies service is intended to be a dual audience – preschool children and their parents or carers – and we would always encourage that, and that is the way the service is and the applications have been built to be used. The CBBC audience is much more about children exploring and using the services on their own, so it’s quite a different way in which we approach it”.

The reason for the parent interaction is, as we have seen in Chapter 2, that most of the programmes require a considerable amount of reading and text-based navigation in order to use them. Parents will commonly read a story from the screen, prompting the child to press the button to turn the page. The success that they have had with this format is largely due to its ‘always on’ availability. When parents are available and willing to sit with their child and go through a learning module, the programmes are waiting on the portal for them to use.

When it comes to enhanced television content, however, companies have encountered difficulties with the early childhood audience. One of the particular difficulties that emerged in Disney research is that enhanced television content, which has been successfully run for slightly older age groups, proved less able to capture this dual
audience. As enhanced content is usually tied to a running television programme, it cannot provide the time flexibility required for parental availability, however its higher production values and more graphical interface makes it a considerably more user-friendly and appropriate interface for an early childhood audience. This is further compounded by the fact that, although enhanced content traditionally uses more audio and visual features than a 24/7 application, most eTV applications still rely on text-based techniques for their interactive functions; such as for choosing menu items, voting, or writing a message. Markham comments that, despite the promise that iTV holds for the early childhood audience, parent research has identified problems in children’s usability:

“…if we were to do enhanced content for preschool shows, then that would need the involvement of parents, and that’s what parents, from our research, didn’t want. They wanted to be able to leave the kids to actually do the tasks on their own, almost effectively like a colouring book but with a digi box and a remote control, which then doesn’t equate.”

The BBC has developed a particular eTV programme designed to combat this by providing dedicated parental content in some children’s programming that provides tips and suggestions for parents to use in talking to their child during the programme. Gauld comments that an incentive for this project has arisen from an awareness that an accompanying parent or guardian allows a child to greatly enhance their understanding of the experience (American Academy of Pediatrics, 1999; Garrison and Christakis, 2005):
“What we’re going to trial next year [2005] is we’re launching a language and literacy program, and alongside it we’re going to do a third screen overlay for the bottom third; a transparent overlay that parents can call up… prompting the parent to talk with their child. What we really want to is to encourage parents to sit down with their children while they’re watching TV, not use it as a baby-sitter. That’s really how children learn, if they’re getting that 2-way communication; they’re getting feedback for their questions. What we want to do is tap into programs like this new literacy program, or Teletubbies, or something like that, and put, not patronising questions at the bottom, but good questions for the parent to ask their child while they’re watching it.”

Though this initiative emerged to combat a nationwide decrease in literacy standards, the BBC have discovered that by providing interactive content that induced parents to assist their children’s viewing experience, they had incorporated a scaffolding learning approach. As we have seen in Chapter 1 (sections 3, 5) scaffolding necessarily requires the involvement of a parent of carer, in order that a child’s learning experience be enhanced and consolidated by their influence (Berk and Winslet, 1995). Through providing text-based content for parents during a children’s programme, this approach proved effective in that it involved text-based content for the parent, and visual and audio content for the child. It also proved cost effective, in that text-based interactivity is significantly cheaper and easier to deploy over a programme than extra video or animation.
This section has explored parental involvement in children’s iTV development, and has demonstrated how awareness of parental influence has significantly shaped current iTV offerings for the early childhood audience. Participants have indicated that the sensitivities associated with return path features have largely discontinued their use, and as such, content for the early childhood audience has proceeded as primarily an educationally focused, value-added service. Cost, technology restrictions, and this absence of a sustainable revenue model, however, have affected the production values of this educational content greatly. As a result, current iTV content for the early childhood audience has almost exclusively been text and still image-based, dual audience fare, residing on a 24/7 portal. Parental involvement, in this case, has been critical to early childhood’s use and understanding of the content.

These industry pressures have meant that programmes featuring early childhood content utilising both high production values and suitable navigation for exclusive child usage are virtually non-existent. In terms of this study, this is a strong indicator that development and broadcast costs are extremely important factors in children’s iTV production. Further evidences of this issue are explored in section 3.4.3.

### 3.4 Hindrances and Difficulties

The ability of the children’s media companies to produce innovative and suitable interactive children’s programmes is constrained by the limitations of the platform.

Chapter 2 included an exploration of numerous hindrances reported from printed media,
literature and other sources that document the technical constraints of interactive television and the implications for quality children’s iTV content.

This section explores the participants’ perspective on the impact of these limitations. In many cases, their daily task in developing and testing iTV content is to continually minimise their impact on a number of fronts. From the interviews, three key categories emerged; technical limitations, production difficulties, and design costs. This section outlines how each of these factors is impacted by the limitations of the medium, and explores the implications both for quality children’s iTV production in general, and this present study’s research goals in particular.

A further purpose of this section is to provide a commercial perspective in which to ground the research performed in this thesis. The ability of the research instrument to provide a realistic and plausible proposition for the children’s industry assists in assessing the ability of iTV to provide benefits to the industry on its own terms. Of particular concern will be the impact of production and broadcast costs on children’s iTV content. A particular consideration for this section is to explore the impact of cost on children’s iTV programming.

### 3.4.1 Technical Limitations

One of the most significant hindrances to iTV development is a lack of standardisation. As we have seen in Chapter 2 (section 4.4) the proliferation of proprietary middleware standards and legacy set top boxes in iTV markets around the world has prevented
speedy development on the part of both platform operators and their content providers. This is a particular hindrance in the UK with the existence of four competing platforms (Chapter 2, section 4.3), of which three (cable, satellite, and terrestrial) have major market shares. Despite the gradual development of compatible middleware standards across the platforms, the fact that the platforms also differ in their capabilities is a significant concern for content developers. As Shallcross explains, the impact of this is that multiple versions of a programme must sometimes be created to suit the abilities of the respective platforms:

“We’re having to put resources into making sure that we’re offering a service to as broad an audience as possible. Offering when we can, [as] some of the formats just won’t work on one of the platforms. So I suppose that it’s the different formats. That’s the issue, because it takes more resources to make something work across all platforms.”

As Markham elaborates: “There’s no one set standard. For the web you have HTML, you have Flash, you have protocol. At the moment you don’t have protocol which is available to all.”

This is further exacerbated by a lack of internal consistency on the part of some platforms. The UK’s fastest growing platform, Freeview (on digital terrestrial), struggles for compelling interactive content due to both its MHEG middleware that can’t support a return path, and lack of consistent protocols on how the interactivity is presented. As
Smallshaw explains, this can not only prevent companies from creating powerful content, but also harms the perception from the consumer’s end:

“The fact that Freeview doesn’t have any shared standards and it doesn’t have someone saying ‘actually the quality’s got to be this’, or ‘you’ve got to use these keys’ or ‘don’t use that one because we’re going to make sure that one always take you back to the beginning’, means that it’s a free for all. Not only haven’t you got anyone doing that sort of checking, but anyone can develop a Freeview box. So you’ve got no standards for the remote controls, some people don’t have a ‘back’ button or a ‘text’ button or a ‘select’ button. So to develop a service on a platform like that is really, really difficult.”

Though consistency is a strong part of children’s usability (as we shall see in section 3.5.4), sometimes platforms can also go the other way, and impose too many restrictions on the content producers. As Smallshaw explains:

“…the cable companies insisted on keeping the fast text keys; Red, Green, Yellow, and Blue. They wanted those to launch ads and to navigate in their service, so we couldn’t use those. We were down to arrow keys and ‘select.’ So it all affects the end product.”

While these technical difficulties make interactive television production a challenge on a domestic front, this is further complicated when a programme pursues international
syndication. The international distribution of TV programmes often plays a critical role in financing children’s programming. Typically, such distribution requires minimal additional cost; commonly requiring only voice overdubs or subtitles. The international syndication of an interactive title, however, requires a considerable amount of extra programming and production work. The array of middleware standards, the differing level of technology on overseas platforms, and the familiarity of its audience all could possibly hinder interactive television titles from reaching international audiences. Chudleigh reflects:

“A lot of people have come to the point where they’ve taken it as far as they can, in an era where international titles are required; and then they’re redubbed rather than [using] shows made specifically for this country. Selling something internationally is becoming vastly the way to do things. Which means that you’ve then got to redub both streams; you’ve created twice the work for yourself when you want to go and take that show to France, or take that show to wherever you want to go.”

Once a show has been aired, however, companies are frequently unable to measure how many people have used the interactive service. As has been outlined in Chapter 2 (section 4.4), the industry has constructed certain ways of providing user data on interactive services. However these methods are either based on return path ‘red-button’ interaction, which involves a charge to the viewer, or involves ‘silent’ return path dialups that direct the costs to the content provider themselves. For the early childhood audience, in which the use of return path functionality is a particularly sensitive subject
to parents, neither of these options are either plausible or sustainable. Aside from bespoke panels such as the Sky View panel in the UK for measuring interactive ads, measurement data is therefore hard to come by in iTV production. However the accountability that it can provide assists in both the justification of iTV programming, and the maintaining of high quality iTV content. As Markham reflects:

“I think for us, we don’t know actually who is interacting. With the ratings system in the UK at the moment, we only know when people are watching the channel. We don’t know when they’re going interactively. So what we have to do [is] we get dialup information. So when people submit a vote into a competition, or send us a message, we get that result. But that doesn’t tell us how many people actually use it passively. Toontips, which is a way that kids can draw characters, you learn to draw kind of the characters on air. That doesn’t cost the kid anything, so therefore we don’t have a dialup, and therefore we don’t know that they’re there.”

Chudleigh agrees, explaining that the considerable costs of building enhanced or interactive content commonly leaves little in the budget for actual feedback on its performance:

“Usually you don’t get ‘ratings’ for ETV. In other words, you can’t use the same justification like you can for the commercial model of TV, because there’s no rating. Now if the ratings for that Enhanced TV footage was included as a multiplex of the ratings for the TV channel – for instance with Disney channel, we measure ‘Disney
Channel’, ‘Disney Channel Plus One’, ‘Playhouse Disney’, and ‘Teen Disney’, and we use that combined total to give us our rating for that month, or that week, or that minute. If we then added a fifth channel, an additional channel – that being ETV, how many people are using ETV at that time – that would go somewhere. But the cost of measuring that enhanced TV channel is both technically hard to do, but also costs a lot to monitor. So you end up with a situation where you’ve got something that’s costing a lot to build, and if you’re then expected to spend a lot of money monitoring it, it just doesn’t make sense.”

### 3.4.2 Production Difficulties

Limitations on the interactive television platform are not completely imposed by their technical design. As Chudleigh explains, the filming of extra content such as alternative video streams is a significant additional cost that companies often find hard to justify:

“It’s very expensive to create live action in particular, or even animation, that isn’t [necessarily] going to be shown. It’s hard work to create video footage for something that is going to be shown to kids. It’s also very hard work to create something that’s not going to be shown. And of what value is it to the kid? You still have a version that people who don’t want to participate – and there will be some – that will still watch TV. You can’t butcher yourself by saying that you have to play at home, because sometimes people don’t want it, or on some platforms it’s just not an option to do that. It’s just too fragmented to be worth doing.”
Though the idea of constructivist learning requires giving control of content to children, and control of content requires the use of alternative assets and storylines, the higher the production values involved, the more reluctance is felt in producing the extra scenes required in order to design a significant experience for children. Interestingly, this has also proven problematic from a creative standpoint. When it comes to interactive programming that involves the filming of multiple video streams in order to give the child control of content, Walley has found that sometimes it is hard for the content producers to relinquish it:

“[Multiple narrative streams] doesn’t endear itself to the writer, because writers like to deliver great narrative; the story with a beginning, middle, and an end. It’s very hard for them to [relinquish that] and to get excited about delivering content where they’re not in ultimate control of the narrative stream.”

While television narratives have traditionally sought an interactive element, Walley’s remarks denote the tangibility of the new iTV experience in which creative power is wrested off the producer and given to the receiver. This is a natural part of other media, such as online games or narratives, however it is a new proposition for linear television. Some programmes that have an element of interactivity to them are ideally suited, therefore, to additional iTV content. However in some cases it is this same attribute of the programme that causes reluctance in producers to introduce interactivity. As Chudleigh explains, sometimes a linear programme with an interactive element to it negates the desire for further interactive features:
“If you’ve got an interactive show like ‘Blues Clues’ which is doing really well in the ratings, it is really hard to then to do something more interactive with it. You have already started with an interactive format; you are not trying to make a show interactive, it’s already there as a linear TV.”

Marcum agrees, commenting that it was this creative difficulty that has prevented Sesame Street, despite years of iTV research, from adopting enhanced content. Interestingly, in Sesame Street’s case, addition of interactive content was considered a distraction from the educative goals of the programme:

“What we have found, overall, is that it’s very difficult to do what is sometimes referred to as enhanced TV, or layering additional interactivity onto our programs, for a couple of reasons. One is that we are dealing with a pre-literate audience, with regard to Sesame Street. They don’t read yet, and so anything we do onscreen really has to involve audio directions, which really doesn’t work on top of the show. Which leads me to the other reason why we don’t find it works, which is that the show is so dense that even if you manage to fit the audio instructions at the beginning of the show, there’s really not much else that you can do from an enhanced standpoint that wouldn’t detract from the actual lessons of the program. We don’t have commercial breaks apart from of course ‘this is brought to you by the letter ‘A’ and the number ‘2’. So it’s not like there’s any wind-down period or wind-up period where we could really fit an enhancement.”
This exemplifies the difficulties involved with ‘bolt-on’ interactivity, in which the interactive enhancements are incompatible with a linear product. As Chudleigh explains, content providers need to plan for interactivity at the preproduction stage in order to make sure that the programme is able to accommodate and best utilise the features of the iTV format:

“One of the main problems is that you need additional material that doesn’t necessarily exist. Therefore if you want to get it you have to be in at the production source. If your show is delivered to you, generally enhanced content hasn’t been thought about in the same way that DVD extra content has been thought about, and put in from the very start. When someone creates a film these days they know they’re going to have to create the DVD extra sections. They know that when they create it, but historically when the [content] gets delivered to us, there is not that additional information. So it’s easier to create enhanced TV for shows that are coming through. But even more so it’s better to cater for interactive shows that, at the core-concept stage, the show is based around voting; like Big Brother is, or Star Ticket was. The show is about interactive and built around voting, and also as it’s an original commission you have complete access. It’s so much easier to make it a quality application because you can create that additional material or that material that you need, or the summary, at the same time.”
When it comes to producing enhanced television programming, the infancy of iTV programming and its general integration into company practice has introduced further difficulties. As Markham explains:

“We’re always trying to catch up with the actual production timeline, which is invariably twelve weeks. Which is, in interactive television terms, really short. We need five or six months to develop something. So in that respect, we’re always up against it.”

The solution, he explains, is better dialogue and general integration of the various departmental processes that are involved:

“…if your production cycle is twelve weeks but your enhanced TV cycle is four months, you’re always trying to catch up with things or you’re trying to jump the gun. Whereas what it really needs to do is be part of the production process. Albeit that you have slightly different teams but they work together. So they have a push-pull relationship, saying ‘well this actually works better for us as part of the application, and this works better for us as part of the show’. It can’t be two different teams operating in isolation of each other.”

This kind of restructuring is already happening in some cases. The BBC’s children’s department has adjusted the way that they produce new media, in order to capitalise on each media device’s strengths. This is outlined in section 3.5.5 as part of an exploration
of the new principles of both interactive design and practice that are emerging in the industry to maximise the effect of iTV.

3.4.3 Design Costs

Creativity is frequently curtailed in many industries. Interface design and creative delivery in interactive television is no exception. With the considerable cost of producing interactive services, creative ideas are often pared down, altered, or abandoned in order to secure a sustainable, cost-efficient product. However, as has been noted in the previous chapter, it is frequently creativity, in the form of rich colour, motion and functionality, which provides a more compelling learning environment for the childhood audience. As Chudleigh explains, interactive television programmes that have educational goals as their core proposition find it typically hard to compete against more commercially attractive fare:

“The other area of concern is that preschool is fantastic on merchandising. If you came to me as an eTV agency and said ‘We’ve got two apps for you. One, we’re going to let the kid choose which one he wants to see, the red and the green. It can make him feel like they’re actually in charge of the show. It can really empower the kid. For me, at Disney, that’s fantastic to see. Equally, you could say ‘Parents, press Red and you could buy the Dora the Explorer doll’. The second is much more, in a world where we’re watching every penny, a much more compelling proposition, frankly.”
Threats to creativity in interactive television are commonly of two forms; problems with the technical capacity of an interactive service, and the costs associated with their development. Technical capacity refers to elements of the service that affect the level of variety and quality that can be creatively delivered. For instance, the nature of the transmission process means that only very small files can be broadcast via the data carousel (See Chapter 2, section 4.2). This implication of this in ‘over the air’ delivered iTV is that, as we have seen in Chapter 2 (section 4.3.3), 24/7 applications delivered via satellite currently have quite rudimentary sound; commonly limited to a looping sound file of 60 seconds duration. This has an enormous impact on the quality and type of programmes that are considered for this service. As Smallshaw explains:

“We budget and say ‘right it’s got to be good, this is the budget for that game’ [however] often it’s the technology that stops you. Say, for example, we have CBeebies stories without sound, so the adults have to read them – now that’s fine, because it can be a sharing activity, which is actually quite nice where you know the parent’s going to have to sit down with the child and read the story out to them – [but] it means it has to be shared; they can’t sit there on their own and hear the audio as well.”

Gauld explains that the implication of this is that in many cases, such as the CBeebies 24/7 portal, this can significantly reduce the appeal of the product to both children and parents alike:
“I think that the Interactive TV platforms are so restricted at the moment. They are just so, so limited. In terms of audio, in terms of animation, and in terms of just the capacity of what they can hold… it’s not as immersive as all that. I think parents will only really want to go there when it becomes a lot richer”.

Hand in hand with these restrictions is the cost of developing the creative ideas. The problem is that sometimes small but critical features of the programme can produce significant extra programming costs. What is commonly sacrificed is the level of visual and audio production values, however, as Smallshaw explains, they are often a vital part of engaging children’s content:

“It’s all bells and whistles and as we break it down we slowly have to snap that off and shave that off, and all the nice bits go. But the trouble with the kid’s content is often those accessories are actually what make it engaging and what make it easy to use, and the extra pictures or a sound file which you get when you press a button; it’s actually the nice bits that are intrinsic to the usability of the thing…For some of the 24/7 games I think we tried really hard with those to include the crucial elements that we needed, but even with those occasionally you have to leave something [out] because of the cost of developing them.”

This thesis has outlined, however, that as technology develops over time, the capacity of interactive services will increase, and the cost of these services will diminish. Children’s content – a troublesome prospect at the moment with similarly frail revenue models to
support it – will over time become an increasingly equipped and cost-efficient service. For instance, as we have seen in Chapter 2 (section 4.3.3), the development of DSL and Fibre technologies allows an iTV service to be comprised of larger assets and therefore deliver higher production values. The additional high-speed return path would allow not just synchronised, but on-demand content, in which every aspect of a child’s learning experience could be enhanced with audio rather than text, video rather than image, and real-time responses to the child’s interaction. Additionally, this would relieve channels of storing – and therefore paying for – such data on the platform’s 24/7 portal. This is already theoretically possible on an IPTV platform, though interactive television has largely not been pursued on IPTV platforms as yet. As it stands with iTV services, regardless of changes in technology, the one seemingly constant obstacle to unencumbered interactive development is bandwidth. Whether the provider is producing an enhanced application with synchronous streams of video, or a game on a 24/7 portal, whether via satellite or broadband, the amount of bandwidth that is required will always be a tempering factor in how much or how far a concept can be taken. As Chudleigh explains, increasing demands of a growing media market keep bandwidth at a premium; resulting in consistently high delivery costs:

“What’s not coming down is the space segment; the bandwidth. The [cost of putting up] the additional TV is very expensive, frankly. And broadcasting is actually a very expensive area. The space-segment is your area on the satellite to get that TV footage out. That is very expensive especially when there’s no means of measuring success, unless you have a return path… With the amount of channels going up on the
platforms, I can’t see a case for space-segments coming down. We’re just filling up the satellites by the minute. So unless someone goes up there and puts up a couple more satellites – we’re just dying to get people on to use them – it looks like it’s just going to stay the same. It’s running out, frankly. There are up to three hundred channels, including the radio channels, and there isn’t the spare capacity. There is a limited choice up there, and it is expensive; very expensive.”

This can be frustrating creatively, as it often means that concepts are curbed or at least modified in order to produce something that will fit into the amount of bandwidth allocated to the production team. As Shallcross explains, this often involves making unwanted compromises on vital aspects of the final product:

“As it stands at the moment [bandwidth] is limited. Because of bandwidth issues we can’t have as much sound as we want. We can’t have a great deal of animation that makes it exciting, that appeals to children obviously. We can’t do all those things, we have to trade off. For a birthday section, do we want to have some really good quality graphical images, or do we want to trade that off so that we can actually have two hundred kid’s birthdays up there rather than only fifty kid’s birthdays? So it’s working out whether we want to give credit to more children, or make it look prettier. But you have to make it look attractive to attract children in the first place; so it’s getting that balance. Those things are a trade off in terms of bandwidth.”
Many aspects of the iTV development and delivery process hinder iTV content from being created to its potential. The absence of unifying standards of architecture have minimised the possibility of cross-platform productions, thereby withholding significant revenue streams that would make children’s content more of a valuable proposition. The difficulty in measuring interaction through use of the return path has meant that children’s usage is largely unmonitored. The costs of programming and then buying the bandwidth for an interactive broadcast and have meant that the elements that hold the most appeal, engagement and impact for the early childhood audience are often the most costly, and therefore the first to go.

These factors all have a significant implication on the research instrument used in this study. The issue of being cost-effective is an important concern later in this thesis, most specifically in the ability of the research instrument to incorporate ideas of best practice, whilst still being designed in a way that would make it a credible, cost-effective children’s programme that would realistically be produced by a commercial company. As this study has indicated, however, providing constructive and feasible feedback to the children’s television industry in this study is in fact entirely contingent upon being able to produce content within reasonable production budgets.

### 3.5 Industry Principles

A product of the insights that children’s interactive media practitioners have gleaned over time is a number of unwritten industry ‘principles’; conventions or techniques that have proven to be effective in the interactive space. Some are used by particular
individuals or companies, and others have been largely adopted as accepted practice.
This study has drawn together a synthesis of five principles used in practical industry
development as a form of ‘best practice’. The following five principles emerged from
the interviews as consistent tenets of iTV practice. This section explores these
conventions and how they relate to children’s learning.

3.5.1 Image-based design

An important principle to emerge from children’s interactive television research has
been related to the appropriate presentation of visual content in the iTV environment.
Creative delivery of visual elements required careful consideration of the needs of the
early childhood audience. As Walley explains, awareness of the importance of visual
presentation has emerged from his research into young children’s usability of text-based
content:

“…the biggest one is text… up until the age of ten they’re not able to be as
sophisticated with interfaces and program guides because their reading skills aren’t
good enough.. Text-heavy interfaces on TV don’t work for kids. Stuff that involves
reading too much doesn’t work. They just like to get to the point; pushing pictures.”

In terms of managing children’s understanding of the iTV environment, Walley’s
experiences have indicated the importance of simplicity in the creative delivery:
“Their poor little heads aren’t ready to deal with the big complex [interactions], they can’t work out what’s happened on the screen when you do stuff, very often, unless it’s really clearly signposted. You get a question where it changes the screen, and it throws them unless you’ve told them what is going to happen and why. You manage the process in a way that you don’t necessarily have to with adults.”

This has lead to the development of a principle of creative delivery; using large, simple instructions in the interactive space. This indicates an awareness that children’s understanding of interactivity is unique, and therefore requires particular attention. Chudleigh comments, “if you are going to do anything with kids which is going to be interactive, you’ve got to make it big, make it clear, and make the navigational system very simple.”

Walley indicates a similar understanding, saying “you need interactivity to be really simple; really big, simple gestures, big, simple buttons”. As Walley explains, the interactive EPG ‘Scamp’, on the TalkTalk TV platform is currently the UK’s most significant representation of creating visually driven, simple navigation into children’s interactivity (see Chapter 2, section 8.2.2):

“We have looked at the potential to build more iconography into EPG’s on kids channels; to use pictures rather than words. I haven’t seen anyone, apart from
Homechoice\(^2\), do it. Homechoice are quite good; they use pictures, not words, on their kids EPG.”

The importance of highly visual and simple creative delivery is significant for all forms of iTV. One of the most important considerations is the use of audio in interactive programming. The next section explores principles that have derived from the industry’s experiences with the use of audio in iTV content.

### 3.5.2 The Use of Audio

All of the interviewees identified audio restrictions on interactive television delivery as a significant impediment to strong and effective content. Though audio has fewer restrictions on a synchronous service, when it is delivered via satellite on a 24/7 service it is often limited to a 60 second loop (Chapter 2, section 4.3.3). This means that audio on a 24/7 service is typically not scheduled along with the visuals, and is therefore largely unable to be used to signify ‘cause and effect’ in an interactive application. On the subject of the current technological capacity of audio on 24/7, Gauld comments:

“I think the limitations of it are a real problem at the moment. Especially with our age group; most of them can’t read. So the audio limitations are incredibly problematic.”

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\(^2\) Now known as TalkTalk TV
Though the use of audio is still limited in its capacity, the belief in audio as a vital contributor to children’s learning is significantly understood in the interview group. Gauld explains that, although the nature of looping, un-synchronous audio has created a restrictive platform when it comes to enhancing interactive content, the benefits of audio in children’s interactive content make it, regardless, a well known convention:

“Even the most intuitive of games – like a snap game, which doesn’t really need audio – if you add audio into it, it really helps the child maintain their attention. We found that again and again with any user-testing, audio helps with attention, even if it’s just background music. And so the lack of audio, and the limitations of audio on the ITV applications, is really restricting with what we do.”

As well as providing a more atmospheric or contextually relevant experience for the viewer, the other critical role of audio for early childhood viewers is that it is the only way to provide interactive or navigational information to them. Cueing children to interact – such as saying ‘to follow the monkey, press the Green button’ – allows the child to autonomously participate in the interactive experience, regardless of their ability to read text. In 24/7 applications, comments Smallshaw, the state of technology is not only inhibiting this functionality, but impeding appropriate educational programming as a result:

“We can’t, say, have a little introductory sentence to say ‘press select to play’ or ‘use the left and right arrows to move’; just little things like that which the technology
hasn’t allowed… I think that’s a huge problem with our services for children; for the young children who can’t read yet…”

With the development of interactive technology, the restrictions on audio can be resolved, and children’s programming will increasingly be able to provide services that offer learning through responsive narratives, visuals, and sounds. For instance, two-way transmission platforms such as IPTV and DCT already have the capacity to synchronise audio with interactive visual content. Though in the UK iTV is in its infancy on DCT, and practically unavailable on IPTV, as technologies develop this capacity will improve. With the introduction of a DSL return path to satellite and terrestrially delivered television, the ability to deliver a similar experience on these largely one-way transmission platforms will also increase. On these platforms, assets can be stored at the head-end and delivered on request via DSL or Fibre to the set top box to supplement the broadcast of the programme and provide the required interactive element to the experience. Until this becomes a reality, however, Gauld reflects that interactive television for children will not fulfil its potential:

“…the stories that we’ve got at the moment, they’re not as popular as the games because they’ve got text, they’re not read out, and they’re not that animated. Whereas the stories that are popular with children are obviously the linear animated stories on the TV, or the website; the fairly animated interactive stories where they can again see cause and effect. They can click on characters that do things; they can click on things to make choices, and it’s really something different. So we can do
multi-path stories, we can include some of it, but we can’t really bring it to life for
them. If our stories were voiced, if they were read out, then the parents wouldn’t
have to be sitting there reading it the whole time, every time, again and again and
again.”

3.5.3 Changing Terminology

Though audio cues have been found to be vital in aiding children’s navigation and usage
of iTV, it appears that early childhood audiences often don’t understand many of the
navigational cues that adult programming takes for granted. As such, a principle of
creating appropriate terminology has emerged, in order to cater to the level of a child’s
understanding. Markham explains that an outcome of Disney’s involvement with parents
has been a greater understanding of how to provide appropriate audio instructions to
young children:

“I think this came from the parents rather than the research team, but it was about the
recognition of colours and words… Those kinds of tasks of effectively getting kids
used to the navigation offered by remote control. ‘Press select now’, kids don’t get
that. They have no idea what a select button is. So it’s ‘press the circular button’, or
showing them exactly what that button was …if you said ‘press the red button now’
then it was whether or not you spell R-E-D or have the colour red, and will they
actually acknowledge which is the red button, from actually having it written or
spoken.”
As a result, a principle has been to provide appropriate terminology to children in order to ensure their interactive experience is free from disorientation or confusion. In enhanced television applications, appropriate terminology is of critical importance. As the programme is delivered on a synchronous broadcast platform, not only do the characters need to deliver appropriate instructions for the early childhood viewers to interact, but the nature of the broadcast means that real time element of synchronous broadcast does not have the flexibility to provide for different reaction times. As such, the programme’s instructions need to be understood immediately so that the viewer can then spend the allotted time making a decision as to which option they would like to choose; whether it is to repeat a song, choose a character, or any other interaction.

One of the challenges with enhanced TV application has been managing this time allotted for choosing options at an interactive juncture. As Chudleigh explains, one of the realisations producers have had to come to terms with is that though you may give children two options, there is always the elusive third option; the child’s decision to not interact at all:

“...You have to remember when you do this stuff, that there is always the third option. And the third option is that they choose...nothing. Therefore you either need to come up with a third option,...say ‘if you don’t choose in this amount of time, then let’s go look at the cars.’”
Another difficulty with managing the interactive juncture is that the synchronous broadcast applications have little flexibility in managing the numerous reaction times of its audience. As Chudleigh explains:

“…you’ve always got to give a time period for them to answer the question. If they answer the question at the beginning of the time period it’s going to seem a bit strange that nothing happens for the next eight seconds. But the time period has got to be long enough, say ten seconds at least, for the kid to say ‘I don’t know’, or ‘I’m going to make a decision, find the remote, navigate to it, and select it’.”

3.5.4 Consistency

Another principle that has emerged is the principle of consistency. This relates to navigational conventions, visual presentation, the use of the coloured buttons, and other symbols used in both the interactive experience and the programme being presented. A programme can have an internal consistency, wherein the same coloured button has the same effect each time it is pressed, or each time a child answers a question correctly the same interstitial screen is presented.

A programme can also have external consistency. This can come in a number of forms. A platform may impose guidelines on how all interactivity is to run on their service, in which the blue button always opens a ‘help’ screen, or any content is presented in a vertical menu at a certain sized font. As Markham reflects, different levels of consistency between platforms can make a vast difference to content providers:
“[Freeview] don’t have the same navigation, and they don’t have the same setup of the remote controls. So you’re going through different apps, and in different apps you press red to back you up to the TV feed, you press blue for a menu. Whereas on the Sky platform every Sky box has the same remote, regardless of who makes it - Panasonic, Amstrad, Pace, whoever – and each broadcaster has to follow the same rules. It creates standardisation which is good - it stifles the market slightly by not allowing you to be different – but we’d rather have it the Sky way than the Freeview way.”

External consistency may also be a product of what has been found to work, in which certain principles of children’s usability manifest themselves consistently across a number of children’s programmes. A group of children’s programmes all deciding to only deliver interactivity to children via the coloured buttons is a strong and positive step in consistency.

The importance of consistency in interactive television has not been confined to children’s programming; Sky in the UK is noted for vigorously maintaining strong creative continuity on any interactive advertising. As Smallshaw explains, though strongly adhering to Sky’s templates can put strain on a company, the benefit is creative consistency for Sky’s interactive content:
“[Sky] have a strict set of guidelines that say ‘okay, this key must always do that’, ‘you can do any of these, but you mustn’t have streaming video’, ‘you mustn’t have this, you must mask that’, and it can be a bit of a pain but it actually means that people are developing applications consistently.”

In terms of children’s interactivity, the greater use of images and symbols instead of text makes consistency very important. Shallcross explains that her experience with the effect of consistency has been gleaned through children’s usage behaviour on the CBeebies website:

“If you get them to [the CBeebies] page, mostly they’ll be able to go in, particularly when they get to three or four years old. My nephew can navigate that himself completely. He goes in through the graphics. He wants to go to Noddy, or he wants to go to Fireman Sam, or he wants to go to Clifford the Big Red Dog. He just clicks on it. He sees the icon for the game. He can’t read that it says ‘full screen’, but he knows that that icon means that instead of it appearing in a small window, it’ll appear in a big window. So he clicks that as soon as he launches the game, because he knows that he’ll get it. And they just get a familiarity with the language, or the icons, or the system that you’re using.”

Another form of consistency that Shallcross comments on is keeping elements constant across platforms. In developing interactive content for the 24/7 portal, Shallcross
remarks that one of their main considerations was not to betray conventions and constancy of familiar elements of the CBeebies online content:

“We make them consistent, as much as possible, across the website. And again, you have a consistency between what they see on the web, and what they see on interactive TV. Seeing it and using it; there’s a familiarity there that they naturally understand what they have to do, or where they have to go.”

3.5.5 Interactivity as Core Concept

As interactive television finds its place in contemporary broadcasting practice, the prevalence of both existing content, and traditional production cycles, has resulted in interactivity being used to ‘enhance’ programmes and advertisements that were, in their inception, never designed for an iTV format. Sometimes the result has been successful, and sometimes it has not. Smallshaw comments that, when it comes to ‘bolt-on’ interactive services, success can be derived from programmes that have an inherently interactive aspect to them.

“I think the interactivity has to complement the narrative of the show, and if the narrative of the show is all about ‘I’m going to engross you in this narrative, into this make-believe world, and you’re really going to believe it’s happened, and you’re going to love this character and hate that one’, then you don’t want to break that spell. Whereas if the point of the program is to encourage you to shout out or to want
to do something, to call a friend and say ‘Aah, can you believe this!’ then that’s great; we can capture some of those emotions and feelings that are being evoked."

In children’s programming, ‘bolt-on’ interactivity poses a particular problem in that interactive enhancements for children rely on high quality assets, such as graphically rich interfaces, clear and obvious instructions, and a consistent look and feel. Addition of simple text and generic assets are not sufficient for the young audience, who, as we have investigated in this chapter thus far, rely on creative consistency, rich audio and video, and navigational clarity for a successful interactive experience. In Disney’s 2004 ‘Kids Awards’ (as discussed in Chapter 2, section 7.4), Markham and colleagues developed interactive enhancements alongside the development of the programme. In this way they were able to produce video clips with the stars instructing children to interact, congratulating the viewer on getting an answer right, and referring to other elements of the interactive experience such as a counter that collated their points when they got an answer correct. When it came time to programme the enhancements they had these rich assets at their disposal, rather than making do with generic symbols, text, and a general disassociation between the content and interactivity. The most important element of this success story, however, was that the programme was already an inherently interactive show. As a live action awards night that tested children’s knowledge on their favourite characters, artists, and TV shows, the programme already had interactivity at conception. If it did not have this element at its core, no amount of preparedness would have produced success. As Walley explains:
“The shows that really do well are ones that the interactivity is core to the idea. The only show I can think of is ‘Who Wants to Be a Millionaire’ – I know it’s not a kids show – but that’s the only show that I can think of where the interactivity is a bolt-on but actually it worked really well. And that probably was because the show, when it was designed, the way it was structured lent itself really, really well to interactivity. So unless the show is like that, then you can normally tell when the interactivity is a bolt on, and people just don’t buy it. They really need to see the uniqueness of the proposition and the value of the proposition; they won’t just vote on something incrementally, or spend money incrementally on an interactive service just because it’s there. The viewers are quite canny.”

An interesting by-product of this principle is that for it to be implemented long-term, it inevitably requires a rethinking of how iTV projects are conceived. Sometimes this is manifested in restructuring of the development process, as producers detach themselves from enhancing a programme and start thinking about how to create interactive propositions from their inception. Shallcross talks about how restructuring the BBC has changed the way projects are not only produced, but regarded in their suite of new media services:

“We’re not separated out to people who work on mobiles, people who work on interactive TV, and people who work on the web…Fortunately, now we’re one department that works across all platforms…We all work together, and we look at the priorities and the programs that are coming up, and the kind of service that we
want to provide as a public service broadcaster; marrying all those things together. If we’ve got a new programme starting, how are we going to support that in terms of interactivity? Do we create a website? Do we create a 24/7 Interactive TV game? Do we create a scheduled enhanced television program? Do we create a mobile offering? Do we create a *whole* website? Do we create just an application or interactive feature within another website? We have that flexibility in terms of how to best serve that brand and that program and best serve our audience in terms of how they would want to interact, or participate, or get involved, or feel a part of that program.”

Though the idea of interactivity as a core concept has emerged as a prominent convention in the children’s media industry, examples of programmes developed specifically for the interactive platform are still rare. Rarer still are programs that do so in an immersive and captivating way, using rich media production values such as full screen video and synchronous interactivity that, as this thesis has argued, are so critical in presenting educational goals. The effect of incorporating this, and indeed all of the principles discussed in this section, is the primary object of this research. Testing the benefits of iTV when compared to linear television cannot be accomplished without using a research instrument that adopts a particular pedagogical position. This is because the hypothesis could be proven true or false depending upon how it is tested. Poor use of interactivity could show little effect, while using a high quality device could show a great effect. The result is entirely contingent upon the quality of the principles embodies in the testing instrument. It is important, therefore, that the study itself adopts a
pedagogical stance on how iTV should be used, and that this stance be informed by both theory and practice, as has been investigated in this study thus far.

4 Discussion

Through interviews with key industry members in children’s interactive television, this chapter has explored the reality of iTV; its pitfalls, its advantages, its usability issues, and its potential for the early childhood audience. Through their experience with the rollout of interactive television technology, their observation of iTV programme deployment, their comparisons with linear television production, and their usability testing with young children, these practitioners have painted a picture of iTV’s current standing in the television industry. Through discussion of these results, four key insights have emerged.

The first is that interactive television as a concept is a powerful and sustainable element of the television industry. Though the limitations in iTV are frustrating at times, they are only technology bound and thus many can be resolved over time. Though children’s iTV is currently only capitalising on a fraction of its potential, the vision of its true capacity as a highly educative, absorbing, and powerful early childhood teacher can also be realised. The interviewees demonstrated a good understanding of iTV’s place in the television offering; that there are times when it is not appropriate and times when it is; that its strengths lies in it being a core concept, there to bolster and drive the goals of the program; that its success relies in it being simple, intuitive, and appetising to the viewer.
All of these factors confirm that the issue under investigation, of whether children’s interactive television programming is a significant improvement to traditional children’s television learning, is both topical and timely for the CiTV industry.

The second insight is that interactive television is well suited to children’s education. From observations of children’s uses of iTV and other new media technologies, it is evident that interactivity plays a familiar role in children’s experience. Rather than a new platform for children to become acquainted with, interactive television is more of a fulfilment of what children have come to expect from all media; that of control, engagement, immediacy, and variety. Through its two-way interaction with the childhood viewer, it is able to put into practice many tenets that are currently considered to be effective methods of engaging and edifying early childhood. Through providing a flexible and open experience where the child can choose an outfit, build a truck, or explore a world, iTV provides a constructivist environment where control and exploration of their learning material is paramount. Through providing a reciprocal interchange where a child’s choices are responded to, iTV creates an environment in which children can not only feel empowered, but experience cause and effect. Through generating programming that provides for a dual audience, iTV can offer opportunities for scaffolding, where a parent can probe and strengthen their child’s learning experience, supported by extra input provided by the programme. These factors all contribute to the notion that, though currently encumbered by developing technology, iTV is a powerful force from an educational perspective.
The third insight is that children are able to use interactive television. Though theoretically sound, the concept of using iTV as a vehicle for learning relies implicitly on young children being able to activate, navigate, and interact with the technology. This chapter has demonstrated children’s proficiency in understanding and using iTV programming. Children are able to use an interactive remote, with the coloured buttons being the most appropriate input device for them to use. It has discovered that they approach the iTV environment in significantly different ways than adults. Rather than a utilitarian device, iTV is an exploratory platform in which the means is perhaps more important than the destination. As such, children are less affected by disorientation and misunderstanding; opting to explore rather than seek. These factors confirm that iTV is not only a potentially powerful force for educating children, but it can also be a familiar and intuitive device for them to use.

The fourth insight is that, though it is powerful and appropriate for children, interactive television is significantly limited by technical limitations, high costs, and bandwidth constraints. This chapter has demonstrated that the multiplicity of middleware and platforms standards, high programming costs, and bandwidth restrictions have created an environment where educational children’s programming has an uphill battle to compete with more commercial or entertainment-based fare. Therefore, attempts to develop new approaches to iTV development need to be conducted with materials that are not only capable of being constructed in the industry, but are also an affordable and credible prospect from a commercial perspective.
Chapter 3

Phase 1

5 Conclusion

This study has demonstrated that interactive television, while a relatively new prospect for children’s broadcast companies, holds significant potential for children’s educative programming. Additionally, the five industry principles that were identified from the fieldwork form a positive foundation for children’s interactive programming; revealing that not only have programme-makers become aware of children’s issues in this space through practical experience, but that efforts are being made to maximise the impact of interactive services, in spite of the limitations of the process.

Despite this, a prominent feature of the interviews persists. Though educative programmers frequently expressed understanding of how iTV can be used effectively, it was rare that this understanding survived the development process to the screen. The costs and inefficiencies associated with interactive television production were a consistent hindrance; not merely to a desired level of production values, but to appropriate presentation of educational goals. As was noted by the children’s television programmers, it is commonly the high-cost elements of iTV programming that provide the appropriate level of production for educational concepts to be successfully delivered.

These costs come in a variety of forms. However, many are post-production expenses, and are not directly pertinent to this study. The costs of international syndication and the costs of creating cross-platform applications, for instance; these expenses are only related to the expansion of an existing programme. Additionally, with the advancement of technology, these will prove less expensive over time. An interactive television
programme can run, for example, on an established platform such as Sky and – with a subscriber base of over 10 million homes – not require these types of outlay.

There is one particular cost, however, that directly impedes children’s iTV programming; the cost of interactive television broadcast. Though production costs can be considerable, they decline with the advancement of software tools. In addition, production and development are themselves commonly geared towards minimising the bandwidth required for broadcast. Clearly, it is the cost of getting the programme on the air that most acutely affects CiTV programming. For current technology, the cost of satellite bandwidth was noted as an ever-increasing expense for all interactive broadcasters (see section 3.4.3). For a company such as Disney UK, in which all of their broadcasts are satellite-based, this is a significant restriction. As long as the high cost of broadcast persists, children’s interactive programming will struggle to maintain a consistency of output and quality.

The implication has been that, though the industry has generally arrived at a set of ‘principles’, these have been rarely implemented to any great degree. Though the respondents widely agreed that the use of audio is crucial to a pre-literate audience, the costs of such principles kept them on the cutting room floor. Though respondents regarded visually-based design as important in children’s spatial awareness, programmers still could not produce consistent, full-video interactive experiences. The implication for this research is that findings will have little value if they are not demonstrated using methods that minimise bandwidth requirements. In terms of the
design of the research instrument, this involves production techniques that, while
minimising bandwidth, retain all of the principles revealed in this study; such as having
interactivity as a core concept.

In terms of the research question, this involves regarding the issue of bandwidth as
critical to the rationale. In doing so, this study can demonstrate the effect of televised
interactivity on children’s learning, based on realistic levels of production and
transmission. In doing so, findings will not only be appropriate to the children’s
television industry, but successful models can be replicated in a commercial
environment.
CHAPTER 4 – Research Question

1 Introduction

The development of a rationale for testing interactive television in children’s education is an unusual proposition. It many ways it inhabits a position in between two largely independent disciplines; the theory of children’s learning and the practical world of media development and delivery. Add to this rapid technological development of television platforms, and CiTV is an elaborate prospect indeed. It is the multifaceted nature of this task that has required a rigorous investigation into these areas. As such, this thesis has investigated each of these areas in turn, in order to bring a level of clarification to the practice of children’s interactive television.

In the first three chapters, this thesis has argued that the interactive television platform has the potential to deliver a more powerful educational experience to children than linear television. This is based on the following. First, I have argued that, contrary to a prevalent stereotype of television viewing behaviour (Winn, 1977; Stewart, 1999; Hardin, 2001; Pose, 2001; Passantino and Batelaan, 2002; Livaditi, Vassilopoulou et al., 2003), children are generally not in a passive state when they watch television, but are actively processing multiple layers of information, cross-referencing it to their own understanding, and revisiting concepts and ideas later in play (Collins, 1979; Salomon,
1979; Collins, 1982; Anderson and Lorch, 1983; Salomon, 1983; Wright and Huston, 1983; Palmer, 1986; Anderson and Collins, 1988; Peters, Fitch, Huston, Wright and Eakins, 1991; Livingstone, 1998; Bickham, Wright et al., 2001; Howard and Roberts, 2002). The formal features of television, such as high production values, animation, the ability to provide a diversity of imagery, sound and pace, all contribute to this capacity for active processing, and propagate an increasingly commonly-held view that television has the potential to be a powerful instrument for early childhood education (Ball and Bogatz, 1972; Watkins, Huston-Stein et al., 1981; Pearl, Bourhilet et al., 1982; Wright and Huston, 1983; Children's Television Workshop, 1991; Anderson, Huston et al., 2001; Fisch and Truglio, 2001; Howard and Roberts, 2002; Askov, Johnston et al., 2003).

Television, however, is a one-way transmission medium, and is therefore unable to provide a reciprocal learning environment between disseminator and viewer in a manner employed by interactive media, as discussed in Chapter 2, section 8.3 (MacKinnon, Walshe, Cummings and Velonis, 1994; Askov, Johnston et al., 2003). As interactive media has this ability, it is also considered to have significant educational potential for early childhood (Wartella, O'Keefe et al., 2000), as this allows it the capacity for an exchange whereby the disseminator is able to adjust the content and pace to suit the particular needs of the individual viewer. In Chapter 2 I argued that the combination of high production values and two-way transmission means that interactive television can provide a high-impact, flexible platform that is able to meet a child’s learning needs, tailor content to suit their pace and difficulty level, and deliver it in a rich, compelling
way. It is important to distinguish between ‘active’ learning and ‘interaction’. Interactive television does indeed allow a physical interaction between the user and the programme, through use of the remote control. However this does in itself imply learning. Notions of ‘active’ viewing is cognitive; occurring through a deep engagement with programme. Whilst interactive television does allow physical interaction, it is the active processing, brought about through the ability to tailor the content more effectively, that is the real potential under investigation.

While this can be supported in a theoretical sense by contemporary educational learning models such as scaffolding and constructivist learning, the notion that any type of interactive media is a strong instrument for children’s education has seen very little formal research beyond usability testing (Carey, Tryee et al., 2002; Livingstone, 2002; Markopoulous and Bekker, 2002; Revelle and Medoff, 2002; Wartella, Lee et al., 2002; Nielsen, 2002, 14th April; Revelle, 2003; Revelle and Medoff, 2003; Barendregt and Bekker, 2005). While studies using adults have provided some data, it has been found that these results are not applicable to children due to differences in experience, interpretations and patterns of behaviour, as discussed in Chapter 2, section 8.2 (Strommen and Frome, 1993; Strommen, Revelle et al., 1996; Bruckleitner, 1999; Pasquier, 2001; Revelle, 2003; Demming, 2004; Fisch, 2004). Additionally, the different approaches that children exhibit towards both television and interactive media indicate that usability studies conducted for other media are unsuited to the field of interactive television (Bukowska, 2001; Revelle, Strommen et al., 2001; Livingstone, 2002).
This is not to say that there can be no sharing of knowledge between the various media used for education (Fisch, 2004). Wright and Huston (1983) distinguish between formal features and content, explaining that in a media text the subject matter that is presented is content, but the screen conventions of television, such as cuts, fades, changes in perspective and other structural features, are known as formal features (Schmitt, Anderson et al., 1999). Wright and Huston, and later Fisch (2004), argue that while knowledge can be shared concerning research on children’s use of content across platforms, this does not apply to form. To explain; a math’s problem, which is defined in the above explanation as content, is typically difficult regardless of the platform on which it is presented. Formal features, however, are unique to their platform. The immersive, rich media and group-viewing experience of television, with its cuts, wipes and other televisual devices differentiate, this platform from others such as a Web-based presentation, simply because they do not share these formal features. According to Wright and Huston, therefore, the development of content for the iTV platform can borrow concepts and findings from other sources, such as computer-based learning, teacher practice, and linear television (1983). However when it comes to the form of iTV, the limitations of the platform, the rich-media television context, and the unique coloured-buttons usability format all contribute to a new media delivery format that requires its own formal testing, independent of other interactive media.

2 Rationale
In view of this evidence, there currently exists an overarching question concerning interactive television for children that has implications for educators, government, and commercial children’s media companies; does an interactive children’s television programme have the potential to deliver educational content in a significantly more memorable and compelling way than its linear equivalent? Specifically, if a children’s programme is interactive, is there a higher likelihood that a learning goal will be met? To address this question, an experimental design is required that statistically compares effects in an interactive programming environment to a linear equivalent. The general hypothesis for this rationale may read as follows:

*Incorporating interactive television programming into children’s educational television significantly increases the educational experience of the programme.*

However, this raises three questions concerning the nature of the objectives. First, as we have seen in the Industry Review Study (Chapter 3), the issues surrounding bandwidth restrictions in iTV production have revealed that testing of iTV concepts must take into account the various cost limitations. Second, in considering the various interactive television models from Chapter 2 (section 8.3), informed by the numerous contemporary educational processes from Chapter 1, it is too broad to consider that children’s education can be enhanced by ‘interactive television’. Rather, it is *forms* of interactivity that can be tested. Third, the outcome measure by which the study is judged successful or unsuccessful needs to be defined.
2.1 The Impact of Bandwidth

As was demonstrated in Chapter 3, production costs are a critical factor in the design of iTV applications. Regardless of the question of appropriate content, interactive interface, educational approach, or choice of outcome measures, the question of production budget is important in providing conclusions in which these findings can make any sort of constructive contribution to the children’s television industry. To this industry, it is an impractical contribution to conclude that children’s iTV programming is effective when demonstrated within the bounds of an unlimited production budget. In other words, any potential contributions by interactive TV platforms must also factor in the potential costs associated with their delivery. The likelihood of actual deployment of such content is maximised where the interactive models deliver both demonstrated benefit and affordable cost.

As such, an important component of the hypothesis is to take into account the feasibility of types of iTV programming in considering their impact. As has been discussed in Chapter 2 (section 7), iTV programming can be developed in a number of different ways, at different levels of production and with different costs. As such, when considering how learning goals can be incorporated and measured in this study, it is possible to incorporate them in a number of different ways; similarly with differing production qualities and development costs. This has a significant impact on this study, as higher production quality necessarily requires a greater budget. Therefore, equally pertinent as the question of the impact of iTV programming on children’s television is determining the effect of production quality on the outcome. For instance, if the
interactive interface and learning goals of an iTV programme are consistent, do effects differ when comparing a live action or animated presentation? This is an important question, as it may make the difference between wide scale and limited deployment of comparable interactive models, regardless of any positive conclusions that this thesis may draw. In order to address these questions, the hypothesis should therefore incorporate not only the question of how iTV programming differs from a linear equivalent, but whether presenting iTV programming at different production levels has any bearing on the end result. As such, the hypothesis of this study requires the incorporation of interactivity testing under differing levels of production quality; conditions that embody examples of both rigorous and simple iTV programming methods.

### 2.2 Defining Interactivity

Second, as has been investigated in Chapter 2 (section 8.3), the practice of incorporating ‘interactivity’ into programming is a broad concept. While one programme may provide options to replay content, another may employ a question-and-answer quiz to supplement content. Interactivity was deployed in different ways in each case, and each requires different testing objectives to measure success. In the first example, the test would most likely measure recall levels, and perhaps attitudinal data concerning the availability of replay content. In the second, measurement using a comprehension test would reveal if the addition of a quiz enables improved understanding of information. In order to determine the interactive objectives of this study, it is necessary to define the major interactive models of children’s television. While this study has revealed a
number of different formats in use in the commercial world (see Chapter 2), and revealed industry comment on effective methods in Chapter 3, there is little evidence in the literature of the ways in which iTV enhances children’s programming.

However, a recent study in iTV for children has consolidated some models into four broad groups: Narrative Choice, Customisation, Repetition, and Participation (Hynd, 2007). ‘Narrative Choice’ describes content in which the viewer can make major plot decisions in the course of a narrative; similar to a ‘choose your own adventure’ storybook. ‘Customisation’ describes content in which the viewer can choose to alter events in the narrative that have no effect on the overall plot of the programme (i.e. choosing to listen to a story about either cats or dogs). While customisation might provide an impact on the immediate environment, it is usually presented in a magazine-style programme, and thus the programme ultimately returns to a uniform plot. The third and fourth approaches involve control that over non-narrative elements. ‘Repetition’ describes the ability of the viewer to repeat a certain piece of content on demand (such as replaying an enjoyable song). Finally, ‘participation’ describes content in which the viewer can change non-narrative elements of the experience. For instance, the viewer might be able to choose the colour of a scene, or select a soundtrack to play behind an event. In either case, the viewer is participating in the scene, and seeing the effect of their interaction, without directly taking control of the narrative.

This study tested prototypes of all four conditions on 498 4/5 year old children from Government, Catholic, and Independent schools in Western Australia (Hynd, 2007). The
study, in comparing the prototypes to linear conditions, found a significantly higher
comprehension effect in children in the ‘Participation’ and ‘Repetition’ groups, and no
significant difference in ‘Narrative Choice’ and ‘Customisation’. It is worth noting that
the two latter groups, in which no effect was recorded, provide interactivity associated
with control over content. Through either interactions that allow direct and lasting
modification of the course of events (‘Narrative Choice’) or that allow modification of
parts of a narrative (‘Customisation’), the viewer was taking control of the way that the
course of events unfolded. It is important to note, then, that the viewers did not
demonstrate evidence of more rigorous concentration. Rather, it was the ability to alter
only incidental parts of a storyline that sustained interest and promoted greater
consideration (‘Participation’ and ‘Repetition’).

As Chapter 2 demonstrated, interactivity can provide a number of different formats for
children. However, the aforementioned study outlines two particular approaches in
which a significant impact is demonstrated. Both Participation and Repetition provide
interactive experiences that allow only a limited amount of interaction with the structure
of the programme; ensuring that control is retained by the producers. This thesis has
commented extensively on the internet/television integration that is the nature of iTV
(see Chapter 2, section 8.3), and it is interesting to surmise that Hynd’s results suggest
that, despite the added functionality and control that interactive services provide, there is
a continuing value in the escapism of television. In determining the effect of iTV on
children’s education programming, this study will incorporate interactivity that provides
both choices that are at the level of participatory, and elements allowing repetition of certain content.

### 2.3 Defining Outcome Measures

In children’s television research, the chosen outcome measure is a product of how the study is to be applied. For instance, in Sesame Street research measuring attention has been used to determine how much interest children showed as an evaluation of a programme’s appeal prior to release (Fisch and Bernstein, 2001). As the present study explores the effect of variables on educational content, we turn to studies seeking a similar objective. Numerous studies with a focus on educational programming objectives look to measures of comprehension as an indicator of successful programming (Collins, 1979; Lorch, Anderson and Levin, 1979; Collins, Sobol and Westby, 1981; Wright, Huston, Ross, Calvert, Rolandelli, Weeks, Raeissi and Potts, 1984; Bickham, Wright et al., 2001; van den Broek, 2001; Revelle and Medoff, 2003). In determining the success of interactivity on the educational impact of a programme, comprehension reveals the extent to which the child was attending and actively processing the content being presented. Outcome measures such as attention and engagement are behavioural measures which can shed light on the reason that particular results are observed, however they are by themselves non-definitive. For instance, Bickham, Wright and Huston have demonstrated that the audio of a children’s programme commonly plays a significant role in a child’s understanding of content (2001). Therefore, a child can comprehend a considerable portion of content despite demonstrating low visual attention scores. Lorch, Anderson, and Levin (1979) have also demonstrated that children can
selectively attend to the parts of a programme that they find comprehensible. What these studies indicate is that measures of attention are not able to capture a child’s true connection with a program; children are able to monitor a programme while looking away, while others may stare at the screen though absorb little (Cole, Richman and McCann Brown, 2001).

Accurate assessment of a programme should involve testing the level to which the objectives of the programme are instilled in the audience. In children’s educational programming this involves testing the level of understanding that is reached in the presenting of educative or social goals (Calvert, Huston, Watkins and Wright, 1982; Palmer and Fisch, 2001; Hynd, 2007). Bloom’s Taxonomy, as discussed in Chapter 1 (section 5), outlines a hierarchical structure to the process of learning, in which a child progressively learns to recall, understand, and then apply a concept (Bloom, 1956). According to this hierarchy, it is testing the application of a concept that provides the most rigorous measurement of learning. This study proposes the testing of comprehension in measuring the success of interactive programming, using a hierarchical system of measurement, and the use of additional behavioural measures. In this study, in which ‘participative’ interactive programming is integrated into a narrative, comprehension testing is used to determine the degree to which interactivity contributed to a child’s ability to remember, understand and apply educative concepts. As such, the measure by which this study will determine success is ultimately comprehension. In addition, behavioural outcome measures can possibly be used for deeper insights into the effects being observed.
3 Hypotheses

In the course of this study, two elements of media research are being carried out that are largely unique; the rigorous study of educational goals in interactive television programming, and the development and testing of a programme in which iTV conventions are applied at programme inception.

This has one particular impact on the hypothesis of the experiment. As the above elements have not been reflected in past research, the hypothesis cannot base its assumptions on any previous results. As such, regardless of the positive indications gleaned from examination of interactivity in chapters’ 1, 2 and 3, this hypothesis cannot assume that the incorporation of interactivity will necessarily have a significant outcome.

This study therefore assumes the null hypothesis, that the implementation of the experimental stimulus will yield no result. Accordingly, it must therefore be assumed that any effect observed by the experiment might provide an effect in either a positive or negative direction (as the incorporation of interactivity might just as easily lead to lower comprehension scores). In using this hypothesis format, if there is a measured significant difference in performance of the two groups (whether positive or negative) the null hypothesis is rejected in favour of the alternative hypothesis. As such, the hypothesis is structured in the following format (Figure 37):
As discussed in section 2, the issue of bandwidth requirements has been revealed as a critical factor in iTV production. To address this issue, this study incorporates a second set of hypotheses in which iTV effects are compared across both rich-media and simple iterations of interactive programming. The rationale behind this activity is to determine whether the implementation of cost cutting measures in iTV programming provokes a decrease in impact for the childhood audience. Alternatively, is the incorporation of effective interactive media principles enough to sustain impact, irrespective of production costs? To explore this question the methodology requires comparison of different interactive models, in which programming is presented at different production levels. For the purposes of this study, these are termed rich-media and simple applications. A more comprehensive outline of what constitutes ‘rich-media’ or ‘simple’ programming is presented in Chapter 7 (section 4). However, essentially the rich-media application presents interactive segments as full-screen live action, whilst programming a simple iTV application produces interactivity segments as still screens of action; in order to save on production and bandwidth costs.
Reverting to screens of still images reduces production costs; however it theoretically also presents a drop in impact for the programme. As has been outlined in the industry review (Chapter 3), children’s programming relies heavily on providing high quality visuals to maintain impact; something that iTV has traditionally struggled with.

**Hypothesis 1**

\[ H_0: \text{The provision of interactivity (iTV) in educational television programming does not significantly increase comprehension of content in young children.}\]

\[ H_1: \text{The provision of interactivity (iTV) in educational television programming significantly increases comprehension of content in young children.}\]

**Hypothesis 2**

\[ H_0: \text{The effect on comprehension of incorporating interactivity (iTV) in children’s educational television programming is not significantly decreased when bandwidth is conserved through simple iTV programming.}\]

\[ H_1: \text{The effect on comprehension of incorporating interactivity (iTV) in children’s educational television programming is significantly decreased when bandwidth is conserved through simple iTV programming.}\]

Figure 38: Hypotheses
Chapter 4

For the purpose of the hypothesis, it will therefore be assumed that presenting simple iTV programming will significantly reduce comprehension, as opposed to a rich-media equivalent, regardless of the incorporation of interactivity. The alternative hypothesis assumes that the outcome measures demonstrate a significant difference between the rich-media and simple iTV treatments, with the alternative hypothesis proposing that there is no difference in comprehension. Therefore, success in this study will conclude that the interactive television programme did successfully increase these outcome measures in children, using commercially sustainable methods. The hypotheses are thus presented as in Figure 38.

4 Conclusion

This study is based upon the measurement of comprehension in children’s programming. However, in order to provide insight into why certain effects are being observed, it is suggested that behavioural measures are also included (section 2.3). Measures of behaviour can provide greater granularity by revealing the state of the child at the site of measurement. As such, determining that children’s comprehension was increased in a certain group can also reveal that this was due, for example, to raised excitement and anticipation of the interactive segments.

Behavioural measures such as attention and engagement have been found to be useful tools of measurement for childhood learning because they provide data that can be coded easily and compared across studies, are less susceptible to subjective measurement bias, and are most likely to reflect the natural state of the child; rather than a bias attributed to
their ability to verbalise their feelings or opinions (Skinner, 1971; Dale, 1976; deVilliers and deVilliers, 1978; Fisch and Bernstein, 2001). In this study, these behavioural measures will be used to determine whether there is a difference in the amount of time a child pays attention to the screen – or displays verbal and non-verbal engagement with the program, its characters and storyline – when comparing the linear and interactive treatments.

It is important to note that measures of both attention and engagement to the screen are traditionally a product of the strength of the storyline, characters, and the execution of events. It is therefore an expectation that a robust storyline will be likely to show a strong effect regardless of whether the platform is linear or interactive. This is because studies have demonstrated that children’s attention is guided by the formal features of television programming – such as animation, humorous segments, high action – that are salient to the child audience (Campbell, 1982; Wright and Huston, 1983). Salience in children’s programming refers to formal features that signal to the child that the programming is either designed for them or is likely to appeal to them (Wright and Huston, 1983). Features such as pace, special voices, and sound effects all contribute to the salience of programming for a child. Campbell (1982) demonstrated the existence of salience in a study where a message on proper nutrition was shown to children; one version using an adult narrator, sedate music, and live footage, and the other with animation, child-like voicing, and sprightly music. An ‘eyes on screen’ comparison demonstrated that the preschool children showed more attention to the second treatment
because, despite the similarity of the message, the manner in which the message was delivered held more salience for them.

The implication of this is that in this study the differences in attention and engagement in children will not be dependent upon salience as a result of the content. This is due to the fact that there are only minor differences in actual production content between interactive and non-interactive treatment groups. However, the groups will still be tested on outcome measures that are related to content. Therefore, any observed differences will be a function of the interactive functionality of the programme. This will then determine whether the provision of ‘participative’ interactivity will have an effect on both the child’s visual attention to the screen and their verbal and non-verbal engagement with the content, as opposed to watching the show in a linear fashion.

It has been suggested by previous studies that a combination of both verbal and behavioural measures, such as are being used in this study, are suitable for proper testing with children (Fisch and Bernstein, 2001). This is because the relationship between these outcome measures often provides a clearer picture of the data than the individual scores. For instance, studies have demonstrated that low comprehension of content can lead to a low attention span during the testing session (Anderson, Alwitt, Lorch and Levin, 1979; Anderson, Lorch, Field and Sanders, 1981). However, other studies have demonstrated that a child’s visual attention to the programming does not reliably indicate their comprehension of the content (Wright and Huston, 1983, p. 842). In considering these findings, it is clear that only a comparison of multiple outcome measures could provide
insight into the reason for observed behaviour. Comparing the child’s comprehension of content in this study will provide evidence of whether interactive television increases a child’s recall as well as both their identification and application of concepts presented in the show, but it is comprehension’s relationship to both engagement and attention that can possibly explain why this is so. This is discussed in more detail in Chapter 7.

As this study performs comparisons of learning goals based on best practice guidelines developed in Chapter 3, the experimental condition invariably uses an interactive interface in the execution of these learning goals. If original programming is used, results rely on this interface having high degrees of usability. Any difficulty in navigating the interface by participants in the experimental conditions serves to skew effects across conditions. This study requires a test to ensure that the use of the chosen interactive interface does not attract usability issues. The development of the stimulus in a formative study is the focus of the next chapter.
1 Requirements of the Research Instrument

This thesis aims to assess the capacity of iTV programming to present educational concepts in a more effective way than its linear equivalent. In the preceding chapters an argument was presented that the design of the iTV platform suggests a tremendous potential in tailoring and delivering a unique and valuable experience to the early childhood audience. Contemporary approaches to educating young children were identified and the frequent difficulty in incorporating them into a linear television environment was discussed (see Chapter 1, section 5). It has been argued that the two-way design of the iTV platform allows a more successful incorporation of these goals as it more closely emulates the reciprocal interaction of the teacher-student interaction (see Chapter 2, section 8.3). The implication of this, however, is that testing this theoretical position requires a research instrument with particular characteristics.

One of the main considerations is that the research instrument must be able to be presented as both an interactive and linear programme so as to isolate potential content effects. This is vital in testing the impact of iTV programming in direct proportion to linear television with any degree of accuracy. What this implies is that the programme
itself must be a synchronous enhanced application, as this is the most direct counterpart to a linear programming experience. Comparisons using any other model, such as a 24/7 application or a game would therefore not be suitable, as there is no linear television equivalent. Another consideration is that the programme, in order to be truly equivalent to a linear model, must present a rich media experience with full motion video and audio. The key here is that the addition of the interactive features such as choice must be the only differing elements in the comparison, as these are the true features that distinguish iTV programming. Pace, production values, or audio are not distinguishing features, and including a comparison of these would hinder the isolating of appropriate testing variables.

These requirements necessitate a particular testing instrument, and in consideration of possible commercially-available content, they suggest a need for testing to be conducted with original programming rather than repurposing an existing programme. This is for two reasons. First, due to the nascent nature of the children’s iTV industry, narrative-driven rich media interactive television programmes that truly exploit the potential of the iTV platform are lacking in the children’s television market (see Chapter 2, section 8.3). As has been investigated, the majority of children’s iTV programming is either adapted from existing linear programming or is a quite simple affair created using still images and text, in order to reside on a 24/7 portal. This experiment, however, requires programming created as a rich media interactive experience, with interactivity as a core concept rather than a peripheral or retrospective addition. It must embody an important standpoint of this thesis; that powerful iTV programming for children requires well
planned integration of interactive goals and narrative from its conception. This necessarily involves developing the interactivity in parallel with the development of the programme, as well as embedding it into a narrative-driven production containing original characters, storylines, and innovative ways for children to interact with the programming. Furthermore, it must be designed with an educational agenda in which the interactive features exist to support the learning goals. In the commercial market, such a programme does not exist. As such, an original programme would allow all of these requirements to be fulfilled.

Second, the use of original programming aids in enhancing the internal validity of the results. By providing content that the child audience has had no prior exposure to, the study can avoid biases attributed to familiarity with storylines, characters, and messages, as well as preconceived preferences and opinions. The methodology then has the flexibility to test participants on their memory of characters, names, relationships, and habits; a method that would normally produce inaccurate data.

In preparing an original programme, however, certain considerations must be taken into account. First, the programme must be sustainable. As discussed in the previous chapter (section 2.1), data obtained from this experiment can only be of value to the industry if the programme itself is feasible as an episodic children’s television programme. It is an impracticable result if this study confirms the value of children’s interactive television on the basis of an atypical programme with no thought given to costs associated with its development, nor its longevity. This includes characters and storylines that are
sufficiently developed to create material for a lifespan of at least a season of production. In terms of costs, this also means that the research instrument must be able to be produced within a reasonable production budget. This includes costs at all levels of development; taking into account a standard production timeline, added shooting schedules associated with extra interactive footage, and costs associated with bandwidth requirements for synchronous interactive content, application design, and possible concurrent video stream broadcasting over, for example, satellite transmission. With the considerable expense for application production, it is cost prohibitive to expect that new application templates be designed for every episode. Therefore the application must be able to be reused over the lifetime of the programme, while still being flexible enough to be used for different purposes and activities throughout.

Second, the programme must have appropriate educational content. While it is the interactivity, not specifically the content itself that is the focus of the study, the educational focus of this study requires that the methods and approaches used in the programme must demonstrate appropriate educational practice. This is done in order to provide data that can inform the children’s media industry and make conclusive inferences concerning the impact of interactivity on the presentation of educative content.

Third, the programme must display external consistency; it must use the formal features and conventions of television in a manner that is consistent with children’s expectations of broadcast television programming. If the programme widely differs in its presentation
to standard television programming, then children’s expectations will not relate to those applied to commercially available content, nor will conclusions be applicable to industry standard programming. This requires the programming to be at a normative episode length, containing characters, storylines, and narratives. By displaying this level of external consistency it avoids validity violations associated with these factors. The consequence of these considerations is that the research instrument will undoubtedly incorporate more elements than are actually tested in the experiment. As is discussed in the final chapter, this introduces a problematic element to the study as it introduces multiple variables and potential interaction effects. However, the use of commercial programming would not resolve this problem. Additionally, a range of elements is necessary as it creates a faithful representation of a children’s iTV programme, secures factors associated with consistency, and provides data applicable to a commercial environment.

While most of these elements can be incorporated into a testing instrument, it is the prospect of interactivity being a core part of the programme design that requires further consideration. This is because, at this stage, the study makes a particular assumption that cannot be substantiated; that the chosen method of incorporating interactivity is comprehensible to the childhood audience. This study is concerned with assessing the ability of an interactive and linear platform to provide an impact on a childhood audience, and this distinction will be rendered invalid if the chosen interactive construct causes confusion or isolation in the testing group. This is further compounded by the fact that this research is based on original programming. To remedy this, the interactive
Chapter 5

Phase 2

construct needs to undergo assessment to determine that it not only conforms to its requirements as a fully integrated interactive schema, but that it is comprehensible to the target age group and thus can be used as a platform for this study.

2 The Interactive Construct

As we have seen in Chapter 2 the interactive construct of an iTV application is, in many cases, a retrospective addition. As such, in the commercial world there exists little evidence of an interactive construct that functions as a fundamental device in the learning goals of the programme. Reasons for this are wide and varied; iTV applications are often developed to grant a new lease on life to existing programming, the interactive coloured buttons are commonly restricted to platform-level navigation functionality, and an application is generally built as cheaply and simply as possible as its ability as a revenue-raiser has not been consistently demonstrated.

Because of this, interactivity generally achieves a very poor integration with the content which it supports, not least in children’s programming (see Chapter 2, section 8.3). One particular consequence of this condition is that the interactive choices provide only a rudimentary impact on the elements of the programme. In children’s programming this is a significant limitation, as it relies heavily on high impact visuals and audio to support educational goals (see Chapter 1). Pre-mediated development of an iTV application for children would, conversely, allow the interactivity to directly coordinate events in the
narrative; strengthening the impact of the experience, and allowing a broader range of educational goals to be implemented in a more compelling manner.

In considering this, a natural step in the development of an interactive construct is to incorporate it into the physical space of the narrative. For instance, interactive choice given to the participant can be reflected in changes in the physical location of the scene.

This provides three compelling advantages. First, it provides a high impact experience where the effect of a child’s interaction is extremely visible. Second, it provides a flexible platform that can incorporate a number of different learning goals, whilst retaining a fixed structure that a child can become familiar with. Finally, it introduces an aspect to the interactivity that enhances its comprehensibility to the child. By tying in physical location with interactivity, interactive navigation becomes a matter of spatial awareness. Assuming that a child is able to conceive of and negotiate the space, their interactivity becomes as intuitive as their understanding of the physical location. For instance, if pressing the red button takes the viewer into the ‘Red Room’, then a child can conceivably extrapolate that pressing the green button will take them into the ‘Green Room’. Accordingly, the child can then assume that re-pressing the red button will take them back into the ‘Red Room’. As long as the structure of the programme can retain consistency with these interactive ‘rules’, then it provides not only an intuitive foundation for interactive activity, but represents a powerful incorporation of interactivity and content.
An example of this construct was developed in McPharlin (2002), in a research tool known as ‘The Magic Cubby Pilot’. This synchronous interactive television programme, aimed at ages 4-7, based its interactivity in such a manner to facilitate interactive choice for its young audience. Designed as a proof of concept of interactive television for children, The Magic Cubby Pilot used its setting, the three rooms of a magical treehouse, to navigate the childhood audience around various activities.

![Diagram of the Magic Cubby Pilot](image)

**Figure 39: The Interactive Construct of The Magic Cubby Pilot**

To maintain consistency across the experience, and to enhance the comprehensibility of the navigational structure, each room is named a particular colour from an interactive remote control (see Figure 39). The main area of action occurs in the ‘red room’, with interactive segments involving characters moving into either the green or yellow room to do various activities. As such the child viewer is called to make a choice by clicking a coloured button to join in these activities. For instance, a child may press the green
button to follow a character through the green door, and into the green room. Consistent with notions of best practice (see Chapter 3), characters use verbal cues to navigate the child around the space, rather than graphical or text-based calls to action.

This construct allows an incorporation of a learning approach consistent with contemporary methods explored in Chapter 1. To explain; the first interactive segment involves a counting exercise in which the two main hosts practice counting to ten. Rather than taking the viewer through a linear instructive experience, the viewer is asked what would they like to count; cars or animals? The viewer is then given the choice to stay in the red room with Jenny and count animals, or press the green button to follow Misagh into the green room to count cars. The point to note about this technique is that while the child is making a choice, it does not cause a divergence in the plot. The programme still counts to ten, however the child is able to choice the context in which this learning experience occurs; a process that was named ‘context tailored learning’ (McPharlin, 2002). Consistent with contemporary approaches discussed in Chapter 1, this process gives the viewer a degree of choice and flexibility but retains the impetus of the teaching goal; the practice of counting to ten. This is reminiscent of the tenets of Vygotsky, who also upholds the teacher, rather than the child, as the primary director of the learning experience (Fosnot, 1992). For these reasons, this research aims to incorporate the tenets of iTV best practice that this thesis has developed so far into the interactive construct developed in McPharlin (2002).
3 Testing the Interactive Construct

The ‘coloured doors’ interactive construct discussed in this chapter is an example of robust integration of interactivity and narrative. However, as this has not be tested on a childhood audience, questions persist concerning the comprehensibility of the navigational prompts, the effectiveness of a spatially based interactive construct, and behaviours and attitudes that children exhibit towards this style of programming. Neither is it appropriate to test current interactive fare, such as 24/7 games on the CBeebies portal or synchronous programming on Disney, as these are not comparable. Similarly, while the interactive methods used in *The Magic Cubby Pilot* are based upon contemporary educational theory, these methods have also not been proven competent in a formal test. The confirmation that children understand and are comfortable with the interactive schema is critical to the successful use of the programme as a research instrument. This is because, in determining the ultimate goal of this thesis – to demonstrate the impact of interactive television on children’s educational programming – an assumption is made that the interactive construct won’t inhibit the ability of the group to execute its functions. As such, this chapter outlines a brief exploratory study in which *The Magic Cubby Pilot* is tested to determine the comprehensibility of the construct on its target audience, and to formulate some recommendations for the development of the testing instrument.
4 Research Design

The primary focus of this test is to inform the final phase of any usability problems associated with the viewing of the ‘coloured doors’ method of interactivity. Such issues under investigation are:

- Difficulty understanding or using the interactive navigation format
- Disinterest with the characters, outcomes or elements of the program itself.
- Problems associated with the choices of interactivity.

As the research in this thesis relies on participants primarily being able to understand how to navigate the interactivity of the programme, this phase ensures that the final research instrument would not contain problematic elements that could invalidate a true comparison between testing conditions. As this is primarily an exploratory usability study, it requires no control group, but rather needs to implement within-groups outcome measures to determine performance of the construct. The following outlines a drawing exercise to measure the understanding and usability of the programme, observational records to identify any prominent issues, and an attention test, to provide a behavioural aspect to the study.
4.1 **Drawing**

The primary purpose of this test is to determine whether the childhood viewers are able to understand and negotiate the coloured doors interactive concept. A determination of comprehensibility implies that the respondents understand the following:

- The coloured buttons on the navigation correspond with the coloured doors in the programme.
- The viewer can click on these buttons to enter the doors, and thereby move around the cubbyhouse to participate in activities or make choices. *The Magic Cubby Pilot*, therefore, presents its interactivity spatially.

What this phase requires, therefore, is a research design that assesses the participant’s ability to conceive of the spatial quality of the cubbyhouse. When it comes to an appropriate technique, however, traditional usability measures such as focus group testing and questionnaires fails to fulfil this goal. Researchers have consistently found it problematic obtaining reliable usability assessments through quizzing very young children. This is mainly due to the developing nature of their ability to express themselves (Cugmas, 2004). As such, studies employ alternative methods to gain an insight into a child’s understanding.

One way of assessing a child’s understanding of these concepts is through artwork. Drawing as a means of testing has been found to be especially useful in young children, as it is a non-verbal representation of a child’s understanding at a time when their verbal
skills are still developing (DiLeo, 1970; DiLeo, 1973; Hammer, 1981; Fury, Carlson and Sroufe, 1997; Cugmas, 2004). Drawing aids in reliably extracting this information as it allows a child to demonstrate their grasp of a concept – in this case the spatial quality of the interactive experience – without being required to put it into words (Koppitz, 1968).

Using drawing as an instrument for measurement requires the use of an appropriate scoring mechanism. The first scoring mechanism for drawing, known as the Draw-A-Man Test, was developed by Goodenough (1926) as a method for collecting data on children’s drawings. In the 1980’s it was revised in a study known as the Draw-A-Scientist test (DAST), that developed scoring for drawings of scientists by Chambers (Chambers, 1983). The DAST was administered to children aged 3-8 in a study that investigated children’s stereotypes of scientists, and has since been frequently used in studies as a reliable data gathering and scoring device for young children (Flick, 1990; Symington and Spurling, 1990; Mason, Kahle and Gardner, 1991; Finson, Beaver et al., 1995; Huber and Burton, 1995; Barman, 1996; Matkins, 1996; Thomas, 1998). In this study, the DAST can aid in developing an idea of children’s understanding of the programme, as it allows a numerical threshold to be established against which children’s artwork can be assessed. In the present study, the understanding of the spatial nature of the interactive experience can be quantified and the participant’s understanding can therefore be numerically measured.

In 1995, Finson, Beaver, and Cramond developed the draw-a-scientist checklist (‘DAST-C’); a 16 point scoresheet for assessing stereotypical attitudes about scientists
(1995). Each element was assigned a ‘1’ for presence of the stereotype, and a ‘0’ for its absence, with such indicators as ‘long sideburns’, ‘lab coat’, and ‘scientific equipment’. Pretest and posttest checklists were then administered and compared using ANOVA.

Rather than comparing a stereotype, as the DAST-C is designed, this study intends to determine a level of knowledge and awareness about a subject. As such, this study uses an adapted version of the DAST-C in which there is no pre or post-test to compare, but a within groups scoring threshold to be met. Design of a checklist of this nature involves an identification of the essential elements that reveal a perception or an understanding, as is the case with the present study. In the DAST-C, these elements revealed a stereotype. In this phase of study, they reveal an understanding of the integrated nature of both interactive choices that are presented to the viewer and the cubby design itself. Therefore, for a participant to demonstrate an understanding, they must show an awareness of the existence of elements that relate to both the cubby and the interactivity. These elements include:

1 The coloured doors  
2 The remote control  
3 The characters who are involved in the interactions  
4 Relationships between these three elements

Figure 40 presents the 7 point checklist that identifies features of the participant’s artwork that correctly demonstrate an understanding of these elements. Consistent with
Chambers’ guidelines, each item is only assigned a maximum of one score, regardless of the amount of times it is represented in the artwork (1983).

| - Interior shot of the Magic Cubby showing different rooms |
| - Usage of different colours to draw the rooms. |
| - Presence of characters inside the magic cubby |
| - Depiction of coloured doors |
| - Depiction of activities occurring inside the rooms |
| - Presence of coloured buttons (can be any colour) |
| - Correct colours used in some way (red, green, yellow, blue) |

Figure 40: Seven-point checklist for scoring interactive elements of The Magic Cubby Pilot (Finson, Beaver and Cramond, 1995)

These seven criteria are chosen as they systematically depict elements of the programme that are identifiable as related to interactivity. These criteria are therefore identified in the same manner as the ‘Draw a Scientist’ test in which elements related to a scientific stereotype were scored. For instance, questions 1 and 2 outline an understanding of the spatial quality of the programme. To draw just one room would not demonstrate an awareness that the viewer could choose to enter three rooms in the cubby (treehouse). Questions 3 to 5 refer to depictions of events occurring in the narrative that relate to the interactive construct; drawings of the coloured doors, the characters and their proximity to interactive elements, and depictions of the various activities all demonstrate recall of the interactive segments and an awareness of their contribution to the narrative. Question 6 describes a depiction of the coloured buttons from the remote control; demonstrating
an awareness of their role in the navigation. Finally, Question 7 outlines a depiction of the colours of the coloured buttons in a correct order. The red, green, yellow, blue combination is evident on the bottom of the onscreen visuals at all times, however representing these – not necessarily in the correct order – demonstrates a quite sophisticated grasp of the construct. Further details on how this outcome measure was implemented are included in section 7.

4.2 Observation

A secondary outcome measure of this phase of study is identifying any usability issues related to the methods of interactivity. The Magic Cubby Pilot contains three interactive segments. The first segment involves a counting game outlined in section 3, in which the two hosts count to ten but allow the viewer to choose whether they count cars or animals. In the second interactive segment, the child chooses whether to stay in the red room and listen to a storytelling session, or go through the yellow door and watch children paint pictures about the virtue of ‘kindness’. In the third interactive segment, the viewer can choose between listening to a repeat of a song performed earlier by the cast, or going into the green room to look through pictures sent in by young viewers.

Each of these activities is an example of a different execution of the construct. For instance, if we take the examples used in Hynd (2007), the first segment is an example of ‘participative’ interactivity, in that the interactive choice only affects what is counted (cars or animals) and does not affect the course of the narrative (counting). Accordingly,

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3 See Chapter 4, section 2.2 for an introduction to Hynd’s study
the second segment is an example of ‘narrative choice’, in which the child is able to
directly intervene in the narrative and change its course (storytelling or painting).
Finally, the third interactive segment is an example of ‘repetition’; allowing the child to
repeat a section of content.

In using these three executions, care must be taken in identifying issues associated with
any of the segments. While the construct itself remains unchanged, the Hynd study has
demonstrated that different executions of a construct can have different effects on the
viewer\(^4\) (see Chapter 4, section 2.2). Additionally, while the drawing exercise can
determine a successful level of comprehension, the fact that it is only implemented at the
end of the session means that it cannot determine any problematic elements associated
with individual executions. Identification of usability problems with a construct such as
this can usually be accomplished with the administering of a questionnaire with rating
scales and comprehension questions. However, as this study involves young children
who are unable to provide reliable data in such a method, an alternative approach is
required. As the interactivity involves the physical action of pressing buttons, it is
reasonable to assume that simple observation will suffice as a method in capturing
prominent issues with the interface. If the child fails to understand navigational prompts,
then this will be evident at times of an interactive call to action. Usability issues can
encompass such things as problems connecting the button press to the effect on the
screen, failure to interact in the time given on the programme, failure to comprehend the
interactive cues given by the characters, or reluctance to participate altogether. All of
these usability issues are easily identifiable through simple observation. This qualitative

\(^{4}\) In Hynd’s study, ‘participation’ and ‘repetition’ formats were found to produce significant effects.
form of measurement can also be used to balance the quantitative nature of the drawing exercise.

4.3 Attention

Numerous studies report that children display sophisticated viewing behaviour when watching linear television; selectively attending to parts of the content that are comprehensible (Lorch, Anderson et al., 1979; Anderson, Lorch et al., 1981; Anderson and Lorch, 1983; Huston and Wright, 1983; Anderson, Lorch, Field, Collins and Nathan, 1986; Campbell, Huston and Wright, 1987; Schmitt, Anderson et al., 1999). A number of Sesame Workshop studies also report that children’s attention to linear programming commonly wanes after approximately 40 minutes (Fisch and Bernstein, 2001). In response to this finding, Sesame Street created a segment known as Elmo’s World (Welsh, 2000). This segment, featuring the show’s most popular character, takes place in the last fifteen minutes of the hour long show, and was designed as a direct challenge to diminishing attention spans. Though children’s attention to television is evidently a complex process, attention to new media devices, such as interactive television, are comparatively unexplored (Potter, Lang and Bolls, 1998). If children do selectively attend to content, as they do in a linear environment, then obtaining results on what parts of an interactive television programme are selectively attended to will provide information on how children approach television-based interactivity. Bearing in mind the Sesame Street example above, it is a reasonable assumption that attention scores will also wane across this programme’s duration (approximately 19 minutes). In order to provide recommendations for the final testing instrument, it is useful to generate
behavioural data related to interactivity’s bearing on a standard attention span, most specifically to determine if the presence of interactive segments in a narrative has any effect on Fisch and Bernstein’s observations of waning attention (Fisch and Bernstein, 2001).

In this usability test, children’s attention to the programme is measured in an interval test. Attention measures in this phase use an ‘Eyes on Screen’ (EOS) method to capture attention data. In this method the participant’s attention to the screen is measured at intervals, with a score being assigned at times of attention to the screen, and no score being assigned at times where the participant is looking away. This quantifies the overall duration of a look, allowing means to be compared between conditions, and minute by minute analysis to be conducted within groups. See Chapter 7, section 2.1, for more discussions on EOS.

EOS is a measure of visual orientation to the screen, and is not by itself a definitive indicator of cognitive engagement or depth of processing. Fixed attention to a programme, in fact, is not even proof of engagement, as in some cases it may measure nothing more than a child daydreaming and staring straight through the screen. For testing of an interactive programme, however, it performs an important function, and that is to show the behaviour of children in and around interactive junctures in the programme. It will be of interest to know if children’s attention to a programme is sustained by calls to action as they occur in the narrative, or if this drops off over time.
An EOS method measured at intervals is consistently used in children’s viewing studies of this nature (Thorson, 1994; Fisch and Bernstein, 2001; Palmer and Fisch, 2001; Calvert, Strong et al., 2005). All EOS data is captured on video and measured in post-analysis. Attention was measured at predetermined intervals in time with event changes in the programme. Each of the 63 intervals was on average 17 seconds apart. Of most interest was the attention patterns observed at times of interactivity; measuring both how viewing behaviour responds to these segments, and how other segments are affected by their proximity to interactivity.

5 Participants

Participants for this study were recruited from Kindergartens in Perth, Western Australia. Schools were randomly selected using a simple random sampling technique from the education department of Western Australia’s school directory portal (http://www2.eddept.wa.edu.au/schoolprofile/home.do). Letters of invitation were sent to the schools informing them of the intended study and requesting their participation, of which four schools registered their interest.

Participants comprised 65 children from early childhood classes. There were 33 males and 32 females. Ages ranged from 3 to 7, with a mean age of 4.9.
6 Apparatus

This study was conducted with the viewing of *The Magic Cubby Pilot* (Running Time: 19 minutes), in DVD format. Other equipment included a digital video recorder, a standard 4x3 television, DVD player with remote control, a television stand, sheets of butcher’s paper, stickers, labels, coloured pencils and pens, and a large sitting mat.

6.1 The Interactive Training Video

As this test involves the childhood audience sitting through a new experience, there existed a need to briefly explain how the mechanics of the programme work. A three minute pre-roll presentation preceded the programme, giving the children an example of how the interactivity works. This video was designed to quickly acquaint the participants with the functionality of the interactivity without affecting their knowledge or opinion of the programme.

The main character of *The Magic Cubby Pilot*, a puppet called Roger, appears and introduces the coloured buttons on the screen. He explains that the coloured buttons are used to make choices, and then asks the participant to press the red button to change the scene. The scene remains static, with Roger issuing gentle prompts until the child presses the red button, and the scene changes. Roger tests the participant with one more interaction to press the green button to return to the previous scene, and the presentation is concluded.

![Figure 41: The Magic Cubby Training Video](image)
7 Procedure

The study was conducted in whole class groups; one group for each of the four participating classes. The sample sizes for each group were 15, 23, 21 and 6. Each group was conducted immediately after the children’s lunch break, with the researcher spending time with the children during the break in order to ensure the group’s comfort and cooperation. Studies were conducted in the class rooms with suitable amounts of distractions surrounding the participants, such as toys, drawings, and posters. Rooms were brightly lit with both internal and external light. The television was set up on the stand at eye level for a seated child on the floor. The video recorder was set up tangential to the group, who sat together on a mat facing the television. Prior to the session, teachers were instructed not to intervene in the participants’ behaviour during the experiment. This means that children who chose to make noise or leave the area to play with the surrounding toys were not stopped.

The researcher then addressed the group, explaining that they were to watch a new television show that would allow them to interact. No mention was made of the video equipment, or the fact that they were being measured. Participants were then instructed that if they would like to interact with the programme they needed to put up their hand. Once a participant was chosen by the researcher, they could go and press the coloured button on the television screen. Participants were instructed that they could interact at any time they desire, and that everyone will have the opportunity to interact. The
researcher sat to one side, out of direct sight of the treatment group. At times of interaction, the researcher controlled the navigation via a remote control without the knowledge of the participants. Participants then watched *The Magic Cubby Training Video* for three minutes, followed by *The Magic Cubby Pilot* for nineteen minutes.

At the end of the programme, participants sat at tables and butcher’s paper was handed out. Participants were given coloured pencils, pens, and two stickers of each of the two main characters; Baby Crocodile and Roger (see Figure 42). Participants were then instructed to draw the Magic Cubby and to use the stickers in the picture if they wished. The researcher collected the pictures at the end of the session and thanked the participants.

Within a week following the session, participants were sent a ‘thank you’ certificate, and parents who had indicated interest were emailed details of the day’s session.

### 8 Results

This was a brief exploratory test using simple methods to identify any prominent issues arising from the usage of the interactivity style that The Magic Cubby employs through testing of the Magic Cubby Pilot. The study utilised three outcome measures; a drawing exercise, observational records, and an attention measure. Table 2 presents the
demographics of the participants of this study. It comprised 65 participants between the ages of three and six. Test groups were conducted in a whole class setting. An alpha level of 0.05 was used on any statistical comparisons.

Table 2: Cell Sizes of Participants by Age and Gender

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<tr>
<td>6</td>
<td>13</td>
<td>9</td>
<td>22</td>
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</table>

8.1 Attention

An ‘eyes on screen’ (EOS) test was used to capture attention data to The Magic Cubby Pilot. The 19 minute programme was divided up 63 intervals, each approximately 17 seconds apart. Three interactive segments occur in the programme, each beginning with a character turning to the screen and asking the participant to press a choice of coloured buttons to participate in activities located in different coloured rooms. An interaction is made at the beginning and end of a segment, as the participant must click the red button to return to the red room once a segment is complete. Therefore, though there are three segments, there are six interactions.
Figure 43: Phase 2 ‘Eyes on Screen’ attention scores showing interactive segments

Figure 43 presents the attention scores, showing the placement of interactive segments in the timeline of the programme. The six interactions can be seen in black, bordering the interactive segments. As the above figure shows, attention scores are consistently high for approximately the first 8 minutes of the programme, and subsequently display clear fluctuation for the remainder of the viewing period. Despite this, it is evident that the interactivity segments influence the attention of the participants in the latter part of the programme. For example, despite fluctuating scores, attention scores are consistently 100% (65 out of 65 children) at the site of each interactive choice.

This is most evident 15 minutes and 44 seconds into the programme, where the lowest attention reading is recorded. Though the number of participants displaying attention to the programme drops from 65 to 48 in 3 minutes, this downward trend is not continued approaching the final interactive segment, in which attention once again rises to 100%.
8.2 Observations

Participants were observed for the duration of the programme using a ‘field notes’ method of observation. Any particular usability problems that were noticed from the group’s usage of The Magic Cubby Pilot were noted. Particular points of interest were any problems associated with response times to the interactive ‘call to action’, failures to interact when prompted, or difficulty in understanding the connection between a button press and the corresponding effect on the screen. Additionally, any outcomes of the experiences that demonstrated successful usage, such as rapid interaction responses or high engagement levels, were also recorded.

8.2.1 Interaction Response Time

The average response time allowed by the programme for the participant to interact was 7 seconds. At the end of this time, the two characters would be in their separate rooms for the activities to begin; the assumption being that the participant has made an interactive choice, and is in one or other of the rooms.

Participants were observed as being generally competent in understanding and using the interactive segments, regardless of age, with one exception which shall be discussed shortly. The functionality of the programme allows the participant to interact and change rooms at any time during the interactive segment. At times that a participant was late in interacting (which occurred on rare occasions) this feature proved useful in allowing them to continue to change rooms, even after the characters had begun their activities.
Chapter 5

The programme elicited frequent engagement responses from the children, such as laughter, gasps, frowns, and verbal exclamations. Whilst these were not formally measured in the fieldwork, it was noted in the observation that future measurement of both verbal and non-verbal indicators would serve as a useful measuring stick of engagement with the programme, in addition to attention.

One particular issue was noted with a group of 3 year olds. At the time of the first interaction, in which a character asks them to choose between counting cars and counting animals, no child in the group responded to the call to action, but sat and watched the programme as if no call to action was announced. This non-reaction seemed to be caused by the participants not realising that they could influence events in the programme. Only the first interactive segment was missed in this way for the 3 year old group; the participants interacting with the subsequent segments with no prompting. However, the 3 year old group were the only group to fail to respond to an interactive call to action.

8.2.2 Usage Behaviour

One particular element of participant viewer behaviour that was consistently evident was their exploratory usage of the interactive buttons. Though participants were largely adept at both understanding the onscreen instructions and responding to them, they often displayed experimental behaviour with the interactive navigation. Participants, once they had pressed a button to enter a room, would frequently press other coloured buttons in an effort to interact further. *The Magic Cubby Pilot* only uses, at most, three of the four
interactive buttons, and so their pressing of the fourth button (blue) would result in no effect, causing confusion. Participants would consistently press all of the interactive buttons, looking for an effect, even though these buttons had not been referred to in the character dialogue nor had been activated for use. During non-interactive segments, participants would also press coloured buttons hoping to enter the other rooms. This non-effect also caused confusion.

This observation was particularly problematic in the second interactive segment (a ‘narrative choice’ segment) in which the participants can choose between a painting activity in one room and a story about kindness in another. Participants would commonly switch between the rooms during the segment out of interest. The effect, however, was that they would inevitably lose track of events and miss out on the learning outcomes that the segment was offering. For instance, in switching between rooms, participants were only exposed to small portions of the story on kindness; both fuelling their disinterest in it, and hindering their grasp of its messages. The result was that very few participants were exposed to a sufficient amount of the story to enable them to understand the ‘kindness to animals’ theme that the story was exploring. In contrast, the first interactive segment, a counting exercise, was not hindered by this exploratory behaviour. With animals being counted in one room, and cars being counted in the other, children’s ability to understand and follow the sequence of events was not significantly impacted by switching rooms midway through the segment. This has an impact on the types of interactions that are suitable for this programme’s learning model,
which shall form part of the recommendations for the research instrument at the close of this chapter.

### 8.3 Drawing Test

A drawing test was conducted in which elements of the drawing were scored to quantify a level of understanding; a technique adapted from the “Draw a Scientist Test – Checklist”, or DAST-C (Finson, Beaver et al., 1995). The drawing exercise tested participant’s understanding of the integrated nature of the interactivity by visual representation. As such, a major indication of successful usability of the programme is being able to demonstrate the spatial relationship that this integration produces. A 7-point checklist was devised to score the children’s drawings subsequent to their viewing of the programme (see section 4.1)

Each image scored a maximum of seven points for the presence of any of these criteria, with each of the criteria only receiving one point regardless of its occurrences. To earn a point, a drawing needed to demonstrate at least one instance of the criteria. In order to explain the use of this checklist in the experiment, Figure 44 gives an example of a drawing, by a 5 year old female.

![Figure 44: Example of a picture that meets all seven criteria points.](image)
participant, that contained all of the elements contained in the checklist. *Interior shot of the cubbyhouse, showing different rooms*; the drawing depicts the interior of the cubby and the separate rooms, consistent with the interior, room-based interactivity in which the programme was based. *Usage of different colours to draw the rooms*; rooms are represented here, all clearly distinguished by bright colours. *Presence of characters inside the cubbyhouse*; the participant has attached a sticker depicting Roger, given out as part of the procedure (section 7).

She has added a body to Roger’s head and has included the male and female adult characters as well. Each of these characters is occupying a different room. This is also consistent with the interactivity methods used in the programme, as characters separate into different rooms when an interactive segment begins. *Depiction of coloured doors*; doors are represented in this drawing behind the characters. The usage of correct colours is not important here, though this participant has actually represented the coloured doors correctly. *Depiction of activities occurring inside the rooms*; in front of the adult characters, the participant has represented the activity of the first interactive segment; a counting activity allowed the child to count animals in the red room with one presenter, and cars in the green room with the other. This indicates a significant awareness of the framework of the interactive segments, and a memory of specific events. The participant does not need to indicate an identical activity to the ones represented in the programme; any type of activity being represented in a room demonstrates an understanding of the function of the rooms. *Presence of coloured buttons*; the participant has drawn a panel of coloured buttons at the top of the page. The number of buttons, or the specific colours
used, is not important. *Correct colours used in some way (red, green, yellow, blue).* This refers to the four colours of the interactive remote, which are used to represent the rooms in the programme, and are also present in a banner image along the bottom of the screen. This participant has coloured the doors in the correct colours, though these colours being represented in a deliberate way as a remote control or as coloured rooms can also earn a point. The correct order of colours is not necessary.

![Bar chart showing mean percentage of identified drawing criteria by age](image)

**Figure 45: Mean Percentage of Identified Drawing Criteria by Age**

Figure 45 outlines the results of the drawing test by age, with scores represented in percentage. The 5 year old age group had the highest percentage of drawing criteria appearing in participant’s work with 66%, followed by 6 y/o (61.8%), and 4 y/o (32%). The 3 year old group had no evidence of any of the criteria appearing in their drawings. The overall mean score for all participants was 40.35%. A Tukey test revealed a significant difference between the drawing scores of ages 3, 4, and 5, $f(2,40) = 51.099, p < 0.001$, with the 5 year old group significantly gaining higher scores. However, there
was no significant difference between the 5 and 6 year olds, who had a slightly lower mean score, $f(1, 45) = 0.677, p = 0.415$.

There was found to be no difference in mean scores related to gender, $f(2, 63) = 0.022, p = 0.882$. Male participants had a total mean of 52.38% (N=33), with female participants obtaining a total mean of 51.34% (N=32).

Figure 46 compares the checklist scores for each age group. The 3 year old group, having a zero score across all criteria, are not represented in the graph. Criteria 1, depicting an interior shot of the cubbyhouse and showing the rooms, had the highest overall representation with an average of 70.6% (inclusive of the 3 year old participants). The second highest mean was criteria 3; depicting the presence of characters inside the cubbyhouse, with 57%. The lowest representation was criteria 6 (depiction of coloured buttons), with 11.5%.
The 4 year old group’s ability to represent the first criteria (interior shot of cubbyhouse showing rooms) was evident in 91% of cases, with a uniformly decreasing score throughout the rest of the checklist. The 4 year old group obtained a zero score on the final criteria (usage of the four correct colours). In a comparison of ages 4 and 5, the largest gap between their scores occurs in criteria 3 (presence of characters inside the cubbyhouse). 62% separates the two scores, with the 5 year old group representing characters inside the cubbyhouse in 100% of cases.

9 Discussion

9.1 Drawing Test

The drawing test portrayed a clear demarcation between the ages of 3 and 4 in which children were able to represent their understanding of the cubbyhouse. What has not been determined, however, is if the 3 year olds’ zero score was a result of a lack of understanding of the interactive model, or merely a lack of drawing skill in this age group.

It is generally assumed that drawing ability increases with age (Vinter, 1999). Developmental drawing studies have also found differences between 3 and 4 year old’s ability to visually represent objects, with some studies identifying progressive stages of drawing development (See Bremner and Moore, 1984; Mounoud, 1984; Cox, 1986; Thomas and Silk, 1990; Vinter, 1990; Caron-Prague, 1992; Nicholls and Kennedy,
1992; Arrowsmith, Cox and Eames, 1994; Vinter and Picard, 1996; Toomela, 1999). In a drawing study of 720 children in Estonia, Toomela identified the transition from 3 to 4 years of age as a time of transition from single unit representation; drawing an object as a whole, to differentiated units; the ability draw the parts of an object (1999). Additional studies have also found other factors such as quality of verbal instructions (Barrett, Beaumont and Jennett, 1985; Beal and Arnold, 1990), characteristics of the object (Barrett and Light, 1976; Cox, 1981; Cox, 1985), and context of the instructions (Light and McEwen, 1987) as contributors to the drawing ability of children. However, as these conditions were constant across the study, they cannot be assumed to be a contributing factor to these differences.

The present study also identifies a prominent difference in the representational abilities of these two age groups; however the abilities of the 3 year old age group do not match the projected developmental categories identified by Toomela (1999). The vast majority of 3 year old drawings were less representative of the single unit stage than they were of Toomela’s initial category, scribbles; a non-representational drawing level more often reported as the level of a 2 year old (Callaghan, 1999; Vinter and Perruchet, 2000). The 4 year old category, however, proved competent at attaining differentiated units status with a 90% attainment of criteria 1; in which they must represent the different rooms of the cubbyhouse (See Figure 46). The smaller sample size, however, may account for the unusual performance of the 3 year olds (N=7), as may the difference in study rationale. Unlike the aforementioned study, the work of the 3 year olds in this study was a product of not only their drawing ability, but their understanding of the programme; a more
challenging proposition. It might have been inferred, therefore, that the observed effects could be a product of their limited understanding of the programme, and not solely their drawing skills.

However, this inference is problematic in that, to concur with previous studies, even non-understanding participants should have drawn representational images of some description. As it stands, these non-representational scribbles have no consistency with previous study’s conclusions on drawing stages; with perhaps frustration at not comprehending the programme being the sole contributing factor. This is certainly consistent with the observation results, in which 3 year olds were the only group to fail to interact with the first segment. It is not the role of this study to comment on Toomela’s stages of development (1999), suffice to identify that there is clearly a significant jump in understanding of the usability of the programme between the ages of 3 and 4. Results in this phase suggest, therefore, that 4 years of age is an appropriate minimum age for this type of testing in the final phase; as it has proven to be an age in which understanding of the interactive model of the testing instrument was reached, and able to be competently represented graphically.

A similarly significant increase in score was demonstrated between the 4 and 5 year old group, with this difference being mostly attributed to 5 year olds representing criteria 3 and 4 (showing characters inside the cubbyhouse; showing coloured doors) substantially more (see Figure 46). This significant increase in understanding may be mirrored in the comprehension scores of the final research phase, in which children’s expressed
understanding of the programme’s events and messages can be more rigorously tested. If so, the final phase of testing will have more to say on the differences in impact on these two age groups. This test also reported no difference related to gender. This is a positive indication that the programme itself does not contain content that unfairly weights it towards either sex and, if mirrored, will be a similar sign of validity in the final phase.

9.2 Observations

Observations in this study indicated primarily that early childhood participants were able to successfully understand and use the testing instrument. This involved their competence with pressing the coloured buttons to effect their desired choice. However, they were frequently observed pressing extra buttons after an interactive segment had occurred; a behaviour which could prove problematic with this design of programme. This behaviour, however, is consistent with findings from the phase 1 study, in which Shallcross (personal communication, 6th July, 2004) and Walley (personal communication, 14th July, 2004) both propose that children’s use of iTV is exploratory (see Chapter 3, section 3.3.1; 3.3.2). The impact of this, therefore, is that one of the expectations of an interactive construct is that children will behave in an exploratory fashion when interacting; including pressing all of the coloured buttons. This rules out the possibility, for instance, of using any of the coloured buttons for other purposes. For instance, using the blue button to activate parental content such as suggestions and tips for helping the child through the programme, while a useful scaffolding tool (Bruner, 1985), would most likely be activated by the child themself and therefore would only serve to confuse. As such, interactions of this nature would best be reserved for other
inputs; such as the ‘info’ button. Children’s exploratory behaviour has already proven problematic in the second interactive segment, where children’s exploratory usage of the painting and story activities meant that the story activity was barely understood. As such, these observations firmly indicate that conceptually different activities in this format are prohibitive, and only serve to detract from the lessons of the programme.

9.3 Attention

Findings of the Sesame Workshop maintain that children’s attention to television programming can gradually wane over time, with 40 minutes being identified as an approximate limit for children watching Sesame Street (Fisch and Bernstein, 2001). What must be borne in mind is that this conclusion was based on a recognisable and celebrated programme; as Sesame Street would have undoubtedly been familiar to the participants. The participants in the present study, however, were watching a completely new programme, with unfamiliar characters, visual devices, events, and therefore more challenging comprehension prospects. With it being largely accepted that attention is heavily influenced by comprehension (Anderson, Lorch et al., 1981; Anderson and Lorch, 1983; Huston and Wright, 1983; Anderson, Lorch et al., 1986; Pingree, 1986; Huston and Wright, 1989; Lorch and Castle, 1997; Schmitt, Anderson et al., 1999), it can be surmised that participant attention to The Magic Cubby Pilot would wane in a much quicker time-span.

The present findings do indeed demonstrate a notable downward trend in attention after approximately 8 minutes. This trend is disrupted, however, by frequent returns to full
attention as a result of the interactive segments. Clearly a relationship exists between attention and interactivity, however, due to lack of a control group, little can be inferred beyond this. To explain; one may look at Figure 43 and conclude that the rise in attention as a result of the interactive segments proves that this is a positive effect, and that the mean attention score is therefore higher than had the interactive segments not existed. However this is potentially erroneous, as it ignores the possibility that the drop in attention between interactive segments is also related to the presence of interactivity. Participants may, for example, show less attention to the screen at these times because they become more interested in the interaction than the narrative. In this case, the skewed expectations of the participants would play a part in their attention to the programme. As such, an equal possibility may be that attention scores would be higher without interactivity.

What this phase informs us of, therefore, is the necessity of cross-outcome comparisons in order to determine a better picture of viewer behaviour in instances such as these. Comparing attention with comprehension of the programme, for example, may indicate in what manner participants are watching. Discussion of this phase of study, therefore, supports these comparisons in the final study, in which a viewer’s performance can be more accurately considered alongside their behaviour.
10 Conclusions and Recommendations

Discussion of these results has produced one recommendation for the final research instrument. Observations of the study revealed that children’s exploratory behaviour was working against the activities chosen for the second segment; a painting activity and a story-reading activity. By switching between these two rooms, the children were not understanding the message behind the story; thus proving this segment unsuccessful. This indicates that, in order to cater for children’s viewing behaviour, interactive segments need to be designed so that the inevitably frequent switching does not disrupt the flow.

The suggestion, therefore, is to not include interactive segments that have incompatible segments running synchronously, but rather allow the segments to be concurrent so that a participant may not be isolated by visiting both. This is evidenced in the first segment, where switching between counting of cars or animals did not detract from the counting activity itself. Children still understood the nature of the activity, regardless of the level of their exposure to either video stream. In this way, having control of the narrative will not serve to disrupt the learning outcomes of the programme, but rather enhance it. The rationale behind interactivity is to allow greater immersion and customisation with the learning outcomes. In certain cases, switching between interactive streams may even serve to enhance the message of the segment, where viewers can experience two viewpoints or contexts as part of their learning outcome. This finding substantially influences the development of the research instrument in the next phase, as it rules out the use of any interactivity associated with unrelated content. It also emphasises that
care must be taken in filming concurrent segments, that elements do not exist to confuse
or isolate a switching viewer.

This test has determined that the interactive methods used in the testing instrument,
primarily the ‘coloured doors’ concept, are devoid of usability issues, and thus are an
appropriate tool for use in the final phase. This has not come without exception,
however, as observational data has revealed that elements of the interactive model are
irreconcilable with the exploratory nature of the early childhood audience. The use of
unrelated narrative-based segments used concurrently in an interactive segment serves to
distract, rather than attract, the childhood viewer. This chapter recommends, therefore,
that interactive segments account for this exploratory behaviour, by presenting
interactive segments that are related; that do not lose their meaning when toggled
between each other. In this way, the research instrument can function effectively in
conveying the goals of an educational programme.
1 Introduction

In the preceding chapters, this thesis has drawn information from three different activities. A discussion of both educational and media based literature has been used to explain and review children’s interactive television (see Chapters’ 1 & 2). A major theme of these reviews has been that iTV is uniquely positioned as a powerful interactive platform for children’s education. They have also indicated that while children’s interactivity on television is not a new occurrence, its uses in the advancing technological landscape requires development of a unique set of norms in both design and execution.

An interview-based study in Phase 1 attempted to develop these norms based on practical insight from content developers in the broadcast and production industry (see Chapter 3). This study outlined five principles for successful iTV programming for children, based upon case studies of live iTV applications and the recommendations of industry practitioners. From rules governing the use of navigation for a child-targeted experience, to precedents around the consistency and integration of interactivity as a
core concept, these principles helped to develop the research question around how interactivity should be tested in the sphere of children’s education.

Finally, a usability study in Phase 2 incorporated the insight from these two previous activities in the development of the interactive construct; the foundation of rules and navigational elements used to drive the research instrument. This study provided insight into how this construct, based on an interactive format developed in McPharlin (2002), will be used by children and what usability issues need to be addressed prior to its incorporation into the greater study (Chapter 7).

In presenting an argument for the use of original programming in the research instrument, the insight in Phase 2 has a particular implication. As discussed in the previous chapter (section 1), the concept of comparing linear and interactive stimuli require the development of a research instrument that is not only based upon the insight and principles of this thesis, but possesses certain characteristics to ensure its validity as a research tool. These refer to the characteristics of a commercial children’s television programme, with memorable and well developed characters, educational goals, narratives, and an overall level of production that indicates a commercial sustainability beyond a mere phase of research. These factors are required, as the research that informs its foundation is from the children’s television industry members; so too should the methodology and findings of this study be similarly applicable. As such, the elements of the interactive construct developed in the previous chapter also took into account production budgets that would normally be in place. Additional to the practical
considerations of how this tool should be developed, it must not only incorporate an educational agenda but it should be incorporated in line with the relevant contemporary approaches and level of integration advocated by the research thus far.

The result of these implications is that the research instrument to be used in this study incorporates more elements than are actually tested in the experiment. Though the interactive construct has been tested, and its implementation considered appropriate for this study, this chapter outlines how it supports the narrative, characters and interactive segments of the programming; based upon contemporary educational approaches discussed earlier. It outlines how the recommendations and principles developed in the previous chapters are used to develop these aspects of the research instrument, and how this tool is prepared for use in the study.

2 Instrument Overview

At the early childhood stage, traditional learning methods, such as those discussed in Chapter 1, often structure learning around scholastic-based outcomes such as numbers and letters. Alternatively, as has also been discussed, social contemporary constructivist approaches emphasise the importance of socially grounding learning objectives. As part of children’s programming, this promotes the use of learning within a socially-based narrative, and involves the development of social and analytical skills rather than rote learning of didactic subject matter (S. Gauld, personal communication, 6th July, 2004). In efforts to align with this contemporary approach, this programme focuses on
storylines that promote character development and prosocial education; education that teaches children to develop skills in relating to, and coping with, the world around them (Fisch, 2005). As such this research instrument also incorporates a socially based narrative, in which the learning of characters is designed to act as a catalyst for viewer learning, rather than a direct statement of outcomes to the viewer. The following synopsis from the programme outlines how the elements of the narrative contribute to prosocial learning:

*The Magic Cubby is a programme aimed at the early childhood audience, typically 3-7 year olds. It is based inside a tree-house in a fictional suburban neighbourhood. The characters comprise three puppet characters; Roger, Ruby and Baby Crocodile, who live inside the cubbyhouse, two local children; Misha and Ben, who come to visit the cubby after school, and two adult neighbours; Hoda and Kal, who also live locally (Figure 47).*

*The programme concentrates on the experiences of young children; their fears, joys and involvement with all the elements that comprise the journey of childhood. In their secret cubby they find refuge and clarity of the world around them; helped along by their puppet friends. Using*
an interactive television platform, the programme also allows the child viewer to actively take part in the experience using their remote control.

2.1 Programme Theme: Virtues

In order to equip the programme with quantifiable outcomes that can be measured in the testing phase, it is required that the pro-social subject matter be incorporated in a manner which specifically identifies it within the programming to enable measurement in post analysis. To deliver pro-social education outcomes as discrete elements allows their use in quantitative analysis.

A number of organisations around the world advocate the teaching of pro-social concepts in early childhood education in the form of ‘virtues’. The Virtues Project, an initiative that originated in Canada in 1991 has achieved international recognition for its approach to this aspect of education (Virtues Project International, 2001). A non-profit organisation run by educators Dan and Linda Kavelin-Popov, The Virtues Project identifies fifty-two virtues that can be taught to children; including kindness, courage, generosity, wisdom, cleanliness, honesty, and trustworthiness, among others. The Virtues Project programme instructs educators to teach virtues by incorporating it into everyday language, and by recognising what it terms ‘teachable moments’; moments during a lesson that an educator is able to draw upon to reiterate the importance of a particular virtue. In this process, the education of children does is not confined to lessons, but encompasses every interaction between teacher and child. For instance, a messy classroom can enable a teacher to counsel on the importance of cleanliness, and a
shortage of coloured pencils during colouring time can facilitate an understanding of the significance of generosity. The Virtues Project has been incorporated into curricula by over 30 organisations, children’s broadcasters, government programmes, and schools in the USA, Australia, Canada and New Zealand.

The Californian organisation, Full-Circle Learning, also advocates the use of virtues as part of an academic programme (http://www.fullcirclelearning.org/). Schools in ten countries have adopted the Full-Circle Learning curriculum, in which academic education is seen as one part of five critical areas of growth for preschool and primary school children; the other areas being character education, arts enrichment, community service, and conflict resolution.

One of the advantages of using virtues as a basis for character education is that it can provide a platform upon which multiple educational elements can be incorporated. For instance, in the fairytale story Jack and the Beanstalk the context of the story provides an opportunity to educate the viewer on the virtues of courage, trustworthiness, and honesty through the actions of the main protagonist. However, the magic beans educate the viewer on colours, Jack’s encounter with the magic bean seller educates the viewer on money and exchange, and the beanstalk educates the viewer on plants and growth. The multiple uses of virtues, the necessity of character education at the early childhood stage, and the ability of virtues to be presented alongside other learning goals, make them an ideal framework for The Magic Cubby. Children’s programmes adopting a social constructivist approach commonly incorporate character education and other goals.
in this way, as it fulfils constructivist ideas about a holistic and socially grounded learning environment.

The use of virtues has been incorporated into this research instrument to comply with educational approaches; however it has also been incorporated to provide elements for testing in the research phase. As such, to aid the testing process, it is beneficial to focus the programme on virtues that are not immediately obvious or widely known by the early childhood audience. This will allow testing of recall and understanding based upon the tenets put forward in the programme, and not by prior understanding. As such the virtue of courage was chosen as a focus, as it can be regarded as a lesser understood virtue among the fifty-two identified by The Virtues Project. It is also beneficial as it provides considerable breadth for associated narratives. It can be particularly featured in a story of Jack and the Beanstalk, in which courage can be highlighted as a major element to the protagonist’s experience (see section 5.1).

3 Interactivity

We have seen in Chapter 2 the various approaches to interactivity that have been employed in iTV programming to date. In many cases, these have involved such elements as memory games, colour matching, arcade style games, competitions, and other activities. Many of these have also been sourced from existing online content for children. Through an investigation of educational approaches and the abilities of the various interactive functionalities available to the television broadcast, this thesis has
developed and tested an interactive construct to be used in this study (see Chapter 5). This construct was based on a number of considerations.

First, the interactivity needs to be comprehensible to young children. A critical element of this is the integration of a verbal, or at least visual, prompt to interact that is independent of a child’s capacity to read. Since, in the socially based narrative of *The Magic Cubby*, the interactivity is integrated into the storyline, then familiarity with the storyline serves to springboard a familiarity with the interactive process. Therefore, it can also enable children to understand when and how to interact.

Additionally, however, it is also important that the methods of interactivity not be too varied so that the practice of interacting becomes unfamiliar to the viewer. If it has a measure of consistency then the child is able to focus on the content rather than having their attention distracted by the changing of interactive rules throughout the program. This is also important from a cost point of view; if the interactive approaches are standardised they allow for an application to be developed that can be used throughout a programme’s season.

In order to comply with these considerations, *The Magic Cubby* builds the interactive construct around the treehouse in which it is based; allowing characters to provide interactivity based on activities occurring in and around the coloured doors (see Figure 48). The main room is known as the *red* room, with the *green* and *yellow* rooms branching out from it. Each room is identified by a band of colour running around its
walls, as seen in the red room in Figure 47. The interactions are then based around the movement in and around these rooms, with the colours of the rooms corresponding to the colours on the remote control. Additional to this, a graphical representation of the four coloured buttons on the viewer’s remote control is positioned at the bottom of the screen. When inside a room, the corresponding button is highlighted on the screen. For instance, if the green room is entered, the green button on the navigation bar depicts a highlighted state.

![Image of rooms with coloured doors and buttons](image)

**Figure 48: The “coloured doors” approach to interactivity**

To illustrate this approach, let us consider a hypothetical interactive activity; giving the viewer the choice to play with either Roger or Baby Crocodile. As part of the narrative, Kal turns to the camera and verbally prompts the viewer to decide who they want to play with, as shown in Figure 48. If they want to play with Roger they are prompted to follow him into the green room by pressing the green button. If they want to play with Baby Crocodile, they are verbally prompted to follow him into the yellow room by pressing
The viewer presses either the green or yellow button to participate in the activity and, in essence, control the event. The viewer is presented with the room that they chose and the narrative continues. If, at end of the activity, the character wants to return to the red room, the viewer is again verbally prompted to follow them through the red door by pressing the red button.

The design of this interface illustrates a strong integration of interactivity and learning goals. By structuring the interactivity as part of the onscreen layout, navigation is firmly embedded into the programme, creating an experience both comprehensible and intuitive. Maintaining consistency in this environment is important, and has a number of implications. First, when the viewer interacts they are entering a new room, and are thus moving through space. Therefore, by interacting with the programme, a viewer’s use of the navigation is assisted by their sense of spatial awareness. By clicking the green button from the red room, they know that they have moved forward and to the left, and if they then press yellow they are moving directly to the right. Once the participant has pressed a button, the spatial nature of the interaction serves to aid them in deciding where they are and how they can get back. By clicking the green button to enter the green room it is a familiar concept for the viewer to understand that to return to the red room, you need to click the red button. Thus the interactivity is integrated into the
experience; the interactive process becomes an intuitive part of the experience for the child, and is not an element of the navigation to continually seek to understand.

Another implication of this schema is that while a viewer is in a room, time is passing in the other rooms. This means that a viewer can flick between the green and yellow room at any time, participating in the events that occur in each. Therefore, if the activity in the green room is singing, and the activity in the yellow room is storytelling, by clicking the yellow button midway through the singing a viewer will enter the yellow room midway through the story. This has repercussions for the types of interactivity that are chosen, simply because interacting midway through a storytelling activity will cause the viewer to miss sections of the story. Implications such as these were investigated in Phase 2 of the study (see Chapter 5, section 10). This phase recommended that continuity between the two video streams be maintained, to avoid this type of confusion. This is incorporated in the four interactive segments discussed in section 5.

Depending on the way that *The Magic Cubby* is designed, having time passing in multiple rooms may present difficulties in a technological sense. This type of design may also significantly increase production costs, design costs, and bandwidth demands in certain cases, through requiring extra channel space or placing high demands on the set top box. The following section explores the technology of *The Magic Cubby*, and investigates how its design for the iTV platform reduces these factors.
4 Technology

When considering a rich media interactive television programme that has, at times, two simultaneous feeds of full screen video being broadcast alongside an interactive application, the importance of minimising costs can be considerable. The following design and delivery considerations ensure that production, development, and deployment costs are kept to a minimum, without compromising the performance or quality of the programme.

Perhaps the most demanding aspect of the design is the use of concurrent streams of full screen video and audio. While some sections of the programme are delivered in a linear format, the interactive sections branch into two video streams, as represented in Figure 49. To simultaneously broadcast these two separate streams normally requires the use of two broadcast channels of spectrum, which significantly increases delivery costs. To minimise this, *The Magic Cubby* is delivered via the pan-and-scan method of video broadcast; a functionality first explored in Chapter 2 (section 7.4).
In this process, the two video streams are rendered side by side in preproduction, so that the resulting stream is an incorporation of both. The application then instructs the set top box to focus in on either one or other of the ‘half streams’, depending upon the actions of the viewer. The selected stream is then stretched to full screen, and displays as if it is a full channel of video. If we again use the hypothetical example of Roger and Baby Crocodile’s activities, this method combines streams from both the yellow and green rooms into one broadcast, which the application is then instructed to control. Figure 50 depicts a pan-and-scan video stream representation of activities in two different rooms of The Magic Cubby. By clicking on one button, the set top box focuses into the events on the left, and
the viewer subsequently joins Baby Crocodile in singing a song. By clicking the yellow button, the set top box focuses on the events on the right; and the viewer helps Roger learn how to ride a horse.

Aside from the obvious advantage of saving bandwidth costs by delivering all content onto one stream, this method also offers two further capabilities. First, as this programme’s application is not designed to support polls, quizzes, or other counters that place additional demands on the set top box, the application is little more than a video switcher. This reduces the size of the application and increases the compatibility of the programme with interactive platforms. Second; under a normal video stream switch a delay would have been observed during which the set top box waits for the next SI (service information) tag to arrive on the broadcast stream (see Chapter 2, section 4.5). The pan-and-scan method bypasses these delays, as the set top box is not required to retune to the broadcast signal, resulting in a more rapid interaction.

One of the advances explored in Chapter 2 was the concept of ‘burning’ interactive elements directly onto the broadcast stream (See Chapter 2, sections 7.3; 7.4). In the case of the BBC’s *Walking with Beasts* and Disney’s *Kids Awards*, this involved representing these assets as picture-in-picture (PIP) and having the navigation bars ‘burned’ directly onto the broadcast stream. This enabled the minimisation of application development which instead functioned as a video-stream switcher, and also allowed quite sophisticated PIP effects and transitions to be deployed regardless of the capacity of the set top box. In the case of *Walking with Beasts*, this also yielded an
application size of just 46kB, which allowed for rapid loading and viewing times (Gorel in Gawlinski, 2003).

This method of production is suited to episodic programmes of a rich media nature for three reasons. First, the reduction in application complexity means that *The Magic Cubby* is more likely to be both set top box independent, and cross-platform compatible; ensuring a larger market will be equipped to purchase and view its episodes. Second, this method significantly reduces costs associated with design of the application, which means that production budgets are more likely to be met. Third, while *The Magic Cubby*’s application template is designed to be unchanged throughout the season, burning interactive assets onto the video broadcast means that the programme still retains flexibility in its interactive execution week by week. As such, different types of interactivity can be deployed each episode without recreating the application to run them. This is an important factor, as it caters for the diverse needs of early childhood audiences without needlessly impacting production costs.

The content of *The Magic Cubby* therefore operates within two frameworks; the framework of the interactive application, and within that, the framework of the interactivity itself; the coloured doors. The challenge remains to retain flexibility in the interactive activities without deviating from this framework for reasons of both cost and navigational consistency with young audiences. The particular ways that it is executed in this study is the subject of the next section.
5 Execution

The research instrument incorporates a number of discrete interactive segments into a 24 minute programme, based upon the interactive construct developed in Chapter 5. This section describes the process by which these four interactive segments are executed, and how they are intended to respond to early childhood educative goals.

These interactive segments are based upon findings discussed in Chapter 4 (section 2.2). This section reports on a recent study by (Hynd, 2007), which suggests that interactive segments have a greater effect when they are not based upon direct narrative control. Rather, the segment should allow the viewer to interact in a participatory fashion, where interaction is based on more incidental aspects to the storyline or action. This study tested educative television for children using a variety of interactive TV formats. It suggests that interaction based upon repetition (allowing repeated viewing of content) and participation (allowing control over only non-critical elements of the narrative) is the most effective in engaging the childhood audience. As such, the following interactive segments employ these formats, and are based upon the interactive construct developed in the previous chapter.

5.1 Segment 1 - Context-tailored learning

The first interactive segment involves a choice of character for the viewer. As this segment focuses on the virtue of courage, a story is told about a courageous young boy
in the fairytale Jack and the Beanstalk. The use of a well known fairytale such as Jack and the Beanstalk can potentially contribute to invalidity, as testing of the virtue of courage by assessing recall of the events can weight towards those familiar with the storyline.

To remedy this, elements of the story are altered. In doing so, it allows for testing to include memory of this story along with children’s understanding of courage.

One way of approaching this is by considering the virtue of justice. The story of Jack and the Beanstalk is told in The Magic Cubby as a part of the education on courage; however the original story contains many examples of injustice. For instance, Jack sneaks into the giant’s castle without permission, steals wealth, and when he is pursued, kills the giant by cutting down the beanstalk. A just account of this story would indeed not have seen Jack living happily ever after. To remedy this, the Magic Cubby alters certain events in the story. For instance, Jack rescues a small mouse being held against its will in the castle, and as a result the mouse gives him a bag of gold. When the giant pursues him, Jack cuts down the beanstalk before the giant can begin to climb; thus the giant does not die. In presenting the importance of virtues and educating early childhood on the betterment of character, it would be erroneous to allow such examples of injustice to be presented alongside them. In testing the comprehension and recall of participants, altering the narrative in this way corrects the imbalance that would undoubtedly emerge from participants that could recall the events based on their previous recollections of the story; allowing this segment to be a part of the testing process.
The interactivity of this segment is provided by the adult female presenter, Kal, who invites the viewer to listen to the fairytale. However, she asks the viewer to choose who they would like to play the character of Jack. The viewer is told that if they would like to see the puppet character Roger play Jack, then click the green button to follow him into the green room. If they would like to see Baby Crocodile play Jack, then click the yellow button to follow him into the yellow room. Once the viewer has chosen their character the story begins inside the chosen room, as shown in Figure 51. The puppet characters play out their part as Kal reads the story; appearing in a PIP feed from the red room. At the end of the story, Kal invites the viewer to follow their puppet character back into the red room.

In terms of design, these two video streams run concurrently in a pan-and-scan format, with Kal’s picture-in-picture being ‘burned’ directly onto the video. The video streams were filmed separately; however – despite the two protagonists – they differed little in how they were presented. Both video streams share the same audio stream; the audio of Kal telling the story. The audio does not need to be adjusted in any way for the two interactive streams, as the main character is referred to as ‘Jack’, regardless of the puppet character playing the part. This also served to provide continuity for the interactivity, as viewers switching between the two interactive streams experienced no interruption of audio and a faster switch to the alternative room.
This process of allowing the child to choose a character is consistent with a social constructivist learning environment in that it allows a degree of manipulation on the part of the child, however frames this control within a systematic learning agenda. In this interactive segment, a child is able to choose a character, however the educational goals that the character explores remain systematic and consistent. It therefore incorporates Vygotsky’s teachings on the importance of including a child’s interests while retaining a measure of control to ensure that their developmental level is exceeded and not merely met (Vygotsky, 1986).

This concept was first approached in the interactive construct developed in McPharlin (2002) as a counting exercise (Figure 52). In this interactive segment, programme presenters Jenny and Misagh invite the audience to count to ten; however the viewer is given the choice of either counting animals with Jenny in the red room, or counting cars with Misagh in the green room. This process provides a learning segment that has an
element of choice for the viewer, but is framed by the broadcast. The child is able to choose how they want the information to be presented, however the learning experience – counting to ten – is consistent regardless of the choice. In this way the child is able to tailor the delivery of the information to suit their interests.

![Red Room vs Green Room](image)

**Figure 52: Context tailored learning shown through a counting exercise in McPharlin (2002).**

Similarly, the ‘choice of character’ segment in the research instrument episode also creates a context-tailored learning experience. Once again, this time by being able to choose either Roger or Baby Crocodile to play the character ‘Jack’, the child is able to choose the context in which the learning experience is framed; the context being the character that participants in the unfolding story and learning outcome. While this segment is not based on academic learning outcomes such as the original pilot, its prosocial and moral learning goals of teaching the virtue of courage remain consistent in either room of the cubbyhouse, regardless of whether Roger or Baby Crocodile is chosen. The focus of the segment, therefore, is to use the twin elements of interactivity
and appealing characters to draw the viewer into the story in order to provide more resonance for the educational message.

In this regard, the puppet character functions as a guide or mentor throughout the learning experience. Using a character in this way has been a consistent practice of the children’s programme Sesame Street, in which the character functions as a ‘trusted friend’ to accompany and guide the child viewer through their learning experience (Revelle, 2003). Other studies have frequently found a positive relationship between children’s enjoyment of programming and appealing characters (Fisch, Cohen, McCann and Hoffman, 1993; Williams, Hall, Cunningham, Albright, Schiro and Fisch, 1997; Valkenburg and Janssen, 1999).

One of the reasons for this effect is that the character serves as a bridge between the viewer and the message. If the viewer can identify with the character, then the experiences that the character has also resonate with the viewer. Studies of older age groups have demonstrated that participants identified more strongly with characters that they perceived were the same age, gender, and possessing similar attitudes or attributes to themselves (Maccoby and Wilson, 1957; von Feilitzen and Linne, 1975; Sprafkin and Liebert, 1978; Reeves and Miller, 1987; Hoffner and Buchanan, 2005). Similarly for the early childhood age group, a study of 140 children aged 8-13 years old in the United States revealed that children identified more with characters from a storybook that they perceived were of similar age (Lehman, 1996).
Another interesting effect associated with choice is the question of whether the act of choosing the character predisposes the viewer more favourably towards the ensuing content. Tanjic, for example, found that predisposition towards an advertising message was significantly greater when the ad was chosen by the viewer (Tanjic, 2001). A conclusion for this behaviour is possibly that the act of choosing attaches an emotional investment to the content; an investment that can manifest itself in loyalties or preferences that support the viewer’s decision to choose the content in the first place.

What choice gives to a participant is a measure of control over the experience, and while studies of this in an interactive television environment are rare, studies in the past have found links between choice and both motivation and performance (Bailey, Perlmuter, Karsh and Monty, 1978). A similar effect in this context-tailored learning environment might lead to an increase in attention to the screen simply because Roger is the viewer’s preferred character. Alternatively, by choosing Roger to be the main character, the child viewer might show an effect because they are concerned that their choice to make him a part of the story now requires their attention to see that he makes it safely through the events. Though Tanjic’s study yields a number of findings for an older age group, this has not yet been explored in detail for children’s educational iTV content.

### 5.2 Segment 2 - Critical Literacy

Critical literacy is the educative goal of the next segment; most specifically, the understanding that a story can be told in different ways, and that similar words and events can have different meanings. To explore this learning goal within the context of courage, the interactive segment involves inviting the viewer to listen to a story about a
young girl, Sally, preparing for her first day of school. The male presenter Hoda addresses the audience, saying that Roger and Ruby are both going to tell Sally’s story in different ways in different rooms. Those who would like to hear Roger’s version of the story are instructed to press green, to follow Roger into the green room. Those who would like to hear Ruby’s version of the story are instructed to press yellow, to follow Ruby into the yellow room. In a design sense, this interactive segment is presented in a similar fashion to context-tailored learning. Hoda’s PIP is burned directly onto the video stream, with the two streams being delivered concurrently via pan-and-scan.

Once the viewer has interacted by pressing a coloured button, the story begins. During Sally’s morning routine of eating her breakfast, washing her hands, and getting dressed, her favourite teddy bear ‘Bear’ is there to help her. While the audio of the story remains unaltered between the two rooms, the associated visuals are presented differently (Figure 53). In the green room Sally is represented as a middle class young girl in a western setting. She is an only child with a single mother. However, viewers who have entered the yellow room see Sally as a young African girl from a larger family in a suburban setting. Both characters go about the process of preparing for school, however in ways slightly differing according to their upbringing and culture. For instance, while in the green room, Sally’s mother brushes her hair, Sally in the yellow room gets her hair braided. While Sally in the green room eats her breakfast on a stool at the kitchen bench, Sally in the yellow room eats her breakfast at the table. While in the green room, Sally wave’s goodbye to her mother and leaves the house, Sally in the red room is walked to school by her family.
By staying on one stream, the viewer sees a story about a girl getting ready for school. However by switching between streams, two goals emerge. First, by observing that same story playing through the eye of different cultures and practices, the viewer observes the oneness of humankind; that two children of different cultures and appearances have the same hopes, the same doubts and the same fears. The more that they interact, the more that they are able to understand that the essential oneness of humankind does not come from uniformity, but from understanding that though cultures may behave in different ways, their motives and intentions are one.

Second, by switching streams that differ in their interpretation of a shared narrative, the viewer observes a key component of critical literacy. Critical literacy has a multitude of meanings; from the understanding that a text is positioned to be presented in a particular way by the author using textual devices (Comber, 1993; Mellor and Patterson, 1994;
O’Brien, 1994), to the idea that a story is limited by the ability and knowledge of the author (MacLachlan and Reid, 1994). Children have been consistently understood to gain skills in critical literacy long before they are able to read (Holdaway, 1979; Teale and Suzby, 1986; Clay, 1991; Dickinson and Smith, 1994; Allington and Cunningham, 1996; Burns, Griffin and Snow, 1999; Hall and Moats, 1999), although in this younger age group it is commonly manifested in other ways, such as in an understanding of images and storytelling (Clay, 1966). This segment focuses on the understanding that a story can be presented in different ways or have multiple meanings; a form of media or narrative literacy (Campbell and Green, 2000; Thoman, 2003). It implies an awareness of the narrator rather than a blind acceptance of the content. In this case, the viewer observes an identical story presented in different settings. Through seeing Sally represented by two characters in their own lives, this tenet is brought to focus. As such, usage of interactivity during the segment is critical to the realisation of the learning goals. In fact, the more that the child interacts, the more exposed they are to the central theme of the content.

While this segment shared some design and execution similarities with the previous segment, its learning goals and usability objectives remained different. For instance, in the context-tailored learning segment the learning experience relies upon the viewer choosing a favourite character and then sharing the experience of that character for the duration of the story. Though they are able to switch streams at any time, the objective of the segment relies upon the viewer feeling a sufficient connection with a character to the point of making a choice and being drawn further into the story as a result.
With the critical literacy segment, however, there is no loyalty tied to either choice; they are merely stated as being two different ways to tell the same story. As a result, the objective relies upon the viewer switching between streams to appreciate the full impact of the segment.

5.3 Segment 3 - Repetition

The third interactive segment involves allowing the viewer to choose to repeat a part of the content. In the second half of the episode, Hoda turns to the viewer and invites them to choose an activity; either they can join him in looking at some pictures of courage that have been sent in by home viewers, or they can go with Ruby to repeat a song that was sung earlier. This particular song, which was based on the theme of how to show courage in everyday life, occurs midway through the episode. The viewer is instructed to click the green button to follow Ruby and Baby Crocodile into the green room to sing the song again. If they would like to stay in the red room and look at viewer’s artwork, they are instructed to not click any buttons. In the green room, Ruby and Baby Crocodile sing the song together, while Hoda gets help from young actor Ben to put some of the viewer’s artwork up onto the cubbyhouse wall (Figure 54).
Repetition has been found to be a powerful force for comprehension and engagement in young children’s programming, with findings that attention to programming does not decline with repeated viewings (Mares, 1998; Richards and Anderson, 2004). As I have demonstrated in Chapter 2, numerous studies have concluded that repetition of content for the early childhood audience significantly increases their comprehension (see Chapter 2, section 8.1). An American study of 108 children aged 3–5 showed that during five repeated viewings of an episode of Blue’s Clues, comprehension was significantly increased for participants; including increases in recall and problem-solving ability (Crawley, Anderson et al., 1999). As such, the ability to provide repetition poses a significant advantage for learning in children’s interactive television programming.
5.4 Segment 4 - Community Building

The final interactive segment looks at the power of interactivity to reflect the community that it operates in. This can be accomplished in many ways – such as by presenting localised stories – however a prominent way that this it is deployed in children’s programming is by showing viewer’s submissions to the program, such as letters, SMS texts, or artwork. While this can be accomplished without the help of interactivity, iTV can enhance the experience in two important ways. First, it can provide viewers with a choice to either see or avoid the segment. Second, on web-based applications, or on certain middleware, such as Digital Video Broadcasting Group’s MHP standard, it can localise the content to the viewer (Piesing, 2005). For instance, set top boxes that can identify their own postcode can be instructed to display only pictures from viewers in that city, country, or general area. In this way, the content being displayed can be customised to suit the locality; thereby increasing its community building power.

This segment accomplishes both of these, and occurs at the end of the programme. As the cast are saying their goodbyes, Hoda turns to the camera and informs the viewer that if they would like to see some more pictures that have been sent in by viewers, to click the green button. At the click of the green button, the main stream moves to burned-on PIP and still screens are displayed of artwork sent in by viewers. By localising the content by postcode, the artwork in a particular area can be displayed, increasing the likelihood that a child’s artwork will appear in on their own screen. If the programmer wishes, this segment can be extended until all artwork is shown.
The scope of this interactive television study only spans the duration of the episode, and since this particular segment occurs beyond the credits, it is not a testable part of the study; however it is included in this chapter as an example of an iTV contribution to community-building programming in CTV.

6 Preparation for Testing

In preparation for testing, DVD was chosen as the format for presenting *The Magic Cubby*, rather than an iTV format. This was for three reasons. Firstly, iTV programming is currently a costly process, and would have required significant levels of funding that were unavailable for this study. While there are certain programmes that can create interactive television content in a cost-effective and timely manner, such as those using a standardised iTV template (i.e. impulse-response applications), they are used for much simpler designs and are not able to manage the demands of rich media synchronous output such as *The Magic Cubby*. Second, the use of iTV authoring to present the test instrument would have increased the scope of the field equipment required during the experiment. As this test was conducted on location, testing in a true native iTV environment would have required the use of a stream recorder (or PC emulator), broadcast modulator (satellite, terrestrial or cable) and set top box to demodulate the program data. Third, the risk of experiencing technical difficulties in the field were significantly lower using a DVD format; an important consideration given the study’s limited access to participants. At the same time, every effort was made to ensure that the
DVD platform emulated, as much as possible, the real world iTV platforms on which they would potentially deploy.

### 6.1 ‘Burned-On’ Interactivity

A technique commonly used in iTV applications, the practice of burning interactive banners and navigational elements directly onto the broadcast stream (see Chapter 2, section 7.3), is equally useful in the DVD environment. Chapter 2 also reports other benefits of burning all assets together, such as reduced bandwidth, load-times, and processing strain on the set top box. Figure 55 illustrates the layering process on an iTV platform, where navigational layers and PIP assets are layered on top of full screen video,

![Figure 55: Layering iTV assets on top of full screen video to be processed by the STB.](image)

and are processed at the client end by the STB. While DVD programming has the ability to recognise navigational elements on top of a video stream, it has less flexibility to
handle this when combined with a video picture-in-picture. In such cases, when full screen video is used in conjunction with navigational assets, it is preferable to burn all assets onto the video stream. This method cuts down on programming complexity and subsequent loading times for DVD data streams, and ensures that button presses operate quickly. Thus, the interactive toolbar is rendered on top of the full screen video in post-production, allowing it to function throughout the programme.

6.2 Stream Switching

The most challenging effect to replicate in the DVD environment is the stream-switching abilities of an iTV programme. While iTV programmes can switch between a number of streams of video in a similar manner to a channel change, especially if they have used a ‘pan and scan’ approach and rendered multiple videos onto one stream (see Chapter 2, section 7.6), the DVD environment is not structured in quite the same way. This is a crucial element, however, as an interaction in *The Magic Cubby* involves a video switch from one room of the cubby to another; meaning that time needs to pass in both rooms at the same rate.

There are two main solutions to this restriction. First, DVD has the functionality to allow for an extra stream of video to run alongside the main stream. This is commonly used for content that requires an extra angle of footage such as sports programmes, and is operable via the ‘angle’ button on the remote control. Running the second room of *The Magic Cubby* on the second stream would allow an instantaneous switch between the two rooms, with an extremely reliable synchrony between the two videos. A restriction
of this method is that the angle function allows interchange between two video streams, but retains only one common audio track. This method would not be able to accommodate this extra functionality should it be required. The angle method is also problematic in that stream switching only toggles between two choices. With red, green and yellow rooms to switch between, this proves unsuitable for The Magic Cubby.

The other option, that does not carry these restrictions, is to use the chapter marker function. This function allows the DVD author to assign markers within the video stream for navigational use. The most common evidence of this process can be seen when watching a DVD movie, and having the option to choose a ‘chapter’ of the feature presentation to start from. The solution is to assign markers throughout the duration of each interactive segment, and reference each marker to the corresponding point on the opposing video stream (Figure 56).

Although this can be a time-consuming process, it allows for a DVD authoring format to replicate two video streams running simultaneously and in real time. The speed at which the changeover occurs is often dependent upon the power of the DVD player’s processor. However, a high-quality DVD player can process this switch rapidly; meaning that a room switch in The Magic Cubby can be accomplished with only a negligible pause in the programming.
Figure 56: Using chapter markers to allow switching between separate video streams

The authoring of *The Magic Cubby* used this latter process of assigning chapter markers. Markers were spaced at approximately one second intervals, which meant that there was commonly less than one second deviation between the timing of the primary and secondary video stream. While this did not present a seamless video switch, it did accomplish near exact replication of the video stream to function appropriately for the purposes of the study.

7 Summary

This chapter has outlined the requirements of the research instrument to be used in the final phase of research for this thesis. It has presented evidence that the specific needs of this study have required the use of an original programme, rather than repurposing an
existing product. One of the major reasons for this was to retain control over the interactive elements of the programme; ensuring that interactive segments both conformed to developed ideas about appropriate educational content for iTV, and maintained the interactivity as a central, rather than incidental, element to the usability and educational goals of the programme. This allowed the development of interactive segments in which both educational concepts and the features of iTV most suited to creating a compelling environment for the early childhood audience could be used to great effect.

Four particular segments were formulated and implemented into the instrument; allowing such features as choice of character, the ability to repeat a segment, the ability to change the context of a story, and choosing between activities. These segments are not to be considered to represent a totality of the capabilities of the iTV platform. Rather, they represent four models that have been developed through insight gained in this experimental process; incorporating features of interactive television and educational goals. By providing detail into the design of The Magic Cubby, results can be drawn based on the build of the programme, and not merely a theoretical sense of interactive television programming.
CHAPTER 7 – Phase 3 (Evaluative) – Testing the effect of interactivity on children’s educational television

1 Research Overview

As this research programme has involved a number of formative stages, here I present an overview of the reviews and studies that inform the development of this final phase.

Education and technology literature reviews (Chapters 1, 2) and an initial phase of research (Chapter 3) have informed the development of the two key issues to be addressed in this chapter; the assessment of interactive television as a tool to enhance comprehension of an educational narrative, and the implications of production and transmission costs associated with its delivery. The commercial implications of interactive programming were explored in Phase 1, and this study has recommended the testing of two interactive conditions (see Chapter 4, section 2.1; 3); one with rich-media production values that the literature has indicated is necessary for effective engagement with children (‘rich media’ programming), and the other using less bandwidth-heavy iTV programming methods that have a reduced cost impact, in both production and delivery (‘simple’ programming). In Chapter 4 these two factors were expressed in the following two hypotheses;
Chapter 7

Hypothesis 1

\[ H_0: \text{The provision of interactivity (iTV) in educational television programming does not significantly increase comprehension of content in young children.} \]

\[ H_1: \text{The provision of interactivity (iTV) in educational television programming significantly increases comprehension of content in young children.} \]

Hypothesis 2

\[ H_0: \text{The effect on comprehension of incorporating interactivity (iTV) in children’s educational television programming is not significantly decreased when bandwidth is conserved through using simple iTV programming.} \]

\[ H_1: \text{The effect on comprehension of incorporating interactivity (iTV) in children’s educational television programming is significantly decreased when bandwidth is conserved through using simple iTV programming.} \]

These twin hypotheses suggest a research programme that incorporates both the principles of educational and usability theory, and the practicalities of commercial production; an industry in which these ideal formats are frequently not incorporated for matters of cost. As such, this chapter proposes a methodology that incorporates the testing of interactive television programming under two conditions; full video interactivity and programming using cost cutting methods available to iTV application developers. These processes; referred to as ‘rich media’ and ‘simple’ programming formats, are discussed in the next section.
In Chapters 5 and 6 an appropriate research instrument was developed and tested for use in this study. This instrument, based upon original concepts and programming, was built around an ‘interactive construct’; an agreed set of ways in which the programme intends to use interactivity. This was based on set of guidelines derived from literature and industry research into the most effective way to deploy interactive programming for early childhood. From this construct, a number of interactive formats were developed based on ‘participative’ interaction (Chapter 4, section 2.2); an approach in which interactive choice impacts only incidental aspects of the narrative, rather than giving complete control over events. Through this approach, the child is motivated to participate in – rather than dictate – the events in the story; the assumption being that this provides a suitable balance of the power of choice and the engaging experience of the television platform. Participative interactivity is also useful for educative programming in that it provides opportunity for classroom-based viewing, in which interactivity can be enjoyed in a group setting and discussed afterwards. To address both hypotheses, this research instrument was prepared in both a ‘rich-media’ format, and a ‘simple’ iTV programming format (see section 4).

2 Methodology

In considering the cost impact of interactive television production, this research seeks to define both the impact of interactive television on an absolute scale, and on a scale that can be managed in a commercially viable sense by the broadcasting industry. The implication for the research methodology is that these two objectives need to be tested as
independent conditions. As discussed in Chapter 4, it is recommended that children’s television incorporate high production values in order to provide an engaging platform. The research instrument, *The Magic Cubby*, incorporates this as a live action narrative in which interactive segments play out in full screen video (as discussed in Chapter 6). To address the second hypothesis, it is required that the research includes a treatment in which respondents observe the stimulus presented as a simple interactive TV application. As the findings from Phase 1 (Chapter 3) indicate, this involves cost cutting in both the filming and editing of interactive segments, and the cost of bandwidth involved in the broadcasting of simultaneous feeds of full screen video. To address this, it is possible in iTV programming to present *The Magic Cubby* built as a ‘simple’ application, in which interactive segments play out as still slides rather than full video. Similar to typical children’s gaming applications such as Bob the Builder (discussed in Chapter 2, section 8.3), still screens are presented during interactive segments; thereby reducing the cost of filming and editing these segments, and of broadcasting them. An outline of how *The Magic Cubby* was repurposed as a simple iTV application can be found in ‘Materials’ (section 4).

Early childhood, the developmental age under investigation roughly conforms to the pre-school age range. In the region that the fieldwork was carried out – Perth, Western Australia, this was children aged 4 and 5. In some classrooms, 3 year old children are sometimes in attendance, which raises the question of participation in this classroom-based fieldwork. It was felt that these ages can participate, but their data will ultimately be not include in the statistical analysis of groups, for two reasons. Firstly, the pilot
study (Chapter 5) demonstrated that 3 year olds were noticeably less capable of understanding the interactive construct as older children. In light of this, including data from 3 year olds will bring non-typical behaviour into the sample. Secondly, 3 and 6 year olds will be in the vast minority in the classroom, and so will not be big enough for any kind of statistical validity as a discrete sample.

This experiment conformed to a 2 (age) x 2 (gender) x 3 (condition) research design, as shown in Figure 57.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control Group Linear Video</th>
<th>Experimental Group Interactive Full Video</th>
<th>Experimental Group Interactive Still Screens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>4y/o 5y/o</td>
<td>4y/o 5y/o</td>
<td>4y/o 5y/o</td>
</tr>
<tr>
<td>Gender</td>
<td>Male/Female</td>
<td>Male/Female</td>
<td>Male/Female</td>
</tr>
</tbody>
</table>

*Figure 57: Summary of Research Structure*

Respondents were exposed to one of three conditions; a linear condition (control group) in which *The Magic Cubby* was screened as a non-interactive programme with no calls to action, an interactive ‘rich-media’ version with full video interactivity, and a ‘simple’ application version with still-screens of the action being shown during the interactivity segments.
2.1 Outcome Measures

Quantitative measurement of television programming can be accomplished through various means; however it is a measure of narrative comprehension that is most pertinent to this study (see Chapter 4, section 2.3). While the use of behavioural measures such as attention or engagement serve to give an idea of a programme’s general appeal, or sometimes enhance the understanding of why an effect is being observed, they are not reliable indicators of success or failure by themselves. For instance, a child can stare fixedly at the television screen and daydream, whilst another can be looking out of the window but listening intently to the narrative. Clearly their outward behaviour can never be a definitive measure of the true impact of the content. Similarly, studies by Anderson and Lorch (1983) demonstrate that the concept of ‘active’ processing of television content does not imply physical action. Active processing is a cognitive activity, not a physical one, so whilst this study does investigate physical interaction with a programme, attention and engagement are by themselves not true measures of educational impact. For that matter, nor is the frequency or vigour with which a viewer may press the interactive buttons.

As discussed in Chapter 4, it is a post-test measurement of comprehension that can provide insight into the level at which educational outcomes have been achieved by the child. As such, this study deems comprehension scores as the factor by which success can be evaluated. However, studies by the Sesame Workshop have discovered that the use of supplementary outcome measures can also provide insight into why an effect is being observed (Fisch and Bernstein, 2001). Research on children’s educational
television by the Sesame Workshop has consistently demonstrated the value of a combination of behavioural and verbal outcome measures, as multiple methods can ‘complement each other and yield a richer picture of children’s knowledge’ (Fisch and Bernstein, 2001, p. 49). Measurement of a single outcome can commonly lead to inaccurate inferences if not measured against another.

As such, the scores associated with comprehension in this study will indicate whether the interactive groups display a stronger understanding of the content of *The Magic Cubby* than the control group, whereas data concerning their behaviour (attention and engagement) can contribute by providing insight into what aspects of their behavioural patterns contributed to the observed effects.

### 2.1.1 Comprehension

In studies related to children’s television viewing, measurement of children’s comprehension is commonly the primary means of determining the success of the study. In each test of comprehension, the nature of the research instrument determines both the format of the measurement, and the style of questions that are used. However, whichever format is used, in order to accurately test the efficacy of a program the study must compare the degree to which the child absorbed and understood the educative or social goals of the programme (Calvert, Huston et al., 1982; Palmer and Fisch, 2001). *The Magic Cubby* has virtues and values education as its central theme, and as such an appropriate test of comprehension for this phase involved measuring whether the
presence of interactivity affected the viewer’s fundamental understanding of the particular virtue presented; in this case the virtue of Courage.

In designing the method of testing, it is necessary to identify the elements of *The Magic Cubby* that will contribute to the testing process. In a children’s program, Huston and Wright draw a distinction between content that is presented and the formal features that deliver this content (1982; Rice, Huston and Wright, 1982). Though studies outlined in section 2.1 demonstrated that it is comprehension and not formal features that primarily determine a child’s attention to the screen, research also suggests that the structure and cues provided by formal features serve to enhance comprehensibility, primarily because they cue the viewer to important content (Calvert, Huston et al., 1982; Campbell, Huston et al., 1987; Linebarger, Kosanic, Greenwood and Doku, 2004).

What is important to identify in *The Magic Cubby* is that the interactivity that is embedded into the user experience primarily affects the *formal features* of the programme, and not the testable content. For instance, in the first interactive segment, children can choose which character they want to play the role of ‘Jack’ in Jack and the Beanstalk. The linear condition presents this fairytale without a choice being offered, however in the interactive conditions the child is now able to make a choice through pressing a button, and the programme responds to their choice by switching streams.

In the interactive stream, therefore, the formal features of their experience are now altered; however the content of the story of Jack remains constant, regardless of what
choice is made. Similarly, in the second interactive segment the viewer can choose the setting of the story about Sally, and the story itself is also unaltered. When children are given the choices in the interactive conditions, they can choose characters and contexts – not content – and therefore the interactivity is designed to give the participant the choice to control some elements of the programme. A child can choose their favourite character to play Jack, but Jack’s story of courage will not deviate from the story presented to any other participant. The audio of the programme, apart from verbal interactivity cues, also remains unaltered. This is consistent with the writings of Freidrich and Stein, who suggest that information central to the content of a programme is delivered primarily by the audio track (1973).

The implication of this is that across all three conditions, whether interactive or linear, all children are receiving the same testable content. The only exception to this rule is the third interactive segment, in which interacting determines whether the child views a drawing activity or sings (see Chapter 6, section 5.3); as such, this part of the programme is not addressed in the comprehension test. The significance of this is that in testing children’s understanding of the central themes of this programme, there is no tangible difference in the actual type or level of detail each child receives on the subject that they are tested on. The interactivity is designed to allow them to control appealing elements – such as character choice – but what they are tested on is content, which remains unaltered. This means that a significant difference in comprehension across groups will be directly related to two things; the presence of interactive control in the television environment, and the appeal generated by characters and aesthetic elements.
that arise from being given this control. The observed differences will not, however, arise from extra information or content derived from the control itself.

When it comes to measurement of within-group factors, some studies have opted to use open-ended questions to gauge comprehension (See Friedlander, Wetstone and Scott, 1974; Calvert, Huston et al., 1982; Cole, Richman et al., 2001). This enables the researcher the flexibility to elaborate on questions in order to ensure that the child has completely understood a concept or event. However, for large scale comparisons in effects across groups, such as the present study, a more standardised quantifiable form of comprehension testing is required in order to provide measurable data for analysis. This study opted to use a five question comprehension test, administered immediately after viewing. The remainder of this section outlines the five questions used in the questionnaire, and their role in the assessment of comprehension across the groups.

The questions posed in the questionnaire were presented to correspond with the order that they occurred in the programme, and to generally increase in complexity; consistent with past studies (Lorch, Anderson et al., 1979). Consistent with Bloom’s Taxonomy (Bloom, 1956), the increase in difficulty reflects an increase in higher-order cognitive demands (discussed in Chapter 1, section 5). So while initial questions test basic recall, subsequent questions test understanding, and eventually application of learned concepts.

Question 1 consisted of a character identification exercise; a lower order recall test. Participants were shown a diagram (Figure 58) and asked to identify and name the
characters that they saw in the show. The diagram included the three main characters, and two random characters that did not appear in the show. One point was awarded for each of the three characters, with a further point for their correct name, with a possible total of 6 points.

Question 2 was a more rigorous recall exercise. Participants were asked to recall events from the story ‘Jack and the Beanstalk’, to a maximum of four points for four recalled events. Caution was exercised with participants who may have recalled the story from their own experience prior to the study.

To avoid invalidity due to previous recollection, the story of Jack and the Beanstalk was presented with altered events, in which Jack saves a mouse from the giant’s castle and helps it escape down the beanstalk (discussed in Chapter 4, section 4). In order to validate their scores, at the end of this question the participant was asked ‘in the story, what did Jack save from the giant?’ If the participant answered with something other than ‘the mouse’, they were not awarded any of their points.

Question 3 tested the participant’s understanding of the main concept in the program; the virtue of courage. Participants were asked to identify ways in which Jack showed courage in the story of ‘Jack and the Beanstalk’; to a maximum of three points for three correct responses. Correct answers were ‘to climb the beanstalk’, ‘when he snuck into
the castle’, ‘when he ran away from the giant’, or ‘when he had to tell his mum about the magic beans’, however any answer that showed both a correct recall of the story and an understanding of the concept of courage was awarded points. This question assesses the children on multiple order levels of cognition in Bloom’s Taxonomy mentioned earlier in this section. They must not only understand the meaning of courage (understanding), but then identify events in the narrative that correspond to this understanding (application). Measures of comprehension for programmes of this nature require testing the participant’s understanding of the central theme of the programme (Calvert, Huston et al., 1982; Dickinson and Smith, 1994; Palmer and Fisch, 2001). As the programme’s central theme is to teach the virtue of courage and promote its usage, then this question is the most robust test of the programme’s efficacy.

Question 4 tested the participant’s recall of events in the story of a young girl, Sally, getting ready for school (see previous chapter for details). The researcher asked the child to recall the story of Sally getting ready for her first day of school. The child was then asked to remember what Sally did to get ready. Acceptable answers included:

- Washed her hands
- Ate her breakfast
- Brushed her teeth
- Put on her shoes
However, additional answers relating to her stuffed teddy ‘Bear’ were also accepted, such as ‘Bear spilt the milk’ or ‘Bear had odd socks on’, as they also demonstrated recall of events. A maximum of four recalled events were awarded a maximum of four points.

Question 5 tested the participant’s opinion of the programme. Tests of enjoyment levels in young children are problematic as there is no reliability that their answer is based on genuine feelings, and not a response related to their anticipation of what the ‘right’ answer is. As such, a ‘Face Scale’ is used widely in studies as a reliable indicator of a child’s enjoyment level (Williams, Wetton and Moon, 1987; Williams, Wetton and Moon, 1989a; Williams, Wetton and Moon, 1989b; Hanna, Risden and Alexander, 1997; Mauthner, 1997). Hanna and colleagues suggest that a design based on a Likert-scale is useful, as the concept of ‘more’ or ‘less’ enjoyable presented along a pictorial scale is more manageable for most children in this age group (Combes, 1992; Hanna, Risden et al., 1997; Hanna, Risden, Czerwinski and Alexander, 1998). This takes the form of a face scale, in which incremental expressions on faces help the child to distinguish between degrees of emotion (Frye and Simeonsson, 1979; Risden, Hanna and Kanerva, 1997; Krahn and Eisert, 2000). A face scale is also useful in that it allows a quantitative measurement of a largely subjective scheme, as points can be allocated to each facial expression (Krahn and Eisert, 2000).

A five point face scale was presented to participants on an A4 sheet of paper (Figure 59). The five faces were briefly explained as characters that had also seen the programme. While explaining the expression on each face, care was taken with the
manner of presenting and inflection of the voice in order to avoid indicating a preference or judgement of any of the expressions. Participants were asked to point to the expression that they felt reflected their enjoyment when watching the programme, with 1 point awarded for least enjoyment to 5 points for most enjoyment.

2.1.2 Behavioural Outcome Measures

The behavioural measures of attention and engagement were employed in this study to possibly explain the source of any observed comprehension effects. Attention, defined as a visual orientation towards the screen, is used frequently in children’s studies to explore children’s response to different type of programming. Engagement, while sometimes a term referring to an intensity of attention (Schmidt and Vandewater, 2008), refers in this study to the eliciting of physical and emotional responses to the programming; also known as programme elicited behaviour (Sproull, 1973).

Studies differ on what holds children’s attention in a television programme. Palmer and Fisch (2001) report on an internal Sesame Workshop study that measured the attention of preschoolers to an Ernie and Bert segment on ghosts. The research indicated that children demonstrated most attention to the screen at times of high visual action and audio volume, with a significant decline in attention during a moment featuring a
comparatively quieter song. One conclusion of this research was that children’s attention to the screen is selective; a theory that has not been discounted in more recent studies. However, the reason for this effect has seen significant re-examination in recent years.

From the above research, The Sesame Workshop had reported that children’s selectivity to content therefore derives heavily from the use of formal features; a finding that was supported by other studies of the time (Bandura, 1977; Huston-Stein and Wright, 1977; Singer, 1980). However, later studies cast doubts on this assumption. A study by Anderson, Lorch, Field and Sanders (1981), tested the attention of children to an episode of Sesame Street where certain segments had been randomised to make them incomprehensible, whilst still retaining all of the production devices that were previously thought to command attention. The programme contained three types of alterations; scenes were presented in orders that made them incomprehensible, some audio dialogue was changed to a foreign language, and some scenes had their audio dialogue reversed, as opposed to the control group, who watched the original episode. Ninety-six children between the ages of two and five participated. The results showed a significant decrease in attention for the experimental group, indicating that children’s attention was not guided primarily by production features, but rather selectively attended to parts of the content that advanced their understanding of the plot (Lorch, Anderson et al., 1979).

Current thinking on children’s attention to television still hold that children are capable of displaying sophisticated viewing behaviour, however more recent studies have concluded that children’s attention is primarily motivated by comprehension of the
Chapter 7

content, not production features (Anderson and Lorch, 1983; Huston and Wright, 1983; Anderson, Lorch et al., 1986; Huston and Wright, 1989; Schmitt, Anderson et al., 1999). This is especially evident in programmes that are of significant length, such as Sesame Street, which runs for an hour.

A study in Germany, for instance, tested the viewing behaviour of 310 children aged 3-6 on an episode of Sesame Street, known in Germany as Sesamstrasse (Rogge, 2003). Researchers observed that children’s attention fluctuated throughout the programme. A within groups analysis indicated that the children were only attending to parts of the narrative that held particular salience for them, such as favourite characters, familiar concepts, or significant advances in the plot, and were turning their attention elsewhere at other times. Lorch, Anderson, and Levin (1979) also conducted research of the viewing behaviour of children to Sesame Street, and included a comparison of attention to comprehension of content. In their study, two groups of 5 year olds watched an episode of Sesame Street; one group containing a distracter in the form of toys for the group to play with.

Between groups analysis indicated that despite a significant drop in attention for the experimental group, there was no proportional drop in comprehension. However, within groups analysis showed that children from the experimental group selectively attended to only parts of the text that were deemed across both groups to be comprehensible, and so their measured comprehension of the content was no lower than the control group. These studies once again confirm that children’s attention is primarily a function of their
comprehension of the content (Anderson, Lorch et al., 1981; Pingree, 1986; Lorch and Castle, 1997); indicating that children demonstrate discerning behaviour to screen texts and attend predominantly to cues that advance their understanding in an efficient manner. Additional to these findings was supporting research investigating children’s behaviour in ‘gazing away’ from the screen (Pingree, 1986; Van Evra, 1998). More recent research from Laitsch has also demonstrated that children can gaze away from television in order to reflect on concepts or absorb ideas (Laitsch, 2006). These findings, along with those related to selective attention behaviour, prompted a realisation that children’s intake of a programme’s message is not proportionally related to their attention to the screen.

This theory that attention to the screen is a function of comprehension and not formal features has also been supported by findings that children’s attention increases with age (Anderson, Lorch et al., 1981; Anderson and Lorch, 1983; Anderson, Lorch et al., 1986; Signorielli, 1991; Schmitt, Anderson et al., 1999; Schmitt, 2001). A study by Anderson et al. (1986) reported that children’s attention to the television increases dramatically throughout childhood, in proportion to their understanding of the content, levelling off at 12 years of age. A study by Anderson and Levin (1976) also reported a linear increase in attention to Sesame Street from ages 1 to 4. As the age group under investigation for this study is 4-5, these studies suggest that this age group will display attention behaviour consistent with their comprehension of the content presented in The Magic Cubby. Furthermore, since the content presented to all groups is the same, whether interactive or linear, it can therefore be inferred that any difference in attention in the interactive group
may be attributed to an increased or decreased level of comprehension caused by the presence of interactivity. Comparisons with comprehension scores will shed more light on whether this effect has occurred.

In this study, attention was defined as visual orientation to the screen; an attention measurement definition known as Eyes on Screen (EOS) that is commonly used in children’s viewing behaviour studies (Thorson, 1994; Fisch and Bernstein, 2001; Calvert, Strong et al., 2005; Mahone, 2005). There are certain ways of measuring EOS in quantitative analyses. One way is to assign a code to the ‘in point’ and ‘out point’ of a participant’s looking habits at the screen (See Sproull, 1973; Zuckerman, Ziegler and Stevenson, 1978; Alwitt, Anderson, Lorch and Levin, 1980; Calvert, Huston et al., 1982; Fisch and Bernstein, 2001). This provides data on both the time of a look, its duration, and frequency, and can be especially useful when investigating within groups trends, such as analysing attention to a commercial. When comparing differences between groups, however, it is useful to divide the content up into time-based intervals, and measure the number of intervals that a participant spends looking at the screen. This provides a more standardised quantifiable factor across groups that allows for statistical comparisons such as comparing means and standard deviations (Fisch and Bernstein, 2001; Palmer and Fisch, 2001). As this study relied on such comprehensive comparison between groups, it implemented an EOS method at a 10-second interval.

Interval testing of this nature can be measured at two levels of detail. A researcher can simply tally the number of intervals the participant spent with their eyes on screen, and
arrive at an average (i.e. the participant watched for 120 of a total of 200 intervals, and was therefore watching 60% of the time). This allows for a comparison of means, which can then be used to determine a statistically significant difference. Alternatively, the researcher can record the intervals as a function of time. This allows a second level of detail as the researcher can also then, if required, compare within group trends and observe how attention behaviour fluctuates throughout the programme. This technique proved useful in studies performed by Palmer and Fisch (2001), as well as Rust (1987) in within-groups tests that compared children’s attention in the presence of a distracter.

The present study measured differences between viewing of a linear and interactive programme in which The Magic Cubby includes interactivity at certain times, and retains a linear storyline at other times. Overall differences in attention between these groups may require information on what parts of the programme are causing these differences. As such, this study measured this second level of detail and included attention data over time.

The final outcome measure, engagement, is a behavioural measure that quantifies verbal responses to the programming. It is defined in this study as behaviour exhibited by the child that indicates cognitive processing of the content (Lorch and Castle, 1997). Engagement (also sometimes referred to as ‘verbal and nonverbal’ or ‘program elicited’ behaviour) is therefore distinguished from attention to the content in that it indicates a physical reaction to what is being watched, rather than just visual orientation to the screen. Measuring engagement is thus a tool for determining differences in behaviour across groups. Insight into why this behaviour is occurring, however, is reliant on
comparisons with comprehension scores in much the same way as the measurement of attention. Engagement is commonly measured in conjunction with attention measures to gain a more comprehensive insight into viewer behaviour (Sproull, 1973), and is used in a similar context in this present study.

In this study, the measured responses of engagement included a combination of verbal and non-verbal behaviours such as laughing, gasping, smiling, frowning, and any other signifiers that indicated a connection to the content (Cole, Richman et al., 2001; Read, MacFarlane and Casey, 2002). Studies have commonly chosen to assign a code to each of these specific behaviours (See Dickinson and Smith, 1994), however it has frequently been the case that the resulting measures have been spread so thinly across these codes as to make significance hard to determine (Sproull, 1973). These same studies have also commonly focused on within-programme factors, such as identifying which parts of a programme are effective. Studies focusing on general behavioural differences across conditions opt for a less complex coding scheme for behavioural codes (See Crawley, Anderson, Santomero, Wilder, Williams, Evans and Bryant, 2002). In these cases, an increase in verbal reaction to a programme is significant, not what particular type of verbal reaction is elicited from the participant. For example, a study by Crawley, Anderson, Wilder, Williams, and Santomero investigated the effects of repetition on children’s comprehension and behaviour (1999). As their study did not focus on programme quality, but whether there was a difference in engagement scores between the different conditions, they chose only two codes; verbal and nonverbal. As the present study is focusing on the effect of introducing interactivity, detailed within-programme
measures of engagement are similarly beyond its scope. What is more relevant is whether there are general differences in engagement behaviour across treatment groups; determining whether the presence of interactivity carries over into a child’s physical behaviour towards the screen. As such, engagement measures in this study were similarly divided into just two codes; verbal and non-verbal.

Non-verbal engagement was defined as smiling, frowning, grinning, dancing, moving to music, or any physical reaction in direct relation to the programme that didn’t involve speech. Verbal engagement was defined as talking to the screen, laughing, crying out, gasping, or any other speech-related behaviour observed as a direct reaction to the programme (Sproull, 1973; Crawley, Anderson et al., 1999; Crawley, Anderson et al., 2002). Both types of engagement were measured separately. Behaviour was measured in ten second intervals. Engagement was considered to have occurred if a participant displayed either verbal or non-verbal behaviour during each interval, with separate codes being assigned for either type of behaviour.

2.2 Group Design

In studies of children’s viewing, researchers can choose from either individual or group data. Individual data collection enables the reduction of data ‘noise’ by testing the child in an environment where they are not distracted or influenced by other participants (Fisch and Bernstein, 2001). With young children, however, studies have sometimes opted for either a double or group collection method. This is commonly done for two reasons. First, group data allows more results to be obtained in a similar amount of time,
and is therefore useful for commercial studies that have a looming deadline. Second, children have been found to be more comfortable in a group setting, as it places them in a more familiar environment with peers that they know and trust (Mauthner, 1997). The group setting also allows the participant someone to communicate with, as opposed to an individual setting where the child might just sit uncomfortably in silence. In measures of engagement this is a concern, as many engagement scores are facilitated by a participant being able to exclaim or comment to a peer (Allen and Feldman, 1973). A study by Anderson, Lorch, Smith, and Bradford (1981) found a strong consistency between individual and group data gathering in young children’s viewing.

The present study opted to use elements of both individual and group testing. It measures comprehension by the administering of individual tests, but the behavioural measures, attention and engagement, are done in a group setting. In this way, children’s behaviour was not affected by their comfort levels, while detailed comprehension measurements were not diluted by questioning children in groups. Children viewed the program in groups of six, consistent with Sesame Workshop studies that employed similar methods in children’s viewing measurement (Palmer and Fisch, 2001). In the interactive conditions, this raised the question of how the group would successfully interact with the programme. The interactive segments were designed so that there were enough interactions in the program for all children in the group to participate at least once. As discussed in the procedure (section 5), interactivity was then based on the child’s preference; children were not forced to interact, but could interact when they
desired to. The remainder of this section outlines the implementation of the Phase 3 experiment.

3 Participants

Participants for this study were recruited from Kindergartens in Perth, Western Australia in a manner similar to Phase 2. A list 80 schools was collected, using a simple random sampling technique, from the education department of Western Australia’s school directory portal (http://www2.eddept.wa.edu.au/schoolprofile/home.do), accessed July, 2004. Letters were sent to principals of the schools inviting them to participate in the study, of which 11 schools consented to participate, providing 34 groups of participants to be assigned to various testing conditions. Consent forms were sent home to parents of children from the kindergartens of these schools (see appendices). Participants comprised 199 children, of which 100 were males and 99 were females. Ages ranged from 4 to 5 years old, with an average of 4.5 years, however due to the diversity of certain classes, data from one 3 year old and two 6 year olds were also recorded.

Ethics approval was obtained under the following conditions:

- Written permission was obtained from parents before the session.
- Children could request to stop participating at any time.
- Parents could request all information that was held on them or their child from the researcher to be produced or withdrawn.
• Footage was kept confidential and children were not identified in the study by name.

• Footage and data was archived for a period of 5 years subsequent to the study.

• A description of the day’s session was to be emailed to parents upon request.

There were no concerns raised by parents or teachers during or following the experiment.

4 Materials

Four DVD’s were used for the implementation of the study:

• The Magic Cubby Training Video (Running Time: 3 minutes)
• The Magic Cubby: Linear Version (Running Time: 24 minutes)
• The Magic Cubby: Interactive Video [Full Video Version] (Running Time: 24 minutes)
• The Magic Cubby: Interactive Stills [Simple Version] (Running Time: 24 minutes)

For details of these videos, refer to Chapter 5 (section 6.1) and Chapter 6 (sections 5 and 6). Other equipment included a digital video recorder, a standard television with stand, a high-quality DVD player with remote, sheets of A4 paper, chairs, sticky labels, coloured pens and pencils. Analysis required the use of a computer, stereo headphones, a stopwatch, a monitoring television, a miniDV deck, Microsoft Excel, and Statistical Package for Social Sciences (SPSS).

Each participant received The Magic Cubby Questionnaire (see appendices). This was printed on a single sided A4 page, and consisted of five questions, with two supporting
diagrams each on a separate A4 page. Due to the age range of the participants, the
questionnaire was read aloud to the participant, and responses were recorded by the
researcher.

4.1 The Research Instrument

Preparation for testing required *The Magic Cubby* to be presented in three different
formats to correspond with three conditions of the study. As discussed in section 2, these
conditions comprise a control group (featuring standard linear programming) and two
experimental conditions; one in which *The Magic Cubby* is presented in full interactive
video format (‘Interactive Video’), and one in which interactivity is presented as still
images, rather than full screen video (‘Interactive Stills’).

While each of these conditions presents *The Magic Cubby* in a different format, it is
essential that the content itself is equivalent across all conditions. The following diagram
illustrates how the three conditions are structured to present the content in 7 sequences
of action (Figure 60).
Sequences 1 and 2 are linearly based segments in which characters are introduced and games are played. Sequence 3 is the first interactive segment involving the story of Jack and the Beanstalk. Sequence 4 comprises a song about the virtue of courage. As this is a non-interactive segment, its presentation is uniform across all conditions. The fifth sequence involves another interactive storytelling segment in which the viewer can choose the context in which the story is told. Sequence 6, the third interactive segment, gives the viewer the choice of either looking at pictures sent in by home viewers (as in the linear group), or watching a repeat of the song from sequence 4. The final sequence is non-interactive, and involves a conclusion of the storyline and a sign off.

For the first two segments of content, programming is identical across the three treatments. It is at segment 3 that the first interactivity occurs, in the telling of the story of Jack and the Beanstalk (see Chapter 6, section 5.1). In the two interactive conditions,
the respondent is able to choose which of two characters (Roger and Baby Crocodile) play the lead in the story. In the linear condition, however, the story commences with Roger playing the character of Jack. No mention is made of there being an option to choose the character. The interactive treatments both give the participant the choice to decide whether Roger or Baby Crocodile play Jack. In the Interactive Video treatment, the story is presented in full video, with the Interactive Stills segment replacing the video stream with still screens of the action. In a technical sense, the Interactive-Stills treatment uses only one stream of video for the PIP, but presents the story of Jack and the Beanstalk as a series of still images, which advance as the story progresses (Figure 61). The still images are sent via the data carousel and processed via the set top box, saving production and bandwidth costs.

![Green Room](image1.png) ![Yellow Room](image2.png)

*Figure 61: Context-tailored learning as represented on the Interactive-Stills treatment*

The fourth segment features a song about the virtue of courage, and is presented in a linear fashion across all of the treatments. The fifth segment gives the choice of context for a story about Sally getting ready for her first day of school (Chapter 6, section 5.2).
The interactivity in this segment allows the participant to change the context of the story between an African and Anglo-European family. The linear segment presents the story in the Anglo-European context, without any mention of interactivity. The Interactive Video treatment presents both choices in full video. The Interactive Stills treatment presents both choices using still screens of action from the video, in the same manner as Figure 61.

The sixth segment shows the presenter Hoda discussing pictures sent in by viewers. The linear version presents this content without interruption or mention of interactivity. The interactive treatments offer the choices to either not press anything, and to continue watching Hoda, or watch a repeat of the ‘courage’ song sung earlier (see Chapter 6, section 5.3). The Interactive Video treatment presents the both streams in full video. The Interactive Stills stream presents only the song choice in still screens, and presents Hoda’s segment in full video. The Interactive Stills condition is able to present this stream in full video as it is not a product of an interaction; but plays out on the linear stream. It should be noted that this final interactive segment is the only one in which differing content is presented to the linear and interactive conditions. If, during the experiment, the interactive group choose to interact, then they will see the repeat of a song, while the linear group will be presented with a segment about artwork. This may have an impact when investigating attention levels between these groups, as attention to different content is incomparable.


5 Procedure

This study was implemented by the researcher with two research assistants. Sessions were conducted in groups of approximately 6 participants; with an upper range of 8, a lower range of 4, and an average group size of 5.9. Due to the nature of accommodating different sizes classes and schedules, group sizes sometimes varied from 5 – 7 participants. Each group was randomly assigned to one of the three conditions; Interactive Video, Interactive Stills, and Control.

Studies were conducted on site in each school’s TV room, annex, or unused classroom. All rooms were brightly lit, located away from external noise, and contained visual distraction surrounding the participants, such as toys, drawings, and posters. The television was set up on a stand at eye level for a seated participant on a chair. Participants were arranged on chairs in two small rows; for instance, a group of six was arranged into two rows of three. It was ensured that all children had a clear view of the screen. The video recorder was set up facing the group. Teachers were not present during the study, and any distracting behaviour by the children was not interfered with by the researchers.

All sessions were preceded by the researcher and assistants spending social time with the participants in order to ensure the group’s comfort and cooperation. At the start of the session all participants were assigned a unique ID number for anonymous coding later. This was worn on a label on their shirtfront.
Each session began with a discussion. The researcher asked the participant group to name their favourite children’s television programmes, and respondents were encouraged to call out their answers. The researcher then provided basic information about the programme that the group was about to watch. All groups were told that this was a new children’s programme, and that it was set inside a cubbyhouse in a tree. For the experimental treatment groups, this also included explaining that the programme is interactive and will allow them to make choices. No comment was made about the video camera or the fact that the session was being recorded or evaluated. Linear groups began watching the linear treatment video with no further preparation. Experimental groups first watched *The Magic Cubby Training Video* (Chapter 5, section 6.1), immediately followed by the research instrument. Along with the training video, respondents in experimental groups were verbally instructed the following:

- This programme lets you make choices at certain points in the story.
- To make a choice, press the buttons on the screen.
- Anybody can make a choice when the characters invite you to do it.
- Everybody in the group will get a chance to press a button and make a choice.

During the program, the researcher sat to one side, out of direct sight of the treatment group. At times of interaction, the researcher controlled the navigation via a remote control without the knowledge of the participants.
At the end of the programme, respondents were given sheets of paper and colouring pens and pencils. The group was instructed to draw their idea of their own Magic Cubby, and were told that one by one they will be called upon to play a game. The research assistants selected respondents one at a time and took them to a separate breakout room, out of earshot of the other participants. The respondent was then taken through the Magic Cubby questionnaire (see appendices). The research assistants asked the questions from the questionnaire and then recorded the answers onto the sheet. The maximum score for the questionnaire was 22.

Certain measures were put in place to assist in validity. First, research assistants were not made aware of the hypothesis of the study, nor were they made aware of the differences between the video treatments used in each group. This minimised bias in the administering of questionnaires. For instance, in testing children in the interactive video group, research assistants would then not pre-empt children’s answers or elaborate on questions in the belief that they had seen the superior programme and were thus more knowledgeable. Second, to assist in validity, researchers frequently swapped over the questionnaires once they had been administered, and tallied up the each other’s answers. In questions such as memory of events, this balanced out biases caused by research assistants who may be generously assigning scores to very rudimentary recollections. In swapping questionnaires, another research assistant would read the answer, and determine whether it counted as a score. Researchers were also instructed to moderate inflections in their voice, to avoid conveying a bias towards particular answers. This was
particularly important in the final question in which children were asked about their enjoyment of the programme. All options, whether happy or bored, were read without conveying a sense that there was a superior or preferred answer, and that all were acceptable.

Once all questionnaires had been administered, participants were thanked for their contribution and the session ended. Within a week following the session, children were sent ‘thank you’ certificates, and parents who had registered their interest in further information were emailed details of the day’s session.

6 Results

This study involved 199 participants. The age range was 4 and 5, though due to the fact that respondents were recruited on a whole-classroom basis, 3 children of other ages were allowed to participate as they were a part of the participating classes. To avoid invalidity associated with the overall academic levels of different schools, children were randomly assigned to one of the three conditions; (1) Linear, (2) Interactive Video, and (3) Interactive Stills, as shown in Table 3.
Table 3: Group Sample Sizes of the Three Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>(1) Linear</th>
<th>(2) Interactive Video</th>
<th>(3) Interactive Stills</th>
<th>Tot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>3</td>
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<td></td>
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<td>15</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Tot</td>
<td>76</td>
<td>63</td>
<td>60</td>
<td>199</td>
</tr>
</tbody>
</table>

Note: Figures denote numbers of participants

6.1 The Hypotheses

The two hypotheses of this thesis concern the comprehension levels derived from exposure to each stimulus. To determine Hypothesis 1 – *that the inclusion of interactivity in children’s programming significantly increases comprehension* – a statistical comparison of the mean comprehension scores between the Interactive Video group and the Linear control group is conducted. To determine Hypothesis 2 – *that comprehension is not significantly reduced with the use of simple iTV programming techniques* – a statistical comparison of the mean comprehension scores between the Interactive Video group and the Interactive Stills group is required.

Comprehension of the elements and concepts presented in the programme was tested with the administering of *The Magic Cubby Questionnaire*. The questionnaire consisted of 5 questions with a maximum attainable score of 22 (see section 2.1.1).
### Table 4: Means Scores and Standard Deviations for Comprehension Scores by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>N</th>
<th>Mean (% 60.5082)</th>
<th>Std Deviation (19.9365)</th>
<th>Std. Error (2.0899)</th>
<th>Lower (56.3563)</th>
<th>Upper (64.6602)</th>
<th>Min (18.75)</th>
<th>Max (106.25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>91</td>
<td>60.5082</td>
<td>19.9365</td>
<td>2.0899</td>
<td>56.3563</td>
<td>64.6602</td>
<td>18.75</td>
<td>106.25</td>
</tr>
<tr>
<td>5</td>
<td>105</td>
<td>68.5714</td>
<td>20.3717</td>
<td>1.9881</td>
<td>64.629</td>
<td>72.5139</td>
<td>31.25</td>
<td>106.25</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>71.845</td>
<td>22.0971</td>
<td>15.625</td>
<td>-126.6594</td>
<td>270.4094</td>
<td>18.75</td>
<td>106.25</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>64.899</td>
<td>20.4875</td>
<td>1.456</td>
<td>32.0277</td>
<td>67.7703</td>
<td>18.75</td>
<td>106.25</td>
</tr>
</tbody>
</table>

Before investigating the mean difference between the three conditions, the following outlines some attributes of the data. Table 4 shows the means and standard deviations of comprehension scores by age. Of the two principle age groups, the 5 year old participants had the highest comprehension with a mean score of 68%. The 4 year old participants demonstrated a lower mean comprehension score, with 60%. It is interesting to note that the two 6 year old participants had the highest mean score, with almost 72%; though their comparisons with the target age group was beyond the scope of the study. An ANOVA was performed, comparing comprehension levels with age, which revealed a strong significance, \( f (2,195) = 4.012, \ p = 0.020 \).

A Tukey’s HSD test revealed that the mean comprehension score of the 5 year old participants was significantly greater than the 4 year old participants (Sig. = 0.015), as shown in Table 5. These results lend validity to the data, as it can be expected that across the three conditions, older children would recall and comprehend more of the programmes events (Huston, Wright, Rice, Kerkman and St. Peters, 1990; Hynd, 2006).
Table 5: Multiple Comparisons (Tukey HSD) test of Comprehension Scores by Age

<table>
<thead>
<tr>
<th>(I) Age</th>
<th>(J) Age</th>
<th>(I-J) Mean Difference</th>
<th>Std Error</th>
<th>Sig.</th>
<th>95% C.I. Lower</th>
<th>95% C.I. Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
<td>-8.0632*</td>
<td>2.8904</td>
<td>0.015*</td>
<td>-14.8375</td>
<td>-1.2889</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>-11.3668</td>
<td>14.4263</td>
<td>0.710</td>
<td>-37.0660</td>
<td>22.4442</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>8.0632*</td>
<td>2.8904</td>
<td>0.015*</td>
<td>1.2889</td>
<td>14.8375</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>-3.3036</td>
<td>14.4056</td>
<td>0.971</td>
<td>-30.4589</td>
<td>37.0660</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>3.3036</td>
<td>14.4056</td>
<td>0.971</td>
<td>-22.4442</td>
<td>45.1777</td>
</tr>
</tbody>
</table>

*. The mean difference is significant at the 0.5 level.

Analysis was performed to ensure that the comprehension scores were not unusually weighted as a result of gender. Previous studies have demonstrated that males and females of this age group should generally display comparable comprehension to children’s programming (Friedlander, Wetstone et al., 1974). As this programme does not contain any programming that would naturally bias it specifically towards one gender, this is another measure of the health of the data. An Independent Samples T-Test revealed no significant difference between males and female comprehension scores, $t(197) = 0.338$, Sig. = 0.736. Therefore, there was no difference in the level of understanding of The Magic Cubby between male and female viewers. With these measures of validity established, we can consider the comprehension levels obtained in the three conditions.
Table 6: Means Scores and Standard Deviation of Comprehension Scores for Each Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>Mean (%)</th>
<th>Std Deviation</th>
<th>Std. Error</th>
<th>95% C.I. for Mean</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>76</td>
<td>57.648</td>
<td>19.7537</td>
<td>2.2659</td>
<td>53.1341</td>
<td>4.7356</td>
<td>18.75</td>
</tr>
<tr>
<td>Interactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video</td>
<td>63</td>
<td>70.9325</td>
<td>19.3831</td>
<td>2.442</td>
<td>66.051</td>
<td>5.2974</td>
<td>31.25</td>
</tr>
<tr>
<td>Interactive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stills</td>
<td>60</td>
<td>67.7083</td>
<td>19.90..</td>
<td>2.5695</td>
<td>62.5668</td>
<td>8.5822</td>
<td>18.75</td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td>64.8869</td>
<td>20.4364</td>
<td>1.4487</td>
<td>62.0301</td>
<td>5.533</td>
<td>18.75</td>
</tr>
</tbody>
</table>

Note: Mean is Comprehension Score in Percentage.

Table 6 presents the means and standard deviations of the comprehension scores by Condition. The average comprehension score obtained from *The Magic Cubby* comprehension test, across all conditions, was 65%. From the above table it is clear that the participants in the Interactive Video group obtained the highest comprehension of the programme, with an average comprehension score of 70.9%. The Interactive Stills group attained a mean comprehension score of 67.7%, with Linear being the lowest group with 57.6%.

An ANOVA comparing mean comprehension scores across the three conditions revealed an extremely strong significant difference in comprehension levels between the three groups; $f(2,196) = 8.728, p = 0.000$. 

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Table 7: Multiple Comparisons (Tukey HSD) test of Comprehension Scores between Conditions

<table>
<thead>
<tr>
<th>(I) Condition</th>
<th>(J) Condition</th>
<th>Mean Difference (I-J)</th>
<th>Std Error</th>
<th>Sig.</th>
<th>95% C.I. Lower</th>
<th>95% C.I. Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>Interactive Video</td>
<td>-13.2845*</td>
<td>3.3536</td>
<td>0.000*</td>
<td>-21.14</td>
<td>-5.42</td>
</tr>
<tr>
<td>Linear</td>
<td>Interactive Still</td>
<td>-10.0603*</td>
<td>3.3391</td>
<td>0.009*</td>
<td>-18.03</td>
<td>-2.09</td>
</tr>
<tr>
<td>Interactive</td>
<td>Linear</td>
<td>13.2845*</td>
<td>3.3536</td>
<td>0.000*</td>
<td>5.42</td>
<td>21.14</td>
</tr>
<tr>
<td>Video</td>
<td>Interactive Still</td>
<td>3.2242</td>
<td>3.5505</td>
<td>0.635</td>
<td>-5.09</td>
<td>11.54</td>
</tr>
<tr>
<td>Interactive</td>
<td>Linear</td>
<td>10.0603*</td>
<td>3.3991</td>
<td>0.009*</td>
<td>2.09</td>
<td>18.02</td>
</tr>
<tr>
<td>Still</td>
<td>Interactive Video</td>
<td>-3.2242</td>
<td>3.5505</td>
<td>0.635</td>
<td>-11.54</td>
<td>5.09</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level

Tukey’s HSD test was conducted in post-hoc analysis to determine the source of this significance. As Table 7 shows, the participants watching either of the interactive versions of the Magic Cubby (Interactive Video and Interactive Stills) demonstrated significantly higher comprehension of the programme than the participants who watched the Linear control version. When compared to the mean comprehension scores of the Linear viewers, the Interactive Stills group had a significance level of 0.009, while the Interactive Video group had a significance level of 0.000. Additionally, despite the fact that the Interactive Stills treatment was constructed using simple iTV programming that presented a slideshow of still images rather than live action, participants did not demonstrate a significantly lower comprehension of the programme than those in the Interactive Video group (Sig. = 0.635), who watched the programme in a rich media format. In addition, scores by age remained consistent between experimental cells, with older children (5 year olds) consistently showing higher average scores than younger children across all conditions.
In terms of the first Hypothesis, this data indicates that the incorporation of interactivity did significantly increase comprehension of content. Though each group was tested on exposure to the same content, those children in the Interactive Video group scored an average of 13.3% higher on comprehension than the Linear control group; an increase in comprehension of 23% (see Figure 62).

However, we have stated in this in terms of the total score obtained across the whole comprehension test. As the test itself contained questions with a range of difficulty, it is necessary to ensure that the better performance of the Interactive Video group was not weighted due to higher scores on only the simple questions. If this were so, this study would demonstrate that the incorporation of interactivity affects only superficial levels
of comprehension. As such, we compare the comprehension scores across the three conditions on the most difficult of the questions; Question 3.

As discussed in section 2.1.1, this question asks the child to recount moments in the story in which Jack was required to use the virtue of courage. Validity is maintained in this rendition of Jack and the Beanstalk through a substantial alteration of the original events in the story (See Chapter 6, section 5.1). As such, prior exposure to the fairytale has no bearing on their performance in this question. This question is an example of the use of Bloom’s Taxonomy, in that it asks the child to recall, understand, and then apply the understanding of a concept. Bloom’s Taxonomy (1956; Hynd, 2006) holds that the ability to apply ones understanding of a concept is a higher-order cognitive process in a hierarchy that begins with ‘recall’ and follows with ‘understanding’ (see discussions in section 2.1.1 and Chapter 1, section 5). As such, by requiring children to understand the meaning of courage through explanations in the narrative, to recall events in the fairytale, and to then apply the concept of courage to these events, this question compares the effect of interactivity on higher order comprehension.

Table 8: Means Scores and Standard Deviation of ‘Question 3’ Scores per Condition

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std Deviation</th>
<th>Std. Error</th>
<th>95% C.I. for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>76</td>
<td>0.7500</td>
<td>0.8813</td>
<td>0.1011</td>
<td>0.5486 - 0.9514</td>
</tr>
<tr>
<td>Interactive Video</td>
<td>63</td>
<td>1.2381</td>
<td>1.01460</td>
<td>0.1444</td>
<td>0.9495 - 1.5267</td>
</tr>
<tr>
<td>Interactive Stills</td>
<td>60</td>
<td>1.1333</td>
<td>1.1118</td>
<td>0.1435</td>
<td>0.8461 - 1.4205</td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td>1.0201</td>
<td>1.0587</td>
<td>7.505E-02</td>
<td>0.8721 - 1.1681</td>
</tr>
</tbody>
</table>

Note: Mean score is of a maximum of 3.0.
Table 8 presents the means and standard deviations of Question 3, which was allocated a maximum of 3 points. As the means show, this question proved challenging to all participants, with participants obtaining an overall average score of 1 out of 3. Being the most in depth question concerning their understanding of the programme, this is consistent with expectations. The highest mean score was Interactive Video, with a mean of 1.2381. Second was Interactive Stills, with the Linear group scoring the lowest, with a mean of 0.75.

A test of Homogeneity of Variances indicated an assumption violation (Sig. = 0.003), and so a non-parametric test was used. A Kruskal-Wallis test revealed that there was indeed a significance difference between the three conditions, $\chi^2(2, N=199) = 6.869, p = 0.032$. When rich-media interactivity was introduced to The Magic Cubby, respondents’ comprehension scores in Question 3 increased by a factor of 65%.

**Table 9: Mann Whitney test comparing 'Question 3' and Condition**

<table>
<thead>
<tr>
<th>Condition / Condition</th>
<th>N</th>
<th>Mean Rank</th>
<th>Mann-Whitney</th>
<th>Wilcoxon</th>
<th>Z</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear / Int. Video</td>
<td>76</td>
<td>62.76 / 78.74</td>
<td>1843.5</td>
<td>4769.5</td>
<td>-2.468</td>
<td>0.014*</td>
</tr>
<tr>
<td>Linear / Int. Stills</td>
<td>76</td>
<td>63.09 / 75.36</td>
<td>1868.5</td>
<td>4794.5</td>
<td>-1.921</td>
<td>0.055*</td>
</tr>
<tr>
<td>Int. Video / Int. Stills</td>
<td>63</td>
<td>63.51 / 60.42</td>
<td>1795</td>
<td>3625</td>
<td>-0.502</td>
<td>0.616</td>
</tr>
</tbody>
</table>

a. Grouping Variable: Condition. * Significant at 0.05
A Mann-Whitney test was used to determine the origin of the significance level (Table 9). The test confirmed that the ability to apply the concept was significantly higher in both Interactive Video and Interactive Stills groups than the Linear group. Also, though the Interactive Video group had the highest mean, it was not significantly higher than the Interactive Stills group. These findings are consistent with the overall comprehension effect; indicating that the increase in comprehension occurred across all levels of rigour.

These two tests provide firm evidence that a strong comprehension effect arose from these conditions. Both the Interactive Video and Interactive Stills conditions produced significantly higher comprehension scores than the linear control; and though the Interactive Video condition had the highest comprehension of all, it was not significantly higher than those exposed to Interactive Stills. As such, we can draw conclusions regarding the two hypotheses.

In terms of the first Hypothesis, we can see that the incorporation of interactivity has significantly increased comprehension of the children’s programme. We reject the null hypothesis and conclude that the incorporation of interactivity does significantly increase comprehension.

In terms of the second Hypothesis, we can see that the use of simple iTV programming methods did not significantly diminish the impact of interactivity in the programme. Therefore, the null hypothesis is retained, and we conclude that the use of simple iTV
programming does not significantly decrease narrative comprehension in children’s interactive television.

6.2 Comprehension and Attention

It is evident that there was a comprehension effect, however comprehension scores do not by themselves isolate and identify the cause of this effect. As such, we turn to additional behaviour outcomes to shed some light on what is being observed. Using an *Eyes on Screen* method of data collection, children’s attention was measured at 10 second intervals (see section 2.1.2). Preliminary analysis was performed to ensure that any behavioural affects was not weighted by age or gender. To test gender effects, an independent samples t-test was performed comparing the attention to the screen between males and females. There was deemed to be no significant effect due to gender, $t(197) = -0.264, p = 0.792$. An ANOVA was performed to determine any attention biases due to age of participants. There was deemed to be no significant difference due to age, $f(3, 195) = 0.348, p = 0.791$. Therefore, the significantly higher attention scores in the linear group were not affected by age or gender. With these controls in place, we can consider the difference in attention between the three conditions.
Table 10: *Means Scores and Standard Deviation of Attention Scores for Three Conditions*

<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>76</td>
<td>95.8469</td>
<td>4.0231</td>
<td>0.4615</td>
<td>94.9276</td>
<td>96.7663</td>
</tr>
<tr>
<td>Interactive Video</td>
<td>63</td>
<td>93.6398</td>
<td>4.1591</td>
<td>0.524</td>
<td>92.5924</td>
<td>94.6873</td>
</tr>
<tr>
<td>Interactive Stills</td>
<td>60</td>
<td>94.1149</td>
<td>5.5601</td>
<td>0.7178</td>
<td>92.6786</td>
<td>95.5513</td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td>94.626</td>
<td>4.6605</td>
<td>0.3304</td>
<td>93.9745</td>
<td>95.2775</td>
</tr>
</tbody>
</table>

*Note:* Mean is percentage of total intervals with eyes on screen.

Table 10 shows statistical detail of the attention means and their standard deviations, in which the mean is represented as a percentage of the total intervals with eyes on screen in the viewing session. As the table shows, children in the Linear group had the highest mean, with children’s eyes being recorded as orientated towards the screen in about 96% of the 10 second intervals. Interactive Stills had the second highest mean (94%), with children in the Interactive Video group demonstrating the lowest attention to the screen (93%). An Analysis of Variance (ANOVA) test revealed that there was a significant difference between these means, $f(2, 196) = 4.536, p = 0.012$. 
Table 11: Multiple Comparisons (Tukey HSD) Test of Attention Scores across Three Conditions

<table>
<thead>
<tr>
<th>(I) Condition</th>
<th>(J) Condition</th>
<th>Mean Difference (I-J)</th>
<th>Std Error</th>
<th>Sig.</th>
<th>95% C.I. Lower</th>
<th>95% C.I. Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>Int. Vid</td>
<td>2.2071*</td>
<td>0.7803</td>
<td>0.013</td>
<td>0.3784</td>
<td>4.0358</td>
</tr>
<tr>
<td>Int. Still</td>
<td>1.732</td>
<td>0.7909</td>
<td>0.073</td>
<td>0.073</td>
<td>-0.1215</td>
<td>3.5855</td>
</tr>
<tr>
<td>Interactive</td>
<td>Linear</td>
<td>-2.2071*</td>
<td>0.7809</td>
<td>0.013</td>
<td>-4.0358</td>
<td>-0.3784</td>
</tr>
<tr>
<td>Video</td>
<td>Int. Still</td>
<td>-0.4751</td>
<td>0.8261</td>
<td>0.833</td>
<td>-2.4112</td>
<td>1.4610</td>
</tr>
<tr>
<td>Interactive</td>
<td>Linear</td>
<td>-1.7320</td>
<td>0.7909</td>
<td>0.073</td>
<td>0.35855</td>
<td>0.1215</td>
</tr>
<tr>
<td>Stills</td>
<td>Int. Vid</td>
<td>0.4751</td>
<td>0.8261</td>
<td>0.833</td>
<td>-1.4610</td>
<td>2.4112</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.5 level. Dependant Variable: Percentage of intervals where participant was attending. C.I = Confidence Interval.

Tukey’s HSD test was conducted to determine the source of the significance. As Table 11 reveals, children in the Linear group displayed a significantly higher attention span than the Interactive Video group (Sig. = 0.013). The Linear group’s attention span was also higher than the Interactive Stills group, though only approaching significance. Therefore, children watching *The Magic Cubby* with no interactive element had their eyes on the screen for a significantly longer duration than children watching the programme with interactive, full video functionality.

A possible contributor to invalidity in this comparison is the element of choice concerning the puppet characters. In the Interactive Video and Interactive Still conditions, the participants were given the choice of watching either Roger or Baby
Crocodile play the part of Jack in Jack and the Beanstalk (see Chapter 6, section 5.1). In the Linear control condition, there is no participant choice, and the viewers must watch Roger playing the part of Jack. Effects could therefore be influenced by participant’s likes or dislikes concerning the two characters. For instance, if the majority of viewers in the linear condition strongly disliked the character of Roger, then not having the choice to substitute him for Baby Crocodile might have affected their attention scores. Analysis was performed to compare the attention scores of both interactive conditions due to their character choice in the first interactive segment. Of the 123 participants in the interactive conditions, data for character choice could not be obtained from 23 due to technical constraints. Of the remaining 100 children, 53 participants watched Roger and 47 watched Baby Crocodile play the part of Jack. A Univariate ANOVA was performed to test their attention scores against character choice (Table 12).

The test revealed that there was no significant effect of either character on the attention directed to the screen. Thus, the choice of character in *Jack and the Beanstalk* did not contribute to the effects seen in the attention results. As such, the significantly higher attention score seen in the Linear condition were not influenced by age, gender, or choice of character viewed.
Table 12: Univariate Analysis of Variance for Character Choice v Condition

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>0.279</td>
<td>3</td>
<td>0.03093</td>
<td>0.003</td>
<td>1.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>869854.508</td>
<td>1</td>
<td>869854.508</td>
<td>32545.937</td>
<td>0.000</td>
</tr>
<tr>
<td>Char_Choice</td>
<td>0.059</td>
<td>1</td>
<td>0.059</td>
<td>0.002</td>
<td>0.963</td>
</tr>
<tr>
<td>Condition</td>
<td>0.224</td>
<td>1</td>
<td>0.224</td>
<td>0.008</td>
<td>0.927</td>
</tr>
<tr>
<td>Char_Choice x Condition</td>
<td>0.005</td>
<td>1</td>
<td>0.005</td>
<td>0.000</td>
<td>0.989</td>
</tr>
<tr>
<td>Error</td>
<td>2565.790</td>
<td>96</td>
<td>26.727</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>879436.861</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>2566.069</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ‘Char_choice’: character choice. Dependant variable: percentage of intervals where participant was attending.

The finding that children who were exposed to the Interactive Video condition exhibited higher comprehension – but lower attention – to the programme is not an entirely unexpected result. The Interactive Video and Interactive Stills conditions are, by their nature, active programmes in which the child participates in the action through physical responses. This naturally involves movement and deliberation; leading to a higher incidence of eyes leaving the screen. Additionally, in section 2.1.2 various studies were mentioned that reported on the relationship between attention and comprehension in children’s viewing (Anderson, Lorch et al., 1981; Pingree, 1986; Lorch and Castle, 1997). Whilst these studies agree that children’s attention to programming is related to their comprehension, studies have shown that young children attend to television programming in quite sophisticated ways; leading to findings that high comprehension is not necessarily causing by high attention to the screen (Calvert, Huston et al., 1982; Pezdek and Hartman, 1983). Indeed, certain studies investigating the role of ‘gazing
away’ in children’s processing of a television programme have suggested that the opposite is often the case (Pingree, 1986; Van Evra, 1998).

Table 13: Distribution Chart Showing Attention Span and Comprehension Scores

Table 13 plots the distribution of participant’s attention scores against their comprehension scores. The results of this study suggest a negative correlation between attention and comprehension. However, as can be seen, participants with consistent attention to the screen have demonstrated both high and low comprehension to the programme in a quite evenly distributed manner. This does not indicate a particularly positive or negative correlation between the two outcome measures. Rather it supports the notion that children attend to programming in their own individual patterns.
Table 14: *Pearson Correlation of Attention and Comprehension Score*

<table>
<thead>
<tr>
<th>Percentage of intervals where participant was attending</th>
<th>Percentage of comprehension correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of intervals</td>
<td>Pearson Correlation 1.000</td>
</tr>
<tr>
<td>where participant was attending</td>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>N</td>
<td>199</td>
</tr>
<tr>
<td>Percentage of comprehension correct</td>
<td>Pearson Correlation 0.120</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.091</td>
</tr>
<tr>
<td>N</td>
<td>199</td>
</tr>
</tbody>
</table>

A Pearson’s Correlation coefficient test was conducted to determine if any statistical correlation existed between these two outcome measures. As Table 14 shows, the participants’ comprehension of the programme was not influenced by their attention to the screen (sig. = 0.091).

As such, this study is consistent with past research in that it demonstrates that children’s attention to the screen is not a measure of comprehension of content. Past research has reported various findings surrounding this dynamic, however the common understanding seems to be that children employ various methods in their understanding of a text, and their attention is a selective process in which attending to and gazing away from a programme can both serve to advance their understanding.

In order to investigate this in more depth, analysis was performed on attention scores at key points in the programme. One segment of particular interest is the narration of the Jack and the Beanstalk fairytale. Respondents in the Interactive Video segment obtained...
a higher comprehension score in the question that related to this segment; Question 3 (see section 6.1). This is a key point of focus, as not only is Question 3 the most rigorous assessment of their comprehension, but it is based entirely on one discrete segment of content.

An Independent Samples T-test was conducted to compare the attention means of the Linear (Mean = 95.755, SD = 2.93) and Interactive Video (Mean = 95.08, SD = 3.83) groups during the Jack and the Beanstalk story segment. The means were derived from mean attention scores at each of the 31 ten-second intervals (N = 31) in which the Jack and the Beanstalk story was told. The test revealed that, despite the fact that Interactive Video had lower overall attention and a significantly higher comprehension score than the Linear group, there was no significant difference in attention of these two groups during this segment of programming, \( t(60) = 0.774, p = 0.442 \). This is in accord with past studies that report on children selectively managing their attention to favour sequences that are either central to the plot, or advance their understanding of the programme (Lorch, Anderson et al., 1979; Anderson, Lorch et al., 1981; Pingree, 1986; Lorch and Castle, 1997; Rogge, 2003). In the present study, respondents have selectively attended to the Jack in the Beanstalk segment at a level comparable to the linear control group; however have allowed their visual orientation to decline at other times.

### 6.2.1 Attention Trends

A consideration of attention scores over time also illustrates this selective behaviour. Figure 63 maps mean attention scores of the Linear control and Interactive Video
conditions. In the below representation, the grey bars are representative of in-point and out-points of interactive segments. It is important to note, therefore, that these only apply to the Interactive Video group; the linear group having no interactive call-to-action at these times. The Linear data, therefore, depicts how participants’ attention responded

![Figure 63: Comparison of Eyes on Screen (EOS) Attention Scores for Interactive Video and Linear Conditions over Programme Duration, Showing Interactive Segments and Content Descriptions](image)

under controlled, non-interactive conditions. Their attention score demonstrates participant attention to the narrative had no choice been presented. Content descriptions are also included, to correlate participants’ behaviour with events onscreen.

Four predominant trends are evident. First, both conditions demonstrate similar attention patterns leading up to the first interactive segment, whereupon the attention patterns
begin to diverge. The Interactive Video condition displays a higher fluctuation of attention span from the control group for the rest of the programme. This is consistent with expectations, as both groups are receiving an identical stimulus up until this point.

Second, the Interactive Video group displays a more extreme fluctuation than the control group; most commonly with extreme drops in attention at certain points, though also frequently with higher rises in attention. The attention drops occur more frequently, and with greater magnitude, towards the end of the programme, the two most extreme drops seen at intervals 106 and 127. The frequency of this viewer behaviour throughout the programme evidently accounts for the lower attention mean of the Interactive Video group.

Third, there is evidence that the dramatic attention drops in the Interactive Video group precede each interactive segment; a decline not mirrored by the Linear group which maintains a more steady attention score, indeed sometimes rising at these points (see intervals 43, 78, 106, 120, 127). The advent of these interactive segments, however, signals a rapid rise in attention. This is consistent with attention behaviour seen in the Phase 2 experiment, in which participant’s attention was also seen to rise rapidly at times of interaction (see Chapter 5, section 8.1).

Finally, some of the extreme drops in the Interactive Video group are preceded by very high attention scores. These highs are seen to occur soon after interactive segment choices, occur for a short time, and then slide into an extreme low. Note the slides from
interval 92 to 106, 113 to 120, and 120 to 127. The slides are disrupted by the occurrence of an interactive segment, which ‘resets’ the attention score before the next decline. From the previous section we have found that despite an overall decrease in attention for the interactive group, their attention during an interactive segment can be equal to the Linear control group (not including the third segment, in which the two groups were watching different content). However, as we can see from this graph, the ‘equal’ attention scores of the interactive group conceal equally disruptive attention behaviour. For example, during the first interactive segment, the interactive group goes from higher attention than control to lower attention at the end; the average of which produces an ‘equal’ effect.

6.3 Comprehension and Engagement

Similar to methods measuring attention, engagement was measured in intervals of 10 seconds. Both verbal and non-verbal engagement behaviour was measured over the three conditions.

Total engagement was measured as a percentage of total intervals with verbal and non-verbal behaviours. As Table 15 shows, the Interactive Stills group had the highest total engagement score, with respondents exhibiting verbal and nonverbal viewing response to the programme 6.65% of the time. The Interactive Video group demonstrated lower engagement behaviour, with 4.26%, and the lowest engagement with the programme was shown by the Linear group (3.6%).
Table 15: Means Scores and Standard Deviation of Total Engagement Scores for Three Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>Mean</th>
<th>Std Deviation</th>
<th>Std. Error</th>
<th>95% C.I. for Mean Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>76</td>
<td>3.6041</td>
<td>4.9516</td>
<td>0.568</td>
<td>2.4726</td>
<td>4.7356</td>
</tr>
<tr>
<td>Interactive Video</td>
<td>63</td>
<td>4.2624</td>
<td>4.1098</td>
<td>0.5178</td>
<td>3.2274</td>
<td>5.2974</td>
</tr>
<tr>
<td>Interactive Stills</td>
<td>60</td>
<td>6.6503</td>
<td>7.4784</td>
<td>0.9655</td>
<td>4.7184</td>
<td>8.5822</td>
</tr>
<tr>
<td>Total</td>
<td>199</td>
<td>4.731</td>
<td>5.7371</td>
<td>0.4067</td>
<td>3.929</td>
<td>5.533</td>
</tr>
</tbody>
</table>

Dependant Variable: Percentage of intervals with Verbal or Nonverbal Engagement

Analysis was performed to ensure that, like measures of attention, engagement was not weighted due to programme bias towards either age or gender. A non-parametric test was required to test gender, as there was a homogeneity of variance assumption violation, Sig. = 0.006. A Kruskal-Wallis test revealed that there was no significant difference in the level of total engagement exhibited towards *The Magic Cubby* by male or female participants, $\chi^2 (1, N=199) = 0.064, p = 0.800$.

Differences in age were compared with a Mann-Whitney test (Table 16). The 3 extraneous participants who were outside the target age of 4 and 5 were not included in this analysis. The test revealed that the 5 year old participants displayed a significantly higher level of total engagement to *The Magic Cubby* than the 4 year olds, with a significance level of 0.009. This is consistent with their higher mean comprehension (see section 6.1). It should be noted, from results reported in section 6.2, that the 5 year old age group did not exhibit a significantly higher level of attention than the 4 year olds.
With these measures outlined, we can now consider the differences in engagement between the three conditions.

### Table 16: Mann-Whitney Test Comparing Engagement and Age

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>N</th>
<th>Mean</th>
<th>Rank</th>
<th>Mann - Whitney U</th>
<th>Wilcoxon W</th>
<th>Z</th>
<th>Asymp. Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>91</td>
<td>87.15</td>
<td>3744.5</td>
<td>7930.5</td>
<td>-2.613</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>105</td>
<td>108.34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>196</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Grouping Variable: Age in years

Parametric analysis could not be performed as a test of homogeneity of variances reported a violation assumption, Sig. = 0.001. Instead, a Kruskal-Wallis test revealed a significant difference in engagement between these three test conditions, $\chi^2 (2, N=199) = 6.12, p = 0.047$.

A Mann-Whitney test revealed the source of significance (Table 17). The participants that watched the Interactive Stills version were found to demonstrate significantly higher total engagement to the programme than the Linear group (Sig. = 0.015), and their comparison to engagement of Interactive Video viewers was approaching significance (Sig. = 0.079).
Table 17: Mann-Whitney Test Comparing Engagement and Condition

<table>
<thead>
<tr>
<th>Condition / Condition</th>
<th>N</th>
<th>Mean Rank</th>
<th>Mann-Whitney U</th>
<th>Wilcoxon W</th>
<th>Z</th>
<th>Asymp. Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear/Int. Video</td>
<td>76</td>
<td>68.50 / 71.81</td>
<td>2280</td>
<td>5206</td>
<td>-0.484</td>
<td>0.629</td>
</tr>
<tr>
<td>Linear/Int. Stills</td>
<td>76</td>
<td>61.21 / 77.73</td>
<td>1726</td>
<td>4652</td>
<td>-2.433</td>
<td>0.015*</td>
</tr>
<tr>
<td>Int. Video/Int. Stills</td>
<td>63</td>
<td>56.51 / 67.77</td>
<td>1544</td>
<td>3560</td>
<td>-1.756</td>
<td>0.079</td>
</tr>
</tbody>
</table>

a. Grouping Variable: Condition. * The mean is significant at the 0.05 level.

The results reveal what appears to be a negative relationship between attention and engagement; in that groups displaying higher attention to the programme displayed lower engagement. Engagement in this study was defined as verbal and nonverbal responses to the programming, and so it might be assumed that less compelling conditions (such as the still-screen imagery used in the Interactive Stills condition) lead to talking and distraction in these groups. In a prominent study on engagement measures such as this, Sproull (1973) distinguished between programme elicited behaviours, such as smiles and frowns, and non-viewing behaviours that encompassed distraction and other indicators of non-attention. In contrast, the present study defined any verbal or nonverbal response as a score, with the assumption that it cannot be determined whether a talking child is causing distraction or commenting on the content. Considering findings on selective attention, any scoring based on the intentions of a talking child can only be arbitrary interpretations.
A comparison with the comprehension scores can shed some light on the findings. The Interactive Video group had the lowest attention scores, relatively high engagement, and scored the highest in comprehension. As the key feature of this condition was a combination of interactivity and rich media delivery, it can be determined that the group’s high engagement was related to their increased comprehension of the programme. It is also safe to assume that the programme’s increased demands on audience participation in this group would bring about a higher level of active responses from respondents. The relationship between interactivity and engagement is also demonstrated in consideration of the other groups. The linear control group, which contained no calls for interactivity also recorded the lowest engagement.

In the Interactive Stills group we see a dual effect. Consistent with the other conditions, the high comprehension of the Interactive Stills group is matched by an increase in engagement. However it is interesting to note that this group recorded higher engagement than the Interactive Video group; who scored the highest in comprehension. As the engagement scores can also record behaviour associated with distraction, it likely that distraction contributed to the strength of the engagement score. However, this did not compromise the comprehension of the viewers to the programming. This is further support for a notion reflected in many similar studies; that children can selectively attend to programming in a sophisticated manner, and divide their attention between tasks without compromising their understanding of the subject matter. In this case, the segments contained still imagery would have lead to increased cases of gazing away, and non-viewing behaviour. We have seen both of these in the results, however we have
also seen that these have not caused a dramatic drop in comprehension. The presence of interactivity, therefore, is powerful enough to offset the effect of a reduction in lower visual impact.

7 Summary of Analysis

This chapter has investigated relationships between the three outcome measures recorded in this study – comprehension, attention, and engagement – of the 199 early childhood participants involved in the three separate treatment conditions; linear programming, interactive full-video programming, and interactive still-screen programming. It has determined that the testing instrument was not weighted by gender or age in terms of the level of attention given to the programme. It has also revealed that 5 year olds displayed higher verbal and nonverbal engagement with the programme, and had better recall and understanding of concepts presented in the programme than 4 year olds.

In terms of the three conditions that were tested in this phase, this chapter has revealed that participants were least visually attentive to interactive programming overall. This was characterised by both erratic visual attention behaviour and quicker declines over a programme segment. Despite their decreased attention to the screen, these same participants demonstrated significantly better recall and understanding of the concepts presented in the programme. The following, and final, chapter discusses these findings and explores their bearing on the both the hypotheses of this study and the children’s television industry.
CHAPTER 8 – Discussion and Implications

1 The Hypotheses

This study field-tested two hypotheses. The first hypothesis involved testing the effect of interactivity in programming on early childhood comprehension. An interactive programme was measured against a non-interactive control to determine its impact on comprehension of content:

Hypothesis 1

\( H_0: \) The provision of interactivity (iTV) in educational television programming does not significantly increase comprehension of content in young children.

\( H_1: \) The provision of interactivity (iTV) in educational television programming significantly increases comprehension of content in young children.

The results revealed that the provision of interactivity in the programme did indeed significantly increase comprehension of content by 23%, at both basic and advanced measures of programme comprehension (Chapter 7, section 6.2). As such, the null hypothesis is rejected in favour of the alternative hypothesis. A key caveat of this
finding was that, in the absence of established and documented principles of children’s interactivity, the stimulus was based upon principles derived from educational literature and industry intelligence. This approach included a complete integration of narrative and interactive construct; a concept applied at the pre-production stage of development. As such, what these findings do not suggest is that any type of interactive television programmes for children could show this effect. Rather, it assumes that there is indeed a set of underlying principles that guide the design of interactive TV for children, and that compliance with these principles can bring about the positive effects seen in this research. Outlining what those principles are, based upon the outcomes in this study, is another role for this chapter.

The second hypothesis involved isolating the contribution that a rich media presentation brought to the comprehension effect; determining whether a highly visual (and therefore more costly) experience was required to generate the comprehension effect observed in the study:

**Hypothesis 2**

\( H_0: \text{The effect of incorporating interactivity (iTV) in children's educational television programming is not significantly decreased when bandwidth is conserved through using simple iTV programming.} \)

\( H_1: \text{The effect of incorporating interactivity (iTV) in children's educational television programming is significantly decreased when bandwidth is conserved through using simple iTV programming.} \)
A key assumption was that the feasibility of commercial interactive TV programming relied heavily on its ability to provide a high impact experience at low cost. This was tested in the fieldwork through the addition of a ‘simple’ iTV version of the stimulus, which executed the same narrative and interactive functionality as the main stimulus. However, through the use of images in place of full video at key interactive junctures, a much simpler and more cost-effective design was attained. The results (Chapter 7, section 6) revealed that those exposed to the ‘simple’ iTV stimulus did not demonstrate significantly lower levels of programme comprehension than those exposed to the full video iTV stimulus. As with Hypothesis 1, a key caveat of this finding is that it was achieved using a comprehensive approach to narrative development based on both academic and industry research. It provides strong evidence that, when executed correctly, interactivity in children’s programming is a powerful contributor to cognitive engagement with the subject matter; and that this effect can still be realised without a significant uplift in cost.

2 Discussion

This study has demonstrated two key outcomes; that the inclusion of interactivity into children’s television programming can significantly increase a child’s comprehension of the programme, and that this effect can be demonstrated without the use of high-cost methods of interactive delivery.
2.1 The Impact of Interactivity

While the comprehension effect is apparent, to understand why it is working we turn to the recorded behaviour effects; attention and engagement. While the results demonstrated that early childhood participants exhibited higher comprehension of events and concepts when they were given interactive choices in the programme, it was also found that they paid significantly lower levels of attention to the screen overall. This result, while unexpected, does not necessarily discount general findings concerning children’s viewing behaviour. Though it is accepted that comprehension of the programme’s messages relies implicitly on a viewer’s intake of the programme (Bandura and Walters, 1963), previous studies have frequently demonstrated that visual attention to the television does not, by itself, denote a child’s comprehension (Friedrich and Stein, 1973; Cullingford, 1984; Van Evra, 1998). Chapter 7, section 2.1.2 provided evidence for this in a discussion of a particularly pertinent study by Lorch, Anderson, and Levin (1979) in which a ‘distracter-test’ demonstrated that children who exhibited reduced attention to the programme as a result of a visual distraction, did not exhibit a corresponding reduction in programming comprehension. Subsequent to this study, learning has been found to be also elicited though listening to the audio (Van Evra, 1998), as well as sophisticated behaviour where children are able to selectively divide their attention between the television and other tasks; determining which parts hold more salience for them and are therefore worth watching (Wright and Huston, 1983). In fact, studies reviewed in Chapter 7 (section 2.1.2) demonstrated that children’s selective attention includes monitoring the audio track for references to these salient features, the occurrence of which can return the viewer to full attention (Wartella and Ettema, 1974;
Anderson and Levin, 1976; Collins, 1979; Lorch, Anderson et al., 1979; Anderson and Lorch, 1983; Pezdek and Hartman, 1983; Pingree, 1986). Most importantly for the present study, more recent research has reported that rather than this audio monitoring being predominantly superficial, children as young as five have been found to continue semantically processing verbal information while still looking away from the television (Rolandelli, Wright, Huston and Eakins, 1991).

While the present study remains consistent with wider research in this regard, related research has only presented evidence of attention studies that have demonstrated a lower or equal amount of comprehension on the part of the distracted child. The present study reports not equal comprehension, but improved comprehension scores, while showing significantly more disrupted attention. Moreover, the disruption in the present study is not the result of attentional distracters, as in previous research, but through the addition of the element of choice. The important element to consider here is that across the three conditions, the testable content was not a variable; it remained consistent. As a result, significant differences in comprehension were observed in an experiment that exposed identical content to each participant. What differed was the level of perceived control that the participant felt that they had over this content.

It is important, therefore, to define what type of control was seen to have an effect. In Hynd’s research into children’s interactive television, four types of interactive control were identified and tested; the ability to directly affect the narrative direction (Narrative

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5 This does not include the third interactive segment (See Chapter 6, section 5.4). However this segment was not tested for comprehension in the study.
Choice), the ability to change an element of the narrative (Customisation), the ability to repeat a segment (Repetition) and the ability to make incidental interactive choices through the course of a narrative (Participation) (Hynd, 2006). Hynd found significant increases in comprehension for Participation and Repetition, and little effect in Narrative Choice and Customisation. Hynd’s overall findings suggested that effectively deploying interactive choice into children’s content required a balance of both interactive segments and non-interactive viewing. In contrast to the highly active nature of PC-based interactivity, this suggests that the medium of television required careful distribution of interactivity to allow narrative advancement of plots, characters, and a general engagement with the programming. It is reasonable to assume that the more effectively a TV programme can develop its characters and events, the more compelling will be the experience of making an interactive choice in the show for the viewer. In achieving this balance, it is necessary to acknowledge that a threshold of interaction must exist. Beyond this, a viewer is called upon to participate excessively, to the point that it serves as a distraction and their engagement with the story is compromised.

Hynd’s findings provide support for this, in that the incorporation of Narrative Choice (in which viewers were called upon to make direct and lasting decisions about the course of events in the show) resulted in an unanticipated drop in attention and no change in comprehension. In contrast, Participation segments (incidental choices) incorporated a form of interactivity in which viewers were called upon to interact in a much less direct manner. Participation segments were ultimately found to produce a significant increase in comprehension. The present study incorporated interactive segments that favoured the
latter; in which the interactive choice supported the narrative, rather than directed it. In support to Hynd’s study, a significant increase in comprehension was recorded (in this case, an increase of 23%).

Customisation, interestingly, did not show an increase in comprehension in Hynd’s study; despite also providing a relatively incidental level of interactivity. This was not so in the present study, in which viewers had the ability to choose between the two puppet characters playing the lead in Jack and Beanstalk (a Customisation task); and demonstrating a significant increase in comprehension as a result. It is, however, impossible to make a direct comparison between the results of these two studies as other variables have undoubtedly contributed. Most fundamentally was the foundation of the stimulus; in Hynd’s study a number of commercial programmes were repurposed to incorporate interactivity; in the present study an entirely new interactive programme was designed. Hynd’s study incorporated a graphically based interactivity that occurred at the borders of the videos; the present study made the interactivity a part of the video and the character’s environment. This cannot help but cause differing reactions from the viewers, and indicates strong support for the principles of interactive design that were developed in this study. Such elements as a rich media presentation, a seamless incorporation of interactive activities and the unfolding story, and an intuitive interactive construct would undoubtedly provide a less distracting and more comprehensible experience for the early childhood audience.
The concept of excessive interactivity compromising the effect of the interaction relates to the dynamics of form and content. Calling upon a viewer to interact draws their attention to the form of the programme, as they contemplate the mechanics of their interaction and their expectation of the outcome. In this, and Hynd’s study, the viewer then returns their attention to the content, and experiences the effect that their decision had on this content. It can be surmised, therefore, that occupying the viewer with the form of the programme can, in cases of excess, compete with their engagement in the content; as suggested by previous studies (Friedlander, Wetstone et al., 1974; Calvert, Huston et al., 1982).

This was perhaps most clearly demonstrated in a study by Calvert, Strong, and Gallagher (2005) in which an online Nickelodeon storybook activity entitled *Blue is My Name* was used to test the effect of control in a computer-based environment. As discussed in Chapter 2 (section 8.1), fifty-three children between the ages of 4 and 5 were tested on their attention and comprehension under two conditions; being in control of the mouse, and having an adult control the mouse. The experimental condition allowed the child total control of the mouse; clicking to turn the page, and rolling over certain assets while an adult read out the text. Children in the control group could only watch while the adult both read and interacted with the programme. Children in the experimental group were found to display higher levels of attention, however showed no increase in understanding of the programme content itself. The conclusion of the study was that control can increase a child’s engagement with the activity, but not their comprehension.
Though Calvert et al.’s study was performed on a different platform to the present study, the design of the interactive storybook, and indeed many online activities, are similar to the majority of 24/7 activities that are currently used in children’s interactive television programming. In fact, the majority of children’s iTV content is largely borrowed and repurposed designs from children’s online applications (see examples of Bob the Builder, Bill and Ben, and The Tweenies in Chapter 2, section 8.3). As such, the elements of control that this study manages and examines are broadly compatible with children’s experience in iTV. The present study, however, uses distinctive methods in its interactive delivery, and has reported different viewing behaviour as a result. Consideration of why this is so provides insight into reasons for the behaviour of children under interactive television conditions.

The children in the experimental group of Calvert’s storybook study had significantly higher attention than the control. The reason for this is that the interactive design that was in place required it. As an online storybook composed of still screens, the programme had two elements that required full attention. First, the story did not advance unless the child either clicked a button or rolled over an icon to animate it. Second, the interactive cues that it provided (‘arrow’ icons that required pressing to advance the page) were visually based. As such, the interacting child had to watch the page to both control and sustain the pace of the story. The non-interactive group, of course, did not require such vigilance, and thus frequent drops in attention were observed (Calvert, Strong et al., 2005).
This meant that the interactive design was composed of interactive segments that were both frequently occurring and visually-based. This required frequent attention to the form of the programme, rather than the content. Freidlander, Wetstone and Scott (1974) have suggested that such a design can serve as a distraction to the central theme of programme (see also Calvert, Huston et al., 1982). This indicates that the effect of this design was that while the child’s interactions prompted higher attention, any surplus cognitive processing was most likely being allocated to scanning and executing the interactive features; provoking an ‘interactive imperative’ where looking for chances to interact are the primary goal. This is one explanation as to why the Blue’s Clues study observed no increase in comprehension.

However, this is not the case in the interactive programme used in the present study. First, interactive choices were periodically spaced; allowing time for participants to simply watch. Second, children’s expectations of interactive segments were carefully managed by verbal cues. This reduced the ‘interactive imperative’ effect seen in the Calvert study, where the participant’s cognitive processes were divided between content and execution. In the present study, viewers were not required to stare at the television anticipating an interactive segment; they could allow themselves time to both think about the story and allow their attention to roam. The most critical distinction of the present design was that, while interactivity was integrated with the narrative, it did not overpower the plot or learning goals.
Though Calvert’s study involved a PC-based stimulus rather than TV, the findings of Calvert, Hynd, and the present study have been consistent in suggesting the importance of balance between interaction and content. This balance gives young viewers the opportunity to reflect and internalise what they have been exposed to. Previous studies have explored this dynamic by investigating children’s ‘gazing away’ behaviours in television viewing (Pingree, 1986; Van Evra, 1998). In a study using 5 year old participants, Laitsch demonstrated that gazing away allowed children to cognitively process difficult questions more effectively (2006). Conversely, research has also determined that children who stare fixedly at a screen could be daydreaming about other things entirely (Lull, 1988). Therefore, children’s selective attention processes work to economise their cognitive demands.

What this indicates in the present study, therefore, is that the fluctuating viewing patterns seen in the attention scores of the interactive group suggest the increased use of selective attention methods. Though the interactive video group had lower attention than the control overall, their attention during the interactive segments was either equal or higher. However, as shown in Chapter 7, section 6.2.1, the interactive group had a much more disruptive viewing pattern; with significantly more pronounced reductions in viewing at certain points in the programme. As these participants came away from the experience with higher comprehension scores, this suggests that the participants were exhibiting selective viewing behaviour relating to what they watched. The inclusion of interactivity generated a greater amount of active processing. Though the interactive
groups paid less attention overall, they were able to extract a greater yield of cognitive processing, leading to a greater understanding of the programming.

Now let us consider the motivating factor behind this effect. As reported in Chapter 7 (section 6.2) interactive groups were observed to display higher initial attention at the beginning of programme segments, however a subsequent rapid decline in attention would subsequently occur; effecting a lower overall attention for many segments.

While previous discussion has suggested that volatile attention fluctuations have been caused by selective attention, these consistent declines indicate an additional behavioural effect of interactivity. As this effect occurs predominantly near the end of programme segments, this points to two possibilities. First, the enjoyment in being able to interact may have given rise to a feeling of frustration in respondents; evoked through an impatient anticipatory sensation at times of no interactivity. This possibility is consistent with the results, as the observed rises in attention at times of interactivity would then signify a sharp reduction in this frustration (see Chapter 7, Figure 7). The other possibility is that these declines are due to participant excitement at the advent of an interactive segment. As these declines occur at the end of a segment, they precede the next interaction. During these times, a character will explain to the viewer than they can now make a choice by pressing one of the interactive buttons. These ‘Calls to Action’ (CTAs) commonly occur in the final 10-15 seconds before an interactive choice must be made; an event in very close proximity to the observed attention drops. The declines in attention, therefore, might be an effect of the participants turning to one another in
excitement. If this is the case, then investigation of the engagement behaviour at these times would show evidence of this. This is because the engagement scores recorded any type of excitement; including smiling, laughter, exclamations, and surprise.

Figure 64: Comparison of Attention and Engagement in the Interactive Video condition, with magnification of particular behaviour during 'Call to Action' (CTA) segments.

Figure 64 outlines a comparison of attention and engagement behaviour for the Interactive Video group. The graph magnifies the five CTA segments in which attention was seen to decline just before an interactive segment, and indicates the state of engagement at these points. As can be seen, there is little consistency in participants engagement behaviour at these points. At segments 1 and 2 there is no engagement reaction from any participant, though attention declines rapidly. This indicates that while
there was high incidence of viewers turning away from the screen, this was not coupled with smiles and exclamations. This is a strong indicator of a negative reaction; which could perhaps amount to frustration, and perhaps confusion. However, in segments 3, 4, and 5, there is evidence of some excitement at these points; showing that when the CTA was announced, there was a prominent increase in incidence of looking away and smiling or exclaiming. This suggests that the CTA might have acted as a priming mechanism; catalysing an increase in interest and a readiness to interact. This lends weight to the theory that the decline in attention was related to excitement. Despite the evidences that these observations present, it is not possible in the results to determine that it was the same participants who looked away that expressed excitement. It could just have easily been other attentive participants. Rather than attempting to make this distinction, though, it is more realistic to presume that both of these sensations were represented by the interactive participants.

As such, this research suggests that the addition of interactivity into children’s television programming can manifest both excitement and frustration; two states of mind which are most certainly not mutually exclusive in a group of selective, active young participants. It is also likely that being able to interact with certain elements of the storyline at certain times excited participants, however having to wait until the next interactive segment often made children restless and fidgety. It could be surmised that this frustration also contributed positively to children’s comprehension, as they may have paid more attention to verbally based content in an effort to listen for CTA’s. Interestingly, Calvert et al.’s online storybook test might have been devoid of this
interactive frustration through the high frequency of its interactivity. Considering the significant comprehension gains made in the present study, perhaps the more conservative spacing of interactivity struck just the right balance between the desire of the participant to interact, and the need for the participant to cognitively process the central themes.

These findings suggest that the addition or exclusion of interactive choice in children’s programming affects viewer expectations. Huston and Wright (1983) define viewer expectations as being a product of ‘motivational judgements’; a continuous and dynamic series of decisions by the participant concerning the appeal of the programme, the appropriateness of its cognitive demands, and the attraction of alternative activities. What this study has suggested is that when a certain type of interactivity is introduced to linear programming, participants’ expectations are raised. As a result, disappointment is felt more strongly, excitement is expressed more readily, and the programme itself is processed more completely. These expectations are even carried over into non-interactive segments; with children’s attention dropping just as readily during these times as others. This also explains the dramatic drop in attention observed in the third interactive segment (see Chapter 7, section 6.2.1). As this segment offered the viewer the option of repeating a previously performed song, the plunging attention at this point reveals exceeded or dashed expectations as to how this segment would play out. As this segment was the only one in which two separate activities were offered, it is surmised that a participant’s apprehension about whether they had made the best choice might have created a more profound effect. Though initially this decline, in which attention
sometimes dropped to 80% of participants, would appear to indicate frustration, segment 5 of Figure 64 (above) also demonstrates that approximately 10% of viewers showed positive engagement at this time. A range of reactions are thereby demonstrated during this segment – perhaps further influenced by lengthy programme duration – though all clearly related to their expectations. Some participants may have looked away in frustration, though at the same time, at least 10% were found to smile, laugh, or exclaim. As children undoubtedly bring their own separate expectations to this experiment (through their own previous experiences with media, programming, characters and stories), this is consistent with the range of behaviours observed in the study. The widely accepted ‘active’ model of children’s viewing is further consolidated by these findings, with children’s scanning of content, selective attention to events, and dramatically greater comprehension of the programme signifying a much more active and engaged participant than the linear equivalent.

2.2 The Impact of Bandwidth

Let us now consider the results of the Interactive Stills treatment; a demonstration of children’s comprehension intake when exposed to programming running a ‘simple’ iTV application. Including this condition in the research was an important step because, as demonstrated in the industry review (Chapter 3), significant rollout of interactive programming for children relies implicitly on it being cost-effective.

As Chapter 7 outlined, the implementation of cost-saving mechanisms in this experiment – such as opting for still-screens instead of video at times of interactivity – did not report
any significant differences to the results obtained by the high production quality used in the ‘Interactive Video’ condition. For the analysis of attention, the Interactive Stills group paid slightly more attention to the programme than the Interactive Video group (though not significantly), and slightly less than the Linear. Most importantly, however, the Interactive Stills group, like the Interactive Video group, demonstrated significantly better comprehension of the programme’s central content than the Linear control group. As such, despite the reduced visual quality of this version of the programme, children were still capable of achieving significantly higher comprehension scores through the inclusion of interactivity.

As the comprehension test focused predominantly on content during interactive segments presented as cycling still screens, this demonstrates the considerable power that the addition of interactivity had on the programming, despite the reduction in visual quality.

Similar conclusions to the discussion in the previous section can be made about these findings; namely that higher comprehension was a result of heightened cognitive activity, anticipation of interactive participation, and increased expectations; all generated through the addition of the element of choice. Though the Interactive Stills group had slightly less compelling scores in attention and comprehension than those obtained by the Interactive Video group, it can be concluded that the addition of these cost-saving measures did not significantly reduce the impact of the programming. The implication of this finding is that not only does interactivity provide a powerful platform
for learning, but these effects are not necessarily beyond the grasp of commercial production budgets.

From the Industry Review in Chapter 3, it is evident that this conclusion holds exciting prospects for children’s television. As an industry sector, children’s TV is often highly cost-sensitive. Advertising restrictions and the reduced buying power of the very young target audience have commonly created markets around the world where children’s TV programming is represented most strongly by Government-funded institutions and a small number of international networks (such as Disney, Turner International, and Viacom). In the case of the latter, they operate in a commercial environment where programmes are often commissioned on their ability to leverage the worth of the programming through spins-offs and merchandising. In such a climate, the worth of educational goals and pioneering efforts in effective communication to the young audience are rapidly reduced in importance. As such, the price-sensitive nature of this industry has currently meant that red button programming for children has been predominantly prohibitive. Even impressive productions like the Disney Kids’ Awards of 2004 were expensive, and largely experimental, one-off affairs that have not seen successors.

With the license-funded players, other factors stand in the way. The prospect of shooting video segments that would only be seen by certain segments of the audience is not only a difficult pill for a creative team to swallow, but can be seen politically as an unjustifiable expense. Additionally, the industry has not yet demonstrated a cost-
efficient approach to interactive TV with an application that allows easy inclusion in a series of episodes. In all respects the prospect of rolling out the high impact, rich media programming type as seen in the Interactive Video condition of this study is a challenging proposition, regardless of its merits.

As such, the results shown by the Interactive Stills condition study are an important contribution to this industry inertia. The use of still screen interactive branching circumvents the creative and financial issues associated with shooting extra interactive footage. In addition, this study has demonstrated an approach to educational children’s interactivity that is not only cost-efficient in the short term, but demonstrates a set of principles of iTV programming design that permit an interactive construct to be carried over from episode to episode. Finally, this approach has demonstrated significant educational metrics without many barriers normally attributed to its execution.

3 Conclusions

At the time of writing this thesis, the state of interactive television is undergoing significant changes, due to high costs in traditional methods of iTV deployment, and the rise in prevalence of broadband. For a UK broadcaster, selling red button advertising comes with annual costs to maintain an iTV infrastructure. Channel 4 and Channel 5 have currently dropped interactive advertising on their broadcasts, (Bearne, 2008) and interactive technology companies such as Ensequence and eMuse have seen a slide in demand for satellite-delivered red button fare. This same period, at a time of rapid
broadband penetration, has seen budgets normally allocated for red button advertising going into more accountable formats such as online pre-roll video advertising. In turn, the increase in broadband usage has stimulated broadcasters into turning their marketing-based websites into dynamic archives of on-demand programming; introducing new areas of online revenue.

On the face of it, this would appear to be the decline of interactive television. To advertising agencies, the current methods of deploying iTV are expensive to maintain, are married to the chosen platform, and struggle to fit neatly into the creative development process that advertising and programming teams are familiar with. In this environment, many would point to the waning number of brand categories that use red button repeatedly, and advocate that television is an absorbing, escapist medium in which interactivity has no place.

However, what we are observing is not the decline of a format, but a technology. The technique of broadcasting interactive data over a satellite transmission is being superseded by a far more powerful idea; the connected television. In this approach, broadband itself becomes the broadcast carrier. Some incarnations feature a broadband enabled set top box, in which broadcast signals arrive through their traditional means (terrestrial, cable, or satellite) and supplementary information is called up through the broadband connection; whether that is on demand content or interactivity. Others send the entire set of content via the broadband connection to the set top box. The broadband connection may also provide a video-on-demand archive (‘TV-VOD’), a catch-up
service of recently aired programming, or a suite of applications that are designed to complement the broadcast. As television platform companies frequently acquire ISP’s to complete a triple-play offering, broadband-enabled set top boxes are an increasing presence. Device manufacturers have also begun a comprehensive foray into this arena, with internet-connected television sets. The broadband connection is plugged directly into the back of the television, allowing the consumer a set of content ‘apps’ to choose from. Regardless of the approach, connected viewing allows the capacity for a much higher quality experience of interactive television viewing.

What this entails for interactive television is an evolution in functionality and depth of experience. Where the current approach of sending interactive content over the air entails ‘burning’ interactivity onto the broadcast stream (Chapter 2, section 7.3) and ‘pan and scan’ methods of video compression (Chapter 2, section 7.4), broadband will reduce the need for such techniques. With broadband, programming is supported by an ‘always on’ data source which is much cheaper to manage, and can optionally cache both video and applications to create a far more profound viewing experience. Established IPTV services such as TalkTalk (UK), TiVo (USA), T Home Entertain (Germany), Telia Sonera (Sweden), Free TV (France) and BT Vision (UK) already have live broadband-enabled set top boxes in the market, however with the main functionality being video on demand, the focus currently remains on functionality around programming, rather than within it.
What this functionality could mean for children’s interactive programming is that new models of interactive programming for children, such as in the style of ‘The Magic Cubby’ could be produced in a far more sophisticated and cost-effective manner. In these models, the broadcast transmission would provide the initial or ‘linear’ stream of video, and the broadband stream would deliver on demand video at interactive segments. Satellite transmission issues associated with using triggers to cue the videos would be resolved by the on demand platform. There would also be the opportunity to host videos and assets for use on multiple platforms, such as online; improving delivery efficiency and potentially saving on hosting costs. As has been shown in this thesis, the prevalence of such programming relies heavily on the commercial viability of the approach, and the ease of technical implementation; both are greatly enhanced by the broadband-enabled set top box. With the current market inertia around development of iTV, IPTV provides the technological impetus to capitalise on the capacity revealed in this study.

### 3.1 Limitations

The findings of this thesis, while exciting for the prospects of children’s iTV programming in general, need to be placed into context. Limitations of the study exist concerning its design and execution. The following three limitations have been identified. First, testing was conducted in a group context. This was done in order to provide more reliable engagement data (discussed in Chapter 7, section 2.2). However, the result of this was that each child was not in control of the interactive choices at all times. While there were enough interactive segments for all to participate, interaction was nevertheless based on who desired to press the button. If a child did not desire to
interact then they did not have too. This may have a tempering effect on some participant’s behavioural data. For instance, in the first interaction where the child chooses a character to play the part of Jack in Jack and the Beanstalk (Chapter 6, section 5.1), only one participant chose the character in each test group. The effect of this was that this segment was watched by 6 group members who may not all have desired the chosen character. Post analysis was performed to determine whether there was a significant effect between attention to the screen and character choice in Chapter 7 (section 6.2), and found no link between these two. While this suggests that there was not a substantial ‘like/dislike’ discrepancy between the characters to provoke a significant effect for non-interacting viewers, the question of ‘control’ still limits this group design. Is it enough that participants only have control of the interactivity some of the time? Had this study been conducted with singular participants, each would have had control at all times; a valid design, as a child may interact in a singular arrangement at home. This thesis has determined that control provides empowerment to the child (Chapter 2, section 8.1), however as has been discussed in the previous section, spacing out the interactive demands on the child may have allowed for more cognitive processing of the programme content. The group design, therefore, may have also contributed to this higher comprehension score, as it also reduced interactive demands on the child. Though this is a possibility, it cannot be conclusively determined by the data of this study. As such, it limits what conclusions can be drawn about the nature of interactive control on the iTV platform. Suggestions for further research, which are included later in this final section, will acknowledge this limitation and provide appropriate recommendations.
Secondly, the modest sample size affected the depth of analyses in a particular respect. A positive interactive effect was found for an ‘early childhood’ population; in this case defined as children of kindergarten age. At this age, the pace of cognitive development suggests that the profoundness of this effect may be different at different ages. For instance, five or six year olds in the sample may respond more positively to the interactive approach than their younger counterparts. This may have been manifested as showing markedly different comprehension or engagement scores. However, due to small sample size, it was not possible to draw these segments out for comparison in a robust fashion. As such, the question of how this approach to immersive interactive narrative affects young children at different ages remains unanswered by this research. It is certainly recommended that future research may address it.

Finally, the nature of this study presents a limitation concerning the universal applicability of the findings. The behaviour that was observed in this study was the result of children’s responses to a particular interactive design. As such, these behaviours may not be cross-compatible with other approaches that possess different designs, budgets or technological capacity. What this study does contribute, however, is one particular tested formula for successful interactive programming. Other possible models can undoubtedly exist. In consideration of the elements used in The Magic Cubby that contributed to its appropriateness, however, certain elements arose that were identified as strong contributors to powerful interactive programming. These four
‘universal principles’ are a critical mainstay for any interactive programming effort; not least for the needs of the early childhood audience.

3.2 Interactive Principles

First, and perhaps most importantly, **interactivity needs to be an integral part of the core design of the programme.** In the Magic Cubby this took the form of interactive doors in the cubbyhouse itself, between which children could move to participate in activities. The interactive design, therefore, used familiar processes (the opening of doors) to execute its activities. As such, interactivity became an intuitive part of the programme, as children could deduce that if clicking the green button takes them into the green room, then clicking the yellow button would accomplish the same result for the yellow room. What is contributed most strongly, however, is an experience where the choices that were offered to the viewer were not disassociated from the core goals of the programme, nor from its creative delivery and execution. Though there are still many cases of ‘bolt-on’ interactivity in the iTV industry, the heightened need for intuitive designs and comprehensible experiences for young children confirms that this age group in particular requires a proper integration of interactivity with learning goals. As has been discussed in Chapter 6 (section 7.5) there exists awareness in the industry of this important tenet of iTV programming. At this stage cost restrictions, rather than any lack of vision, would be the most significant cause of any continued inertia in adopting this principle.
Second, an inevitable part of this integration is the principle of consistency; both of an internal and external nature. Internal consistency is achieved by maintaining a consistency in look and feel, in the effect of particular interactions, and the design of the interactive navigation system. In The Magic Cubby this meant that coloured buttons needed to have the same function at all times. Clicking the green button consistently took a child into the green room. Coloured doors needed to have exactly the same shade of colour as the button they were associated with. It also required vigilance in maintaining consistency of cause and effect; such as ensuring that time passes evenly in all rooms of the cubbyhouse, regardless of where the child may be. For instance, a child switching rooms in the middle of a story should arrive at exactly the same point in the story, even if this requires extra programming effort. External consistency poses considerable challenges for the children’s iTV industry. As has been explored in this thesis (Chapter 2) technology, cost, and standardisation issues all contribute to a fragmented iTV delivery market; creating an uphill battle for external consistency between children’s programmes using a multitude of standards, platforms, and developer tools. Further discussion of these issues and the importance of consistency can be found in Chapter 3 (section 3.5.4) and Chapter 5 (section 1).

Third, for both of the previous principles to occur, interactivity needs to be developed at the pre-production stage. To avoid a ‘bolt-on’ look, an increasingly common practice involves shooting extra scenes to use as interactive assets, rather than settling for generic or text-based designs. While this aids in internal consistency, it does not allow the interactivity to be a core element of the programme, as it is still disassociated
from the narrative. As such, pre-production consideration of how an interactive element might contribute to the learning goals or appeal of a programme is required. In The Magic Cubby, to begin development on interactivity at any time other than the initial stages would have been impossible as interactivity was a core element of both storyline and the design of the programme. As discussed in Chapter 3 (section 3.5.5), BBC restructuring in the UK has allowed developers to increasingly use this approach, and over time technological and production synchrony will provide more capabilities for this principle.

Fourth, iTV development for children must be supplemented by research and usability testing. As interactive research studies in computer-based learning have demonstrated, usability issues in children’s media products can only be unearthed by children themselves (Hanna, Risden et al., 1997; Hanna, Risden et al., 1998). The fieldwork phases of this study have indeed discovered a number of unexpected findings. Discussions with industry practitioners in Phase 1 have revealed that children employ exploratory rather than utilitarian methods in their usage of EPG’s and other navigation devices (Chapter 3, section 3.3.1, 3.3.2). Testing in Phase 2 has revealed a number of interesting issues in interactive design (Chapter 5). Coloured buttons have been found to be a very successful navigational device; however children can be expected to press all buttons, regardless of their function. Additionally, though narrative-based interactivity is appealing to children, their exploratory methods found to rule out having two concurrent streams of unrelated content, as children frequently switch between them and lose continuity (Chapter 5, section 8.2.2). Finally, Phase 3 has identified certain elements of
children’s viewing behaviour (Chapter 7). Comparisons between Phase 3 results and an interactivity study performed by Calvert *et al* (2005) have suggested that interactivity can serve as a distracter just as readily as it can be an object of appeal; confirming the need for it to be both tied closely to the central themes of the programme’s goals, and managed carefully for its duration. Analysis of behaviour trends have revealed that interactivity can both entice and frustrate participants, depending on how their expectations are managed. Expectations themselves have been found to play a critical role in how readily children attend to the central elements of the programme. As such, iterations of testing in the creation of this research instrument have lead to an approach that ultimately capitalised on certain features of children’s viewing, and avoided other previously unforseen pitfalls. Its importance in interactive development, as with all media products for children, cannot be understated.

### 3.3 Suggestions for further research

This study has approached this new area of children’s learning with broad brush strokes. In doing so, intriguing behavioural elements, such as those mentioned above, have opened the door for more specific research in many of these areas. This thesis offers four suggestions for further research.

First, further investigation needs to be conducted to determine how iTV differs from computer-based learning. The infancy of formal interactive television study has meant that the results of this study have had little to draw from in the iTV arena. As such, in
this thesis they have found clarity when compared with related platforms such as linear television and computer-based learning. Comparisons with Calvert et al.’s online storybook study has raised the issue of cognitive distraction in children’s learning (2005). More specifically, in what forms and manners interactive choice can distract from the learning goals of the programme. Results in this study suggest that disproportionate levels of interactive choice in a programme can distract from the learning goals. While this is a likely phenomenon, there exists the question of how this relates to interactivity tied to either central or incidental content. Further research would do well to compare the differences in children’s behaviour, such as their distraction threshold when viewing an interactive segment that was either a central part of, or an incidental addition to, the learning goals.

Second, in terms of the first group design limitation discussed at the beginning of this section, further research needs to take into account the effect of iTV programming in a single child setting. As we have seen, a group design has provided findings concerning a child’s attention levels, engagement behaviour, and comprehension of content when in a group setting. It has concluded that the behaviour is heavily influenced by the presence of interactivity, and comprehension of content is subsequently enhanced. Factors that possibly influenced this data included the fact that each child was required at some point to view the programme while another made the interactive decision. Additionally, the presence of other children may serve to enhance or detract from the experience. Comparisons with a single child study would certainly serve to provide data on both how the more sociable setting of a group design affects data, and also how a child’s
behaviour is affected by being given complete control over the programme without the presence of other participants. Hynd’s study has provided a methodology that utilises single viewing for children (Hynd, 2006), however as this used repurposed programming, it would be beneficial to explore the effect of single viewing on an original ‘interactivity as core concept’ programme.

Third, more longitudinal-style studies could assess the sustainability of iTV effects in young children. A tempering element of the current findings is the impact of the ‘novelty factor’ on children’s interpretations of the iTV programming. As both the interactive design of the interactive programme – and general interactive programming of this kind – are currently not a prominent part of a child’s viewing encounters, this experience was most certainly unique for all participants. The level of impact that this had on the observed effects is not known, though an ‘enchantment’ effect with new technology can influence results (Gell, 1992; Read, MacFarlane et al., 2002) As such, familiarity with this type of programming may, over time, diminish the intensity of the results that were obtained in this study. Research that assesses these effects of more than one episode can hopefully obtain scores unfettered by any novelty effect, and discover the true staying power of iTV programming over time.

Finally, more research is required on the relationship between iTV programming and children’s expectations (as discussed in section 2.1). This study has identified that the addition of choice in a rich-media platform raises children’s expectations. These can be surmised as including heightened expectations concerning the overall appeal of the
programme, the level of control that they will be given, and the impact that their choices will have on events in the programme. New areas of interest include how a child’s previous experiences and preferences influence their expectations when watching iTV, how both fulfilled and unfulfilled expectations influence viewing behaviour and comprehension, and how their expectations change at various points in an interactive experience; such as before, during, and after an interactive segment. For instance, expectation measurement tools such as the Smileyometer, developed by Read, MacFarlane and Casey, could help measure basic expectations (2002). A Likert-based vertical face scale, the power of this tool derives from its use multiple times throughout a programme. Using a tool such as the Smileyometer at critical times such as at the beginning of the show, before and immediately after each interactive segment, and at the end, would allow children’s expectations of enjoyment to be measured alongside their viewing behaviour. In turn, this would allow insight into not only how a child’s expectations change at point of interaction, but how it changes after each consecutive interaction. Qualitative data at these points would provide even more insight. Asking a child at the advent of an interactive segment ‘what is going to happen next?’ would provide valuable data on what children expect from such a technology.

3.4 Summary

These findings provide clear evidence to educators and industry developers alike that interactive television is both a powerful and viable platform for children’s programming. This thesis has explored its potentials in an educational sense, performed usability tests on its designs, and compared its effects to linear television. In doing so it has revealed
that interactive television is a platform found to be well suited to many appropriate learning techniques. It has theorised that the two-way nature of the platform provides a reciprocal dynamic between child and programme that allows a much more powerful customisation of the presented learning goals. At the same time it has demonstrated the inherent usability and appeal of the platform for the early childhood audience. Finally, it has presented evidence that not only does iTV evoke a more active response from the child, not only does it cause greater memorability and comprehension of central learning goals, but it is able to replicate these effects using considerably cut-down production methods and delivery costs. This provides a clear challenge to the children’s industry on two fronts. Firstly, this platform asks as much as it gives. The heightened expectations observed in this study indicate mere interactivity is not enough. Along with a more active interface, developers are going to need to work hard to provide similarly compelling content, fresh ideas, and a powerful integration of all three. Second, a platform is available that provides all of these elements to the childhood audience; a platform that can both deliver and collect more specific and tailored information, and provide an immersive, captivating experience for a young and impressionable viewing group. It is up to each and every one of us to determine the appropriate direction and manner in which this powerful technology is used.
Appendices
Excerpts from Phase 1 industry interviews:

Paul Marcum – Interactive Media Group Head
Sesame Workshop, New York
Interviewed on the 16th June, 2004

Hamish McPharlin: Do you find that parents will be a bit more reassured by the TV being interactive more than the PC?

Paul Marcum: Yeah, I think that at the end of the day parents are very scared of PC’s. There’s a lot of stuff that can go wrong with a PC. Very little goes wrong with TV, even if it’s digital, and I think that’s a reassuring thing for parents of young kids. Obviously there’s a million ways you can do it. The distributor can choose to give access to the internet through the TV, or they can choose not to. Most of them currently don’t have internet access so there’s no fear of coming upon inappropriate content, or being exposed to sexual predators, even though TV has plenty of inappropriate content there already. The preschool market has pretty much been ignored by console manufacturers. There’s not the shelf space, there’s no retail opportunity to sell video games. We’ve tried, everyone’s tried, but you don’t see any competitive releases in the preschool stakes for Playstation 2 or X-Box at this point. So if their older siblings are playing games on TV, and they want to play games on TV, then we think we’ve found a very easy way for them to do it. So we’re looking very seriously at games services, which aren’t in any way tied to the video, and aren’t in any way tied to the broadcast or need the broadcast in any way. So it’s a stand alone service.

H: Would the idea be then to embed it in the Sesame Street program?

P: Probably not.

H: Or have it more as a Walled Garden?

P: Yes, Walled Garden is the likely model. You could see a way that there’s a cross promotion there if the right video distribution offer came in, that we could actually promote the interactive service. But ultimately this is a service which I expect would be sold to consumers on a monthly subscription fee basis.

H: Moving towards the ITV space, how do you see the business model looking in the future? Where do you see it going?

P: Well, everybody’s got to get paid, right? So the distributors going to take a chunk, the content provider’s going to take a chunk, and the developer’s going to get a chunk. It’s basically a matter of how much can you charge, and how much everybody thinks their particular chunk is worth. It’s possible that some distributors would choose to, like contests done with Video on Demand, choose
Appendix A

Excerpts from Phase 1 industry interviews

to not charge for, and rather give it away to their subscribers as a value-added, churning retention vehicle.

I hope they don’t do that, personally. I’m an online veteran; I’ve seen a lot of content lose its value because it’s been given away as a promotional tool. That’s just simply bad business. So I’m not crazy about it, even if they’re licensing it from us and paying a fee. For this content in particular, I just think that it’s a better model to have parents actually paying. A contest from anyone else is going to get us ten cents a sub for every subscriber, and give access to this stuff for every subscriber, then heck, we’d be fools not to take it. Ten cents a sub a month is a great rate. That said, barring that kind of opportunity, a simple subscription model is good, and sponsorship is not something we consider here. It’s just not appropriate for our audience. With older kids, you’d have a better shot at it. In fact with older kids you’d have a fantastic shot at it, but for us it’s not part of the deal.

With the success of BSkyB over in the UK, you’re getting a lot of developers jumping into the space. If you look at other gaming businesses a lot of games have been developed strictly as work-for-hire. Some have been developed as work-for-hire with a development royalty ‘kicker’. I think that this will be probably more along those lines, than it would be along the strictly work-for-hire model. Yeah, so the MSO’s and the satellite companies, they take their cut, and we’ll see how much they’re able to let everybody fight amongst each other to give them their share.

H: You were talking about doing testing and things like that with interactivity. Can you describe any types of tests you do with children?

P: It’s kind of funny. We’ve actually done a few studies, casually, with remote control usage on this thing. People who have kids hear that and they go ‘Oh okay’. And you talk to somebody who actually has a three or four or five year old kid in the house and they look at you like you’re insane, like ‘you didn’t need to test that; I could have told you that. My kid can use a remote control’. That’s something that is quite important for us to do it, and to make sure that the design that we’re using, which is the arrow keys and the ‘okay’ or ‘select’ button actually are usable.

H: What age groups are you using?

P: We’re looking at threes and fours. I hasten to add, though, that it’s not yet a formal study. It’s not something that we would be able to publish at this point. And that’s probably only important to folks like us, and academics as well, of course. What we’ve done, as a group we’ve designed pretty much every interactive platform that has come around. So we know what works and we know, generally, what the best way to design the interface for the input controller is. Hey, we would love that; to develop more input controllers as part of this.
That said, barring the ‘kids custom remote’, which just adds a level of complexity from a marketing standpoint, I think we can accomplish what we need to do using a standard remote. We’re not talking about [sophisticated operations] here; we’re talking about selecting options on a screen.

H: Do you think there’s room for a merchandising opportunity where you’d be able to sell a game pad style remote?

P: Not a game pad. Not for this age group. I think that there are other devices. Yeah, you could see there’s an opportunity for some kind of premium device.

H: You said that children as young as three have proven, well not exactly proven…

P: Yeah, I think that proven is a loaded word. But there is a great anecdotal story where one of the Time Warner Cable people, they had somebody bring in their three year old, before they launched this field trial. And sure enough the kid did start screaming, and it was when they took the remote away from her, and didn’t allow her to tickle Elmo onscreen any more. And that’s when she got upset. That was with a three year old, I think we’ve gone down to two; I can’t recall exactly how they did with that. I’m optimistic, lets put it that way, that when we’ve finished with research that we’ll know that kids as young as two are able to use this thing.

Robert Markham – Executive Producer in New Media
Disney Channel, London
Interviewed on the 5th July, 2004

Robert Markham: I’m a New Media Manager for Disney Channel UK, and we develop websites, Enhanced TV, actually any form of digital technology – emerging technologies – and we get involved in them and develop content, and also project manager on a day to day basis.

Hamish McPharlin: What sort of ITV things do you work in, or are involved in at present?

R: We’ve done five different actual applications to date. We developed the first kid’s enhanced app in 2001, and we won a BAFTA for our second, which we launched in 2002. So what we do is we do the 24/7 applications, or we do program synchronous apps, those that then play out directly with UK-produced shows that we have full editorial control over.

H: Have you had to decide whether you need to do a show from scratch, or build ITV into an existing show? Has that ever been an issue?
R: Yeah, our first app that we did – which was a Studio Disney app – we built around an existing programming block. Our second app, called Star Ticket Active, got in at the point where they were developing the show. So we basically went in there and said ‘we could do the ordering’. It was effectively a Pop Idol for kids, so an Australian Idol for kids. We got in at that point and said ‘look we can do the whole mechanics for you. So you don’t have to worry how people submit the votes, we’ll do all of that for you. All we need is X, Y, and Z.’ And then we worked with them to find actually how that voting element would appear. We did three additional video feeds that were available 24 hours a day. On that we did a competition, we did news, we did live messaging. So all of those bits come together in a twelve week production run, which was amazing, and I’ll show you on a CDROM later on. An amazing show, which I don’t think has been beat since, either by us or by other people. We got to the point where we were thinking ‘that’s as good as it gets’.

H: What made it the best? Is it just the sheer scale that you had running?

R: Cause and effect. You ask kids to vote, they vote, it causes something. That’s the thing. We’re not doing anything just for the hell of it, to try and actually get some additional revenue; it was really about kid empowerment. We had this ethos that basically the whole development of the band was on the basis of what kids wanted. I’ll give you the background. Five thousand kids were auditioned up and down the UK. Basically it then went down to fifty, and then that fifty was picked directly from kids’ votes across five different mediums (sic); ETV, web, telephony, mobile, and I think banner advertising or something like that. Then the kids were whittled down to five that made up a band, and they performed in front of twelve thousand kids at an awards show that we hosted as well. So they had the time of their life. They had choreography, they had vocal training, they had styling. Kids came up with the brand, the name and the look of the band.

H: The age was the same as the kids that were voting?

R: Yeah.

H: What was that age group?

R: The core age group is eight to eleven, but I think we went slightly older for that; it was eight to thirteen. It was still quite key for all of them. Slightly aspiration for the eight years olds and for the younger ones. We had two kids up against each other in an afternoon. They were both quite talented, and we were publishing the results back in real time to the Enhanced TV and also to the web. We always had, effectively, an ‘embarrassment factor’. So no kid got less than 20 percent.
H: That’s an interesting thing to come to terms with as well. How did you come across that? Was it something that came about through research or through discussions?

R: Through discussions. Through working with the production teams we had to do stuff like that, because these were kids we were just bringing in off the street. These weren’t stage school kids who knew how to take rejection. These kids could be mortified and wounded for life. Disney hire chaperones that then work with kids all day. Advisors. Basically the kids are never left on their own with anybody that doesn’t really, truly understand kids. You have to be careful. Albeit that we have producers and researchers that work with kids daily. [There was always] one head, in a team of people who were brought in, whose sole purpose was to look after the kids through the whole process of them coming through. So it was great, like an experience as well, with the regional heats. That person stuck with them as they came to the studio, did rehearsals, went on the shoots for the video, went backstage, and did all those things. So that was quite good. Those people advised us as well. So we had this level set that no kid could get less than 20 percent, and as we started to vote on the Friday one of the kids, Eamon, was right on that limit, and stayed on that limit for hours. So we were contemplating whether or not to increase it, to say 30 percent. But gradually over that day, kids had the opportunity to watch Eamon perform through the enhanced app. They could actually watch his performance and make a judgement on him on the basis of that. What we found was percentage by percentage he crept up, because people not only thought he was good, but they felt slightly sorry for him, but they felt that they had control and they could see it go up.

H: So that’s something interesting that came about.

R: Yeah, and in the end he won! He got 51 percent. Within the last couple of minutes it was fifty-fifty, right up until the last moment, and then with 51 he won.

H: This must have been one of those shows that you find yourself standing around and cracking open champagne at various points of the show.

R: Very much so. That day was an amazing day. We got sixteen thousand votes in a day, which for us was unbelievable. But you have a good story, and that’s what happens. So no wonder it did so well.

H: So did you walk away with a lot of things you’d learnt from the show that you’re going to do next time?

R: Yes, a huge amount.

H: What sort of things? One obviously is the ‘embarrassment factor’ and things like that.
R: Yeah, all of that stuff. I would say that the next apps that we plan will be more about the events rather than the kids. The kids’ experience of the events that we do, shall we say. The truly original thing about Star Ticket was that the kids were the stars, and I don’t see in the actual productions that we’re going to be doing in the next year or so that we have a similar setup whereby you’re going out and finding somebody or you’re doing it that way. They’re more productions for kids. But, yeah, loads of stuff like that. Certainly messaging, we’ve put that into our new application now. The messaging sits on the front page. It creates more of a discussion and dialogue. The thing we found is that kids and parents don’t think that seeing a written message through Enhanced TV is any different from a presenter reading it out on air. During our preschool hours in the morning we find that the mums send through the messages to wish their children a happy birthday or to actually send a message through that the kids can see, albeit that they’re telling the kids ‘That’s your name, you’re up on TV. How amazing that is.’

H: Where do you see interactive television going in the future? Do you see it getting stronger and stronger? Does it justify itself at this stage?

R: It’s a very expensive thing to do. You have to have very, very deep pockets to do Enhanced TV. I think certainly in the UK I would only say there are a handful of people who could do it. They are the big terrestrial players, and then there are also people like Sky who run the platform, and then ourselves maybe after that.

H: Is it worth it?

R: Yeah, definitely, because it engages kids first and foremost. Secondly, where it’s going. It’s pointless actually saying ‘y’know what? We’re not going to invest in this now’, because we won’t have the learnings for when it is mass market. If you educate the kids now, to say ‘this is what Enhanced is’, they understand it, they feel confident with it. They’re going to be your next generation of teenagers and adults to actually fully embrace Enhanced TV. It’s one of those things, certainly for Disney, that we just can’t sit back and watch other people develop it. Disney has always had that air of innovation about it. And obviously within our close relationship with Sky in the UK, we can take advantage of the fact that eighty percent of our audience can see the stuff, and that the platforms can handle it, and we’re a premium service and therefore people pay for stuff like this. So I’d say it was key, for the future it’s got to get cheaper. It’s got to get cheaper and easier to produce.

H: What part of it has to get cheaper?

R: Well, there’s no one set standard. For the web you have HTML, you have Flash, you have protocol. At the moment you don’t have protocol which is available to all. The risk that you also hold in publishing to a satellite comes with its costs.
You have to take out indemnity against blowing up the satellite, or if you're working with an agency, they do for what they develop. Which can cost anywhere up to 100,000 pounds per enhanced application that you produce. Which is huge.

H: How about costs association with content creation? Is that a bit less of a factor?

R: Yeah, still pretty low. You're probably talking south of GBP 100,000 for an Enhanced app to be built, but then you've got to have content management systems behind it if you’re going to actually update it. You got to pay for bandwidth costs, which are probably the lion’s share of the costs. If you’re having it available all the time, you’re talking about a couple of hundred thousand per annum on bandwidth costs. So you’ve got to make sure whatever you put up there is actually worthwhile.

David Chudleigh – New Media Senior Coordinator
Disney Channel, London
Interviewed on the 5th July, 2004

David Chudleigh: In the UK market there are 19 kids channels in which you have dedicated channels just for pre-schoolers including ‘Nick Junior’, ‘Playhouse Disney’, ‘CBeebies’. It’s highly competitive, every one of them has some degree of Enhanced TV service already, and really the programs on them like Blues Clues and the interactive programming is because kids are there and they want to join in. If you are going to do anything with kids which is going to be interactive you’ve got to make it big, make it clear and make the navigational system very simple. For example the colour buttons, and things like that.

You have also got to look at how they use it. They sit there with their Mum and Dad. When we did some research, they use the TV passively; because they are going to put the kid in front, then they put it on the channel and put the remote - which costs 20 pounds - up on the mantelpiece. Now, the reason they are going to do that is because the kid is going to chew it, and has a high chance of breaking it. Lots of people go out there and make these kid remotes. But the parents wants to have a lot of control; either from a ‘buying a remote’ perspective, or for the educational purposes of the kid, to make sure that they don’t wander on to some of the other channels that are on there, in the EPG. The preschool kids can’t read the EPG; they can’t really read it until seven. They could probably just use the up and down buttons.

Hamish McPharlin: The usability issues are very much what I am interested in.

D: They can use the up and down buttons but there is research to say that they can’t actually read the EPG, as it stands, until about seven. Until that point their brain is still literally growing; the biological part of it. The brain is actually growing,
until about seven where it gets to a size where it’s just a matter of putting
information on it.

H: So you need to make stuff that is simple but also quite intuitive, so that they can
figure it out. If they’re not sure what is going on, they can at least figure it out.

D: The problem with it is that a lot of the time the enhanced TV material isn’t there
and has to be created again. Especially if you’ve got an interactive show like
‘Blues Clues’ which is doing really well in the ratings, it is really hard to then to
do some thing more interactive with it. You have already started with an
interactive format; you are not trying to make a show interactive, it’s already
there as a linear TV. The only way to really make money out of enhanced TV
service is to use the return path, to use the back channel in some way. It is
probably ethically wrong to actually make a kid pay the 25p because they have
not got that decision making process, they don’t know what 25p is.

H: The web is such an easy medium to provide interactive intuitive content on, to
develop on, and to even just have available for children. What is the justification
for taking it to ITV level for pre-school children?

D: From a broadcasting perspective you would expect the kids to use the web if
there was nothing else on TV, and one of the main reasons to we’re doing
Enhanced TV is that they’re not entirely satisfied with what is on the TV channel
and they want to just ‘dip out’ for a few minutes. So they’ve got the remote in
their hand; they can either change channel or they can go to your enhanced TV
service. So you can still keep them in the world of the channel. The alternative
being they click to a rival channel and that’s one of the justifications for having
Enhanced TV.

H: Keeping the ratings up?

D: Yeah. Keeping the ratings up, keeping them in the channel, and perhaps keeping
them more interested in the program. Ideally you’d want to know - if they are a
fan of Bob the Builder, and if you’ve got some Enhanced Bob the Builder
content – then when Bob the Builder finishes you can keep them on the channel,
or you can use it to promote the next Bob the Builder episode.

It is very hard to do that age bracket. We wanted to do a ‘bouncing ball’ karaoke
sing along. It was a lot easier, and so much cheaper, to do it on the web. And we
did. We know that kids like singing along and they like the interactive programs,
which are our big winners. It is so much cheaper and easier to do it on the web
site that we may as well because at the end of the day we are not going to make
any charge for this and they won’t be able to read; they’re gonna need the carer
or the parent to sing along with them. But it is something that they like to do and
it is a successful piece of content. More often that not it adds up to do something
on the web, just from a cost perspective.
H: Then, I suppose they can benefit from the immediacy of television?

D: Yes, they are already sitting there in the environment on the settee. But it’s the case of who is going to press the red button. Will it be the little fella? Or is it going to be the parent or the carer?

Rebecca Shallcross – Interactive Executive (CBBC)
BBC, London
*Interviewed on the 6th July, 2004*

Hamish McPharlin: With your research, do you find it’s a challenge to keep it really simple for kids?

Rebecca Shallcross: What’s interesting is that because we produce content for the web, and because we’re doing some new stuff like headlines on mobile now, and working with Interactive Television, obviously the formats and the capabilities are very different. It’s always interesting going into a brainstorming, for example thinking about a game for our 24/7 Interactive TV service on CBeebies; thinking about the capabilities of the template that we currently have, and working with those constraints that currently exist. We try not to limit ourselves in terms of the platform. We try and think ‘if we could do this’, and then look at how we could make that work on what we have.

So I suppose it’s trying not to think about the limitations, rather than stomping off from that point, and then working out how you would achieve that, and by which platform. Fortunately, now we’re one department that works across all platforms. We’re not separated out to people who work on mobiles, people who work on Interactive TV, and people who work on the web. We all work together, and we look at the priorities and the programs that are coming up, and the kind of service that we want to provide as a public service broadcaster; marrying all those things together. If we’ve got a new program starting, how are we going to support that in terms of interactivity? Do we create a website? Do we create a 24/7 Interactive TV game? Do we create a scheduled enhanced television program? Do we create a mobile offering? Do we create a whole website? Do we create just an application or interactive feature within another website? We have that flexibility in terms of how to best serve that brand and that program and best serve our audience in terms of how they would want to interact, or participate, or get involved, or feel a part of that program.

H: Having said that, what would make you choose ITV?

R: Obviously live programs, which require something that the child can participate in at that point in time. So you’re actually giving a call to action within a live show. So things like doing the Blue Peter version of Test the Nation – what we’re calling ‘The Brain of Blue Peter’ – that whole concept is based around
Appendix A  Excerpts from Phase 1 industry interviews

children being able to have that immediate access to answer questions and participate throughout that program. So Interactive TV is the obvious choice. Although we will offer them being able to participate via the web, because that can be done at a set time. So that whole concept doesn’t work unless you use Interactive Television. We’re doing a service for our Saturday morning show – which is Dick and Dom in the Bungalow – which is a live magazine program. But the service will be available both on Saturday morning and Sunday morning when the program is on air. It’s not actually going to be strictly tied to the program, although at one point in the program they’re going to actually give a call to action that the kids can participate in, and it will then follow on. There’s going to be a competition element that will then go on to the following week. That we’re doing because it’s a big priority brand for us. It’s a Saturday/Sunday morning program, that’s big for any channel, plus [it has] two of our most popular presenters. It’s real slapstick. Fun, lots of gunge, bogeys, and all those kinds of things. So in terms of fiction and narrative Dick and Dom are real comedic presenters; they play off each other, bounce off each other. They have lots of little inserts in the program where they’re out and about and up to mischief, and that sort of stuff. So that kind of humour element, and the narrative that can go with it, can work really well with an interactive TV application which just strengthens children’s loyalty and ownership of the brand. So a lot of factors have led up us to think of doing an application for Dick and Dom. We have a format that already exists, called ‘Stream Switcher’, which enables children to have control. So it’s like a story, it makes choices within the narrative. Considering the format of the Dick and Dom program, and the capability and the comedic material that is available there, that we can use for that, it’s perfect for that format as well as it being a really high priority for the channel, and for children generally. So a lot of different factors – the format, whether it works, whether the presenters and the program team buy into it, because they think it will add value to their show – all kind of play a part.

H: Do you believe that interactive TV has the ability to educate children fundamentally?

R: I think without a doubt. The services that we offer, particularly on 24/7 – with the games and stories – all those have early learning goals underlying. We treat those in the same way as we treat anything we produce online, anything we produce on television, in terms of what we’re trying to achieve with those programs. All our preschool programs have those objectives. Obviously we’re an entertainment service, but we’re about learning through play; that’s one of the lines of CBBC. So it’s all the time, and for CBBC it’s about finding out things for fun. So it’s about developing your skills, developing your knowledge base, and all those have had a great deal of thought put behind them in terms of what they deliver. We’re always going to be working within the constraints of the platform, whether that be the web, Interactive Television, or mobile. But we’re always thinking in those terms; we want to offer education and entertainment for children in the best possible way. We’re always thinking ‘what will they gain
from it’, ‘what will they learn from it’, ‘how will they develop from using this?’ Whether that’s their motor skills or whether it’s something about the way their memory works. Whether it’s their recognition – whether it’s colour recognition, shape recognition – numeracy, literacy, letters, numbers, and using the brands which they love to get them interested in doing those things, and learning without even realising it. So that’s what it’s about.

H: The common conception of standard linear TV is that the child is sometimes a passive viewer of it; they’ll just sit there and watch. There are various ways of changing that; getting kids to stand up and make things…

R: A show we’ve got coming up called Boogie-Beebies, which is a dance and movement show, is all about getting kids up in front of the TV and moving. A lot of companies like Ragdoll, who make Teletubbies, and who make BoohBah – which is on ITV – all those programs have been years in development to get children [involved]. A child naturally shouts out at the television. They don’t understand that this isn’t real. My sister has found my nephew talking to the presenters. Because he thinks they’re in there. That, to them, is real. If a presenter asks them something they will shout out, because they think they can hear them. They’re not at the stage where they understand that.

H: They are inherently an active viewer.

R: Yeah, they are. Very rarely is a child completely passive. So I think that you’re missing a trick if you don’t tap into that, because they have a willingness; they’re always wanting to learn, they’re always wanting to try new things, they’re always wanting to develop and take part. They are at that stage where they are just absorbing, absorbing, absorbing. So it seems crazy not to tap into that. This program here, The Shiny Show, the whole thing is about talking to the audience the whole time, and looking for Shinys. The puppets collect the Shinys as they go through the show, but they ask the audience to help them. So even though we don’t actually have an interactive application for it, where they can press the interactive button to take part, they would be doing that anyway. So the 24/7 service that we’ve got where there’s stories, games and applications that you can participate in, we always have a slide at the end that says ‘well done, you did this’ or ‘you got this’, to actually give them recognition back that they’ve achieved something, that they then go on to achieve something else. So it’s all about reward and what they get back from that experience.

Stephanie Gauld – Interactive Editor (CBeebies)
BBC, London
Interviewed on 6th July, 2004

Stephanie Gauld: I’m the CBeebies Interactive Editor, which means that I’m responsible for all editorial content for interactive platforms. So on online and Interactive TV, I have to sign it off.
Hamish McPharlin: Are you involved a lot with testing with kids?

S: My team tests an awful lot. I think that testing with children is something that you just have to do cumulatively. Children just vary so much that you just have build up lots and lots of knowledge; everyone in the team goes out and does testing every two weeks. We haven’t done Interactive TV testing as frequently because there isn’t enough output; because of limitations in the technology and it just being so complex at the moment, and the whole sort of testing process being so long. There are so many restrictions around Interactive TV that we do less of it, but we’re planning to do more of it.

H: What do you anticipate will be the results out of ITV? Do you think that it has the ability to educate children much?

S: Well, my age group is eighteen months to six year olds; that’s what we classify as preschool. As you probably know, that’s an age group where children are learning hugely. And I tried to explain to some people at the education department a while ago that really within that age group you can’t separate education and play, because everything they’re doing is a learning experience. If you don’t make it fun then they’ll just lose interest really, really quickly. So education and play really go together. Really, our role in CBeebies across any platform - whether it’s linear TV, Interactive TV, online – is to help children learn and develop and explore in the most fun, positive way possible.

H: I suppose linear TV has its pro’s and con’s. It does have restrictions, such as if a child wants to see something again they might as well have videos so that they can rewind it. And ITV, if you engineered it in a certain way, you could give them the option to see someone again. There’s lots of testing to say that children love to see things they’re familiar with.

S: I think you’re right. You have that very practical level that they can actually see something again. So if you had an Interactive TV loop, or a video loop, or a karaoke loop, then they could watch that again and again and they would love that, because they do love repetition. But I think with certain programs, you can have very didactic programs that are very good and very helpful, but very didactic. So throughout one program you might learn the word ‘Por Favor’, for example, and it will go round a whole story which really helps children to learn one word, and it’s very, very didactic. Whereas you might have some programs which are all about imaginative play; maybe they’re doing finger puppets, and it’s all about interaction with finger puppets. So children can then go off afterwards and they can then play, so really the program doesn’t stop with the linear program. The program really carries on afterwards, and it’s very interactive. I think the great thing about preschoolers is that they’ve got such a huge imagination; such a capacity for imaginative play. That’s how they learn many things. That’s how they make sense of emotions is through role playing.
and imaginative play. So I think there are some programs that really tap into that and they really stimulate that, and allow children to go off afterwards and continue the program.

H: I suppose you could say, therefore, that Interactive TV has always been around.

S: I think it has. With this age group you only have to watch a four year old watching The Tweenies, for example, and it’s interactive. They’re dancing and they’re singing and the child might be moving in front of the TV, and it’s only really if the preschool child is quite tired that they actually use TV in that ‘sit back and entertain me’ kind of way. With a preschooler it really is more of an interactive activity.

... I think that the Interactive TV platforms are so restricted at the moment. They are just so, so limited. In terms of audio, in terms of animation, and in terms of just the capacity of what they can hold. If it is another broadcast stream, an ETV loop like the ‘Sing a Song’ that Rebecca [Shallcross] showed to you, that’s just completely broadcast, then that’s fine, because that’s got everything. But if it is one of the Interactive TV games that we do alongside the program then we are just restricted. I don’t understand the technology of it, but we’re restricted.

H: So the games are too simple?

S: I think that’s it. I think it goes back to our initial user-testing. It’s fun a couple of times, and then you maybe you wander off, and then maybe you want to play it one or two more times. Maybe a week later you want to play it again a couple more times, but it’s not really like a web experience where the average time per user on CBeebies is seventeen minutes. And I wouldn’t want it to be much longer than that, I think seventeen minutes is quite a healthy amount of time for a child to sit and play a game. But it’s not as immersive as that. I think parents will only really want to go there for gaming when it becomes a lot richer. Whereas the text prompts for parents specifically, we can do now, technically.

H: To overcome these restrictions, what needs to happen?

S: We need more bandwidth.

H: More bandwidth. I’ve been listening to people saying that the price of bandwidth is not coming down, and the satellites are running out of room.

S: I don’t understand that side of it; I just say ‘more bandwidth!’

H: Let’s say there was more bandwidth, what would you do? What changes would you make?
**Appendix A**

Excerpts from Phase 1 industry interviews

**S:** If there was more bandwidth what could we do? Our most popular games online are karaoke. So I think things like that would be great, and they love seeing their favourite characters, they love seeing them animated. As you know the age group is forming their own identities, they’re really finding out who they are. Which is why they have these characters they aspire to, and they learn from, and they really attach to the characters they watch on the program. It’s really quite sweet. When we show them images of characters they will point to their favourite character. Like in The Tweenies, they will have a favourite character, and they’ll know that character, and that character is their friend; their slightly older friend who they kind of look up to. So I think we’d need to bring the characters to life more, the way they are on the web, and the way they are on the linear programs. So that’s really what we need to do, and do that through animations, and do that through songs. Doing something like karaoke is perfect; seeing the Tweenies singing their favourite karaoke song, and being able to dance along and sing with them, is something perfect for the preschool age group.

**Diane Smallshaw – Interactive Producer (CBBC)**

**BBC, London**

*Interviewed on the 7th July, 2004*

Hamish McPharlin: Maybe we’ll just start by telling me what your duties are here.

Diane Smallshaw: I am the new Interactive Producer for CBBC, which includes CBBC and CBeebies. We’re literally just forming an embryonic Interactive TV team in Children’s [Television] at the moment, because before all that we’ve really only just tested the water on a few things; different people have done them, so we’re just actually beginning to form a team where people can come through with questions and deliver projects. So my responsibility is to work with the relevant people - well mostly the TV production departments and all the other areas of business that deliver Interactive TV – to come up with proposals to submit to our Interactive TV commissioning round, hopefully get some of those commissions, and then work with the production team to deliver them.

**H:** Do you have criteria for these proposals, what are you looking for?

D: At the moment we have really very limited resources so we’re not looking at that many projects. So rather than saying ‘I really want to just focus on this side or the other’, we’re really just looking at programs where there’s a natural match for interactivity. So rather than forcing something upon the program that just doesn’t suit, we’re really looking for those few where it forms a perfect match. For example in January we’re going to do an interactive ‘The Brain of Blue Peter’, which is very similar to the ‘Test the Nation’ project - we’ve had many of those now and they’ve all been really successful - but just to have a quiz for kids that you can play along at home. Which is brilliant, because we’ve got a fantastic one like ‘Blue Peter’; a real flagship program, we know that the interactive service works really, really well, so it’s a really nice starting project for us.
Appendix A

Excerpts from Phase 1 industry interviews

D: I do think we’ve learned so many lessons over the past three years. In the early days it was all about doing more and having very complex applications, having lots of choices; you want to have some text over here and some video there with some pictures, and all those sorts of things. I think slowly we’re paring it down to some of those key crucial areas that people really, really want; the reasons why they’re really going for the application. And I think when costs are so high that is actually really important to work out; what they really want and why they’re going there.

H: What do you think are some of the things children really, really want in ITV?

D: I don’t think they really know yet. I mean, we’ve done so little and I’m not sure what’s going on abroad but I mean, certainly the kids in the UK haven’t really had a huge amount of experience of it yet.

H: What might you think?

D: I do think they would like to affect actions, to make things happen. One of the projects we’re working on at the moment is for a show called ‘Dick and Dom’, which is a really zany off the wall weekend/morning program that’s on BBC1 and CBBC. It’s basically two characters who are completely mad and they’re willing to do almost anything it seems; it’s quite anarchic. So to get an additional game to complement the show, we’re working on a quiz application at the stream switcher. So you can appear to affect the actions, and we haven’t quite decided how it’s going to work. It might be challenges or it might just be some sort of zany narrative, but the idea is that at key moments they can press the button and make things happen; they can make them throw the custard pie or whatever it is.

H: Is audio a bit of a commodity? One of the fundamental things about preschool Interactive TV is that you can’t rely on text, you’ve got to rely on audio cues; ‘hey kids, pick this or pick that’.

D: I think that’s a huge problem with our services for children; for the young children who can’t read yet.

H: There’s only a certain amount of streams and things?

D: When we develop the ETV applications we’ll be able to provide audio and that’s absolutely fine, that’s not a problem. That’s synchronous. Or providing maybe alternative audio; something we’re looking at, at the moment. But with the stand-alone games, which are not actually linked to a TV program, you haven’t got the audio stream that’s associated with the video stream. So you’re basically looking at them playing sound files.

H: You get about 60 seconds?
D: Yeah you get so little. With satellite you can get a couple of short clips, but hardly anything.

H: And it just loops over?

D: Yeah, and Freeview. On cable, they insist that - this is where commercial interest afflicts your service - they have so far insisted that their ‘Video On Demand’ channel is shown in a little tiny video screen. So that affects some of their children’s content; you’ve got that audio running all the time.

H: Oh right, so that will be running while the kids are playing a game or so? How do you feel about that?

D: I think that’s being negotiated on, so that’s fine, but those things in the past have caused problems. Similar for cable, the cable companies insisted on keeping the fast text keys; Red, Green, Yellow, and Blue. They wanted those to launch ads and to navigate in their service, so we couldn’t use those. We were down to arrow keys and ‘select.’ So it all affects the end product.

H: That’s a big compromise for kids because your fundamental keys would be the colour keys.

D: Yeah absolutely; it’s so much easier to use colours than the numbers or the arrows.

H: Especially since they many not know how to. Clicking one button, like red, is very easy for a child, but scrolling across to a button and clicking is a big deal, especially when you’re five.

D: Yeah, it’s really quite different.

...I think for good or bad kids have an increasingly strong relationship with their TV. So many more of them have TV’s in their bedrooms now, and it’s a big part of their day. We were talking about passive viewing and that sort of thing earlier but I do think this is one way in which you can potentially make that experience more rewarding. It doesn’t have to be overtly educational – it doesn’t have to be rammed down their throat – but they can take part in a way that requires more of their minds than just sitting there and consuming; letting it wash over them. And I really believe that has to be a good thing. For the children’s channels, most of our programs aren’t overtly educational – we have some sections of the schedule that are – but I think that the interactivity that we will propose obviously would match the channel or the program. But I think there are quite a few programs where they do set out to stimulate the children’s mind and engage them, often they’re asking them questions with the presenter face to face with the camera saying ‘do you remember, how many apples has Tom got’ or ‘there are spelling
bee competitions and quizzes coming up for CBBC’, and that sort of thing. And I think we could provide a mechanism where rather than just shouting out or thinking ‘oh, I could have done that’ they can actually say ‘yeah I could do that, I could do better’ and have go at home and take part in a way which is just a bit more. I believe educational materials, they have to engage you like that; you have to be taking part and practising, I suppose.

H: I was just trying to bring up the point where you say the kids call out or yell out to the television and they don’t ever see a response from their action. But ITV does provide that response.

D: Yes. We can do that. We can do that now, thank goodness. So often it’s a case of ‘oh well soon we’ll be able to do this’ and it’s actually five years later and you still can’t do it. But we can – just about on all platforms now – provide applications where we can capture their responses and give them feedback. And it seems to be one of the fundamental units of learning; watch something or read something, take the material in, have a response, and close the circle by saying ‘right’ or ‘wrong’, ‘well done’, or you keep going; reinforcing the learning of the program.

H: That doesn’t necessarily have to involve a return path does it; it can just keep a local score on your box.

D: No, it doesn’t have to at all. What was really interesting with the ‘Test the Nation’ service -which was our first play along quiz which was really, really successful – was, if you asked people on the grid: ‘did you feel that you were getting a response from the program or they were communicating to you?’, and they really felt that this was interactive. As in, that they were getting that personal response. But they didn’t use the return path at all, they didn’t make any connection; it was all done in the application. But they felt they were being personally communicated to by being given their IQ or their score, or whatever the quiz happened to be.

H: The illusion of interactivity.

D: Exactly. It’s like an illusion, and it’s actually much more successful than just sending your vote in using the return path. What do you ever get back? If you happen to be in the group with sixty percent then you can make something happen over there later. There’s the cost of it and you get very little back, even though you’re not officially communicating. So I think with the definitions of communication or interaction, sometimes people think of them as being too narrow, and that you have to make that connection. Actually you can have the perception of interactivity and communication much more successfully without having to use a return path.
Nigel Walley – Managing Director
Decipher Consultancy, London
Interviewed on the 14th July, 2004

Nigel Walley: We are a media strategy consultancy, but we specialise in the bits of media where new technologies are impacting audience behaviour and viewer behaviour. We look at the behavioural changes that are occurring, the technology adoption issues, and the business models which arrive out of it. So very broadly we work for two kinds of clients; we work for big media owners – so we work for most of the major TV platforms and TV channels, looking at the business models for PVR’s, Video on Demand, broadband content, the content model’s pricing, how to package and proposition new forms of TV, with a one, three and five year horizon. So it’s kind of ‘strategic media change’ in a broader sense. We also work for big advertisers who are themselves, with their agencies, trying to get their head around how their spending behaviour on media will change in the same kind of time frame; one, three, and five years. So it’s big advertisers particularly who are very exposed to traditional TV advertising, and are getting concerned that that exposure will be a problem for them in the future. So they work with us; evaluating new forms of advertising on TV, and looking at the same kind of issues; TV change, looking at new opportunities to advertise on things like broadband. With the big advertisers we tend to run innovation programs, and experiment on trial programs, where they are setting up trials and new forms of advertising, and measuring them and evaluating them and comparing when to bring them into their mainstream of activity.

So those two groups are apart, and you can imagine that they are both interested in what the other one’s are doing; the advertisers want to know what the media companies are doing, and the media companies want to know what the intentions of the advertisers are over time. So, theoretically, there is a virtuous circle where we can bring that insight.

Hamish McPharlin: Speaking of which, do you do much work with interactive children’s media?

N: Yeah, we do a little bit of stuff with people like Disney, Cartoon Network, and Nickelodeon we do quite a bit with; looking again at interactive, ‘Red Button’ stuff.

H: What are their main concerns when they come to you?

N: There is a huge issue around annoying parents – though things like costs and that sort of thing – TV companies are terrified of being seen to use interactivity as a way of gouging more money out of the kids market. So they’re torn between trying to find a commercial basis to develop interactivity, and not being seen to squeeze all this value out of kids unnecessarily. So they’re very conscious of the cost issues; very conscious of the ‘50p to play’ syndrome. They’ve all fallen foul
of it in the last couple of years. There’s been a backlash by parents; parents stopping their kids from using the interactive services. So they are very worried about that.

The minor channels are very interested in how they can use this new media to broaden their reach into a market that is still, over here, dominated by some of the big, main channels. The absolute, most popular TV program in the UK for kids between twelve and fourteen is actually ‘EastEnders’; it’s a grown-up soap. So actually there are lots of kids channels - we’re oversupplied with kids channels – but they all have very, very small audiences compared to the audiences that the big channels have. So they’re really interested in how they can use new media to get under the skin of the kid’s audience in different ways, and break down the dominance that the big networks have got.

H: Do you find that there are any usability issues with young kids, in terms of getting the hang of using remotes?

N: Yes, well the biggest one is text; that up until the age of ten they’re not able to be as sophisticated with interfaces and program guides, just because their reading skills aren’t good enough. So we have looked at the potential to build more iconography into EPG’s on kids channels; to use pictures rather than words. I haven’t seen anyone, apart from Homechoice, do it. Homechoice are quite good; they use pictures, not words, on their kids EPG.

H: You can see it a lot in web space as well. Go to your average website and there’s text everywhere, but go to Disney.co.uk and its all buttons and faces.

N: Yeah, and that hasn’t really hit the TV world yet; apart from Homechoice. Homechoice are also bringing out a kid’s remote control. We do find that the kids find the normal remote controls big and heavy. So remote control issues seem to be an issue. Text-heavy interfaces on TV don’t work for kids. Stuff that involves reading too much doesn’t work. They just like to get to the point; pushing pictures.

H: Do you find that the content is most effectively delivered if the interactivity is confined just to the coloured buttons, or the cursors and select as well?

N: It depends on the age of the kid.

H: What age are we talking; under ten? Seven or so?

N: Yeah, well the coloured buttons work better, but once you get to that age, they struggle to work with complex interactive concepts anyway. So you need to interactivity to be really simple; really big, simple gestures, big, simple buttons.

H: Audio cues as well?
N: Yeah. Their poor little heads aren’t ready to deal with the big complex [interactions], they can’t work out what’s happened on the screen when you do stuff, very often, unless it’s really clearly signposted. You get a question where it changes the screen, and it throws them unless you’ve told them what is going to happen, and why. You manage the process in a way that you don’t necessarily have to with adults.

N: ...What we have seen; some of the work that we’ve been doing around Video on Demand has shown that when you move out of the non-linear environment, adults have a much stronger need to have a sense of ‘home’ on the TV. When you get lost; you’re three layers down in the VOD menu looking for a program - you’ve gone left and right, you suddenly can’t remember where you are – adults really feel the need to have a big ‘home’ button on here. So if I get lost I know that I can go back to the TV Guide and start again. Whereas kids don’t seem to have that same need to have that locator space on the EPG. The adults are much more nervous of getting lost, and therefore need this strong sense that all roads lead back to the main page and the EPG.

H: We need more of a visual cue about where we are; like spatial awareness.

N: HomeChoice (aka Talktalk TV) never used to have one. They’ve now got this, which is the main top page of your channel, and it helps a lot. Most people use this as their kind of ‘if anything goes wrong, I’ll get myself back to here, and I’ll start again.’ So I don’t mind going to the VOD menu and drilling down five layers now, because if I’m really lost I can just press this button and I know exactly where it’ll get me back too, and I’ll know where I am from then on. So that’s been quite interesting. Kids don’t have that same need to have that kind of anchor point. They would go off and delve.

H: So you could observe a child drill down, get lost, and then?

N: Experiment; go left and right. Whereas the adults go in, come back out, because they get confused. ...The big con is that most viewers can tell where interactivity is just ‘bolt-on’. The shows that really do well are ones that the interactivity is core to the idea. The only show I can think of is ‘Who Wants to Be a Millionaire’ – I know it’s not a kids show – but that’s the only show that I can think of where the interactivity is a bolt-on but actually it worked really well. And that probably was because the show, when it was designed, the way it was structured lent itself really, really well to interactivity. So unless the show is like that, then you can normally tell when the interactivity is a bolt on, and people just don’t buy it. They really need to see the uniqueness of the proposition and the value of the proposition; they won’t just vote on something incrementally, or spend money incrementally on an interactive service just because it’s there. The viewers are quite canny.
Dear Parent,

I am a PHD student at Murdoch University, studying the ways in which children’s television can be made more educational and stimulating through interactivity.

I will be conducting a study at your child’s school on the [date]. I have designed a short interactive children’s television show called ‘The Magic Cubby’, which gives children the option to choose the activities that the onscreen characters take part in. It is designed to be entertaining and educational, and investigates counting, colours, singing, storytelling, and moral education. I will be asking the group of children questions about their enjoyment and understanding of The Magic Cubby at the end. The session will be video recorded, to assist in interpreting group reactions to the program, but the video will not be released or published. All data will be kept strictly confidential.

If you are willing for your child to participate in this short study, please fill out the form below and return to [name of school]. I am very grateful for your consideration. If you would like feedback on the findings of the study, please also fill out the email field.

Kind Regards

Hamish McPharlin

If you have any questions about this project please feel free to contact either myself, Hamish McPharlin on 61-8-93607390 or h.mcpharlin@murdoch.edu.au, or my supervisor Professor Duane Varan on 61-8-93606035 or d.varan@murdoch.edu.au. My supervisor and I are happy to discuss with you any concerns you may have on how this study has been conducted, or alternatively you can contact Murdoch University’s Human Research Ethics Committee on 61-8-93606677 (ethics@central.murdoch.edu.au).

PARTICIPANT CONSENT FORM

[DATE OF STUDY: ____________]

Child Name: ______________________________________________________

Date of Birth: ___/___/___    Age:_________    M/F:_________

Parent/Guardian Name: ____________________________________________

I have read the above information and give consent for my child to participate in this exploratory study of ‘Enhancing Children’s Television with ITV’. I understand that I may withdraw my consent at any time, or request feedback from the investigator. I understand that the session will be video recorded, but that it will not be published or disseminated. I also understand that all information provided is confidential and will not be released by the investigator unless required to do so by law, and that any data gathered from this study for use in a publication will not contain information which might identify me or my child.

Signed: _________________________________________ Date: ___/___/___

Email: (optional) ___________________________________ Researcher:___________
FADE IN

[The scene is inside the RED room of the magic cubby. There is a large window on the left hand side with a slide entering the room. At the back is a bright green door, with a yellow door to its right. A small laundry chute is on the far right]

[Roger, Baby Crocodile, and Ruby are playing dress-ups. There is a small Japanese screen that they jump behind to dress up].

ROGER: Okay my turn, my turn!

[Roger runs behind the screen, clothes begin flying out]

RUBY: [to the audience] Hi everyone! Welcome to the Magic Cubby. I’m playing with Roger and Baby Crocodile in the Red Room! We’re playing dress ups. Roger is behind the screen getting dressed up. Hmm.. I wonder what he’s going to be?

[Roger appears, wearing a white coat with a stethoscope around his neck]
ROGER:  Ta daa!! Okay, what am I?

RUBY:  Umm…. Well, let’s see. You’re wearing a white coat… and what’s that around your neck?

ROGER:  That’s a stethoscope. You can use it to hear your heartbeat!

RUBY:  Heartbeat? You’re a DOCTOR!

ROGER:  Yes!

RUBY:  Okay, my turn my turn!

[Ruby runs behind the screen. Clothes begin flying out from behind the screen again]

ROGER:  [to Baby Crocodile] Hmm… I wonder what she’s going to dress up as?

BC:  [squeaks]

[Ruby emerges wearing big rabbit ears and holding a carrot]

RUBY:  There! Can you guess what I am?

ROGER:  Hmm.. let’s see. You’ve got big floppy ears, and what’s that Ruby is holding?

BC:  [squeaks]

ROGER:  A carrot? Ok. Look, Ruby is hopping around. She must be some sort of animal.

RUBY:  Keep guessing!

BC:  [squeaks]

ROGER:  Ohh.. thanks Baby Crocodile. Are you a rabbit?

RUBY:  Yes!!

BC:  [squeaks frantically]

ROGER:  Okay, Baby Crocodile’s turn!

[BC runs behind the screen. Frantic squeaking is heard for a while. Strange things fly out from behind the screen; a banana, a plastic frog, an inflatable cow, a turnip, a
steering wheel, a spade, etc. Suddenly there is silence. Roger and Ruby look at each other nervously]

RUBY: What is Baby Crocodile doing?

ROGER: I don’t know.

[Suddenly a fanfare is heard from an unknown location, and Baby Crocodile triumphantly emerges, looking exactly as he always does. Roger and Ruby look confused]

BC: [squeaks]

RUBY: But Baby Crocodile, you look exactly the same!

BC: [squeaks]

RUBY: Oh, okay okay. We’ll guess…. Um..well, let’s see. You’re green…

BC: [squeaks]

ROGER: And you’ve got a row of sharp teeth

BC: [squeaks]

RUBY: Are you a…. baby crocodile?

BC: [squeaks in approval]

ROGER: Well done. You got it!

RUBY: Wow that was very sneaky Baby Crocodile! Okay, we’ve all had a turn, so it looks like it’s your turn again, Roger!

ROGER: Fantastic! I’ve got the best idea!

[Roger dives behind the screen again. Clothes again fly from behind the screen. Roger emerges wearing glasses, a fake moustache, and a fake nose. He carries a magnifying glass. He creeps stealthily around the room peering at things]

RUBY: Hmmm…this is a hard one. Let’s see what he is wearing. He has a fake moustache…. And a big fake nose….

BC: [squeaks]
RUBY: That’s right, he seems to be exploring, or maybe investigating? Are you a policeman?

ROGER: No.

RUBY: Are you a professor? Or a scientist?

ROGER: No. I’ll give you a clue. I’m undercover.

RUBY: Ooh! Are you an undercover detective?

ROGER: That’s right!

RUBY: Y’know, I don’t really know what an undercover detective does!

ROGER: Well, an undercover detective has to look for clues, to find out what happened. Sometimes they look for footprints…

[Roger creeps along behind Baby Crocodile, following his footsteps. SFX: Stealthy music]

…and sometimes they have to surprise people!

[Roger springs around and surprises Ruby and Baby Crocodile, who recoil in mock alarm. SFX: dramatic music]

…and sometimes they have to be very quiet, so that no one can see them…

[Baby Crocodile sidles over to Stage Left, near the foot of the Cubbyhouse slide. He begins poking around for clues. SFX: quiet, comical music plays]

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LOCATION: OUTSIDE

[Misha arrives at the foot of the Cubbyhouse tree. She is wearing a school uniform, with a school bag on her back. She looks up at the Cubby in the tree, and smiles when she hears Roger, Ruby, and Baby Crocodile bickering about something. She begins to climb]

LOCATION: THE RED ROOM

[Meanwhile, Roger is still poking about at Stage Left. At this point, Misha slides in on the Cubbyhouse slide. She encounters Roger at the foot of the slide, who looks up at her. Misha peers down at Roger’s moustache and big nose and looks startled. She takes them off Roger’s face]
MISHA:  Roger, is that you?

ROGER:  Hey everyone it’s Misha!

[The puppets excitedly cluster around Misha]

RUBY:  Misha! How was school!

ROGER:  Yeah, what did you do at school today?

MISHA:  School was fun. But guess what! Tomorrow it is my turn for ‘show and tell’.

RUBY:  Fantastic! What are you going to do?

MISHA:  I don’t know.

RUBY:  Hey I’ve got an idea, how about we play dress-ups! I’ll dress you up, and we can get ideas about what you can talk about for ‘show and tell’.

MISHA:  Ok!

[Ruby squashes Misha behind the Japanese screen, which can barely accommodate her, and clothes begin flying around once again. Roger and Baby Crocodile look on excitedly]

ROGER:  [to Baby Crocodile] This is very exciting. What do you think Ruby is going to make her?

RUBY:  [from behind the screen] Baby Crocodile! It looks like I’m going to need your help.

[Baby Crocodile creeps forward inquisitively, but as he nears the screen, Ruby jumps out and snatches him. BC squeaks in alarm]

[Eventually, Misha emerges with a pirate hat on her head and an eye patch. Baby Crocodile is dressed as a parrot]

ROGER:  Wow! That’s amazing. What are you?

RUBY:  Have a look. What do you see?

ROGER:  Well, she’s wearing a big hat. And Baby Crocodile is looking like a parrot. Are you a sailor?
Appendix C

The Magic Cubby - script

BC:  [squeaks]

ROGER:  Well, he doesn’t sound much like a parrot.

RUBY:  Well, she is a sailor, but she’s a special type of sailor. She’s a pirate.

BC:  [squeaks]

ROGER:  Ooh. What is a pirate?

RUBY:  Well, a pirate sails on the ocean, and they are always looking for gold! They sometimes have a parrot on their shoulder, like Baby Crocodile, and sometimes they say ‘arrrrrrr’.

[Suddenly a voice is heard from outside. All turn to listen]

KAL:  [from out the window] Helloo!! Is anyone in the Magic Cubby?

ROGER:  Ooh! Who is that?

MISHA:  That’s my neighbour, Kal! Yes Kal, come in!

[Kal slides in on the Cubbyhouse slide]

KAL:  Hi Misha! Ooh, and hello Roger, Ruby, and Baby Crocodile.

ALL:  Hi Kal.

KAL:  Oooh, Misha! You’re dressed as a pirate!

RUBY:  Yes, she has got show and tell at school tomorrow, so we’re thinking of ideas for her to talk about.

ROGER:  Ok! So Misha are you going to talk about pirates for show and tell?

MISHA:  Yes!

ROGER:  I’ve got an idea, let’s have a practice. We can pretend to be the class, and you can give the talk to us!

MISHA:  Ok.

[Kal and the puppets excitedly arrange themselves like students at a classroom. Ruby assumes the role of teacher.]

RUBY:  [clearing her throat] Ok class. Quiet please.
[Roger and Baby Crocodile shuffle in their seats, and begin to pay attention]

RUBY: Today it’s Misha’s turn for show and tell; she is going to talk about pirates. Take it awaaaaayyyyyy….. Misha!

[Ruby joins the other puppets, and Misha stands in front of them. She looks distinctly nervous, and shakes her head]

RUBY: Quiet class. Misha is going to speak.

MISHA: Ruby, I don’t want to speak.

RUBY: Oooh, really? Are you alright?

[The puppets cluster around her]

MISHA: I don’t know.

RUBY: Hmmmm…. I wonder what the matter is… Let’s try and guess!

ROGER: Ok, umm…have you lost your voice?

MISHA: No.

RUBY: Did you forget what to say?

MISHA: No.

KAL: Let me guess. Have you ever done ‘show and tell’ before?

MISHA: No, I haven’t!

ROGER: Aahh. So how do you feel?

MISHA: Ok. Well, I feel a bit scared standing in front of the class.

RUBY: Aaahh. Why would you feel scared?

MISHA: In case I say the wrong things, and everyone laughs at me.

KAL: I see. I know what you need to help you.

RUBY: What is that?

KAL: You need courage!
ROGER: What is courage?

KAL: Courage is like being brave. You can use courage for all sorts of things. Sometimes you need courage when you're afraid of the dark. And sometimes you need courage to ride a bike. And sometimes you need courage when you go to the doctors. And sometimes, you need courage to stand up and talk in front of people.

I’d like to tell you a story about a young boy who had to show a lot of courage. It’s the story of Jack and the Beanstalk.

ROGER: Ooh! Can I be Jack?

KAL: Yes, of course you can be Jack.

BC: [squeaks frantically]

KAL: Ooh. Baby Crocodile, do you want to play Jack as well? Ok, I’ll tell you what. You can both play Jack. [turns to audience] Hi everyone, YOU can choose who you want to watch. Roger is going to play Jack in the GREEN room, so if you would like Roger to be the star of the story, then click the GREEN button. And Baby Crocodile is going to play Jack in the YELLOW room, so if you want Baby Crocodile to be the star, then click the YELLOW button to follow Baby Crocodile into the YELLOW room. Are you ready guys?

ROGER: Yes, I’m going into the GREEN room.

BC: [squeak]

KAL: That’s right Baby Crocodile, you’re going into the Yellow room. Ok. So press either the GREEN button or the YELLOW button now. By guys!

ROGER: Bye everyone!

BC: [squeak]

[Roger and Baby Crocodile go through their respective doors. Misha sits down to listen to the story]

[END OF SCENE 2]

Scene 3 – Jack and the Beanstalk
Location: Red Room / Green Room / Yellow Room
Cast: Kal/Roger/Baby Crocodile
[Kal turns towards the camera and begins telling the story. She appears as a picture in picture display in both the GREEN and YELLOW rooms, while each room shows still-pics/video as the story is told, with Roger and Baby Crocodile playing the lead.]

KAL:  Once upon a time there was a young boy called Jack. He lived with his mum in a small house. They had a cow called Buttercup that would give them milk every morning.

One day, the Buttercup stopped giving milk, so Jack’s mum said to Jack, “Jack, I’m very busy today, so can you take Buttercup to the market and sell her, and with the money we can buy a new cow”

So Jack took Buttercup and he began to walk to the market. On the way he met an old man. The old man said to Jack, “Young boy! Where are you going with that cow?” Jack said “I am taking her to market to sell”. The old man said “In that case, how would you like to sell your cow right now. I will give you some magic beans”

“Magic Beans?” thought Jack. “They must be worth a lot more than Buttercup, who doesn’t even give any milk!” So Jack said “Ok, sir. I will give you my cow for those magic beans”, and he took the beans and ran home to tell his mum.

On the way Jack thought, ‘Hm. I hope that these beans ARE magic. I hope that mum isn’t mad that I gave the cow away for just normal beans’ When he got home, Jack said ‘Mum, I’m sorry but I thought that these were magic beans, so I swapped the cow for them!’ Mum was a bit upset, but she said ‘Don’t worry Jack, you’re very young, so it’s alright. And do you know what? Maybe they ARE magic beans! Let’s go and plant them in the garden to see what happens’.

Well, the next morning, when Jack looked out of the window he saw that the beans had grown into a huge beanstalk! The beanstalk stretched all the way up into the clouds. Jack thought ‘Wow, they were magic beans after all. I had better climb this beanstalk to see what is at the top! But it’s really really high. I hope that I don’t fall.’

So Jack had to use all his courage to climb the beanstalk. Up and up and up it went, until his head popped through the clouds. He looked around and saw a big castle.
Jack was hungry from all the climbing, so he walked up to the castle to ask for some food! But when we went inside, he heard a big scary voice. It said ‘Fe Fi Fo Fum, I smell the blood of an Englishman!’

Uh oh! It sounds like a giant! And it’s getting closer! Jack was scared, so he quickly hid inside a cupboard. And suddenly he heard a little voice ‘Help me!’ Scared was shocked, but he looked around and it was just a little mouse. ‘What are you doing in here mouse?’ said Jack.

‘Ooh. The giant has caught me and I think he wants to eat me!’ said the mouse. ‘But I’m too scared to escape!’ ‘Come on’, said Jack, ‘we can escape together!’ Suddenly, in came the giant, walking with his big feet… stomp stomp. Jack opened the cupboard door, just a little bit, so that he could see what the giant was doing.

The giant sat down on a his big giant chair, and then suddenly he looked around “Fe fi fo fum! I smell the blood of an Englishman!” . He got up and started to look around the room. Jack and his new friend the mouse had to stay very quiet. The giant gave up looking, and sat down. Before too long he was fast asleep.

‘Come on’, whispered Jack, ‘now is our time to escape!’ . He picked up the mouse, and slowly crept out of the cupboard. He could hear the giant’s big snores, and the mouse was very afraid, but Jack keep creeping along. Suddenly the giant woke up! “Fe fi fo fum! I smell the blood of an Englishman!” Jack and the mouse ran out of the door as fast as they could, but the giant kept running.

‘Come with me!’ said Jack, and he began running towards the beanstalk. He got to the top of the beanstalk, and he said to the mouse ‘Would you like to come and live with me and my mother?’ ‘Okay!’ said the mouse, ‘first let me get my things’ And with that, the little mouse ran into a small mouse hole, and came out pulling a bag of gold! So Jack put the mouse in his pocket and the gold in his other pocket and began to climb quickly down the beanstalk. He could hear the giant’s big feet getting closer and closer! Stomp stomp

When he was almost at the bottom, he called, ‘Mother mother, quickly bring the axe! Jack’s mother heard him, and she came running out of the house with an axe, and as soon as Jack was safely on the ground she chopped and chopped the beanstalk, until it came falling down. Timber!

Now the giant couldn’t get down, and so they were safe. ‘Thankyou thankyou!’ said the mouse. You showed a lot of courage when you saved me from the giant. I would like you to have this bag of gold’. ‘Wow’, said Jack, ‘with this bag of gold, we can buy a new cow, mother!’
And so they bought a new cow that gave them milk every morning, and Jack, and his mother, and their new friend mouse lived happily ever after!

And that’s the end of the story. Ok Roger, and Baby Crocodile, it’s time to come back into the RED room now, so if you’re watching, press the RED button to come back into the RED room. Press it now!

[Roger and Baby Crocodile come back into the RED room, and join Misha]

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<tbody>
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<td>Location: Red Room</td>
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[Kal, Misha, Ben, Baby Crocodile, Roger, and Ruby are all sitting around in the Red room]

KAL: So there you go everyone. That was the story of a little boy called Jack, who had to show a lot of courage! What are some of the things that he had to do to show courage?

ROGER: He had to climb the really high beanstalk?

KAL: That’s right, what else?

RUBY: Umm… Jack had to sneak into the giant’s castle?

KAL: Yes! When Jack went into the castle he had to show courage by being very quiet, because he was scared of the giant. He had to sneak around and…ooh. Ssh. Do you hear that?


[OUTSIDE: Hoda is standing at the bottom of the tree. Ben arrives with his school bag]

HODA: Hey Ben.

BEN: Hi Hoda.

HODA: I can’t hear anyone in the Magic Cubby. Can I come up with you?

BEN: Yes!

[Ben begins to climb]

[BACK IN THE RED ROOM]
ROGER: OOOhh… Shhh… It’s Hoda! Let’s all surprise Hoda and see if he has courage!

[Ben slides into the red room]

KAL: Ooh. It’s Ben! Hi Ben! Quickly, come and hide!

[All dive for cover as Hoda comes down the slide]

HODA: [looking around in confusion] Hello? Where is everyone?

HODA: [moves to stage right] Roger?

[Roger appears on stage left, and creeps towards Hoda. Hoda hears something and spins around. Roger disappears from sight, but Ruby appears stage right, and so on]

SFX: Stealthy music

HODA: Ruby? Baby Crocodile? Are you there?

[Hoda opens the door to the Green room]

HODA: Hello! Is anyone in the green room? Hmm… howabout in the yellow room? Is anyone in there?

[Hoda opens the door to the Yellow room]

HODA: Hello? Anyone in here?

[As Hoda turns around, they all jump out from their respective hiding places]

ALL: Tadaa!!

[Hoda jumps, but recovers and laughs along with everyone]

HODA: Aha! There you all are! I was beginning to think that the Magic Cubby was empty! What is everyone doing?

KAL: We are learning about courage!

ROGER: Yeah, courage is about being brave!

KAL: Not always, sometimes you need courage to do the right thing. Like if you accidentally break a glass at home, you need courage to go and tell
mum about it. There are lots of times that you need courage, like when you first ride a bike, or when you need to visit the doctor...

KAL:  [singing]

SONG:

VERSE
I’m going to the doctor today
To keep me healthy, fit, and strong
I’ll need a needle in my arm
I am really scared

HODA:  [joining in]

CHORUS
Courage, courage everywhere
You can do it if you dare
You might be scared but you will see
Courage, courage is the key

VERSE
I’ve been learning to ride my bike
With training wheels put on the side
Today I’m going to take them off
I hope that I don’t fall.

CHORUS
Courage, courage everywhere
You can do it if you dare
You might be scared but you will see
Courage, courage is the key

KAL:  Yes, there are all sorts of times that you need to show courage.

MISHA:  I have to go home to learn more about pirates!

RUBY:  Really? That’s so great! I can’t wait to learn about pirates. Are you going to come back and do show and tell?

MISHA:  Yes. Bye!

ALL:  Bye Misha!

[Misha disappears down the hatch]
Appendix C

The Magic Cubby - script

Scene 5 – Critical Literacy
Location: Red Room / Green Room / Yellow Room
Cast: Kal, Hoda, Misha, Ben, Baby Crocodile, Roger, Ruby

[The puppets turn around to Hoda]

RUBY: Hoda. Do you have a story for us about courage?

HODA: Courage? Well, I have a story about a young girl’s first day at school. Is that about courage?

RUBY: Yes!

ROGER: No! [turning to Ruby] Ooh. Is it?

RUBY: Well, is it scary on the first day of school?

ROGER: Yes. Sometimes it is scary!

RUBY: Well then, what do you need when things are scary?

ROGER: Courage!

HODA: That’s right. This story IS about courage. But I need two storytellers. Ruby can you be my first storyteller?

RUBY: Yes! Yay!

HODA: And Roger, can you be my second storyteller?

ROGER: Who me? Of course!

HODA: Okay, both Roger and Ruby are going to show the story in different ways, in the two rooms. Roger, you can tell yours in the GREEN room, so if you want to see Roger’s version of the story, then follow Roger into the GREEN room by pressing the GREEN button. And Ruby is going to tell her version of the story in the YELLOW room, so if you want to see Ruby’s version of the story, then follow her into the YELLOW room by pressing the YELLOW button. You choose. Okay, bye guys!

ROGER/RUBY: Bye!

Scene 6 – Bear story
Location: Red Room in the Magic Cubby
Cast: Hoda
HODA: [STORY]

It was early one morning, when Sally’s mum came into her room, and said ‘Sally, it’s time for your first day of school!’ Sally yawned [yawns] and said ‘I’m coming, but Bear is still asleep!’

‘Come on Bear, said Sally’, as she went into the bathroom. But Bear was still waking up.

‘Don’t forget to wash your hands’, said Mum. ‘I won’t’, said Sally, ‘but Bear doesn’t want to get his paws wet’.

‘Don’t forget to eat all of your breakfast, said Mum. ‘I won’t’ said Sally, ‘But Bear has spilt the milk!’

‘Now, it’s time to brush your teeth’ said Mum. ‘I’m coming’, said Sally, ‘But Bear is still eating in the kitchen!’

‘Time to put on your shoes, Sally’, said Bear, ‘Look at Bear, he has odd socks on!’ said Sally.

Come along Bear!’ said Mum, ‘finish your breakfast, or Sally will be late for her first day of school.’

‘Don’t worry about Bear’, said Sally, ‘he won’t make me late’.

Are you scared of going to your first day of school, Sally?’ asked mum.

Sally said ‘No. Bear is going to be with me!’

And so off they went to school.

And that’s the end of the story. If you’re in the GREEN room, or the YELLOW room, it’s time to come back into the RED room. So to do that, you need to click your RED button. So click your RED button now.

Scene 7 – Wrap Up
Location: Red Room / Green Room
Cast: Kal, Hoda, Misha, Ben, Baby Crocodile, Roger, Ruby

HODA: Did you like that story?

ROGER: Yes! I remember my first day at monster school. I was a bit scared of all the other monsters!
RUBY: But then you met me! And we became friends. And all you needed was… what?

ROGER: Umm… I forgot!

MISHA: Courage!

KAL: Haha, that’s right. Well, come and have a look at this picture that Ben has drawn about courage.

[The puppets cluster around Ben and Kal]

BEN: [explains the picture that he has drawn]

HODA: [addressing the audience] That’s great Ben, and don’t forget that you can send your pictures of courage into the Magic Cubby, and we’ll put them up on the Cubbyhouse wall.

In fact, we’re going to have a look at some of the pictures that were sent in from last week. Last week we looked at friendliness. And we had lots of pictures sent in about friendliness. So we’re going to go to the Magic Cubby wall and have a look at some.

BC: [squeaks frantically]

HODA: What is Baby Crocodile saying?

RUBY: Aah. What a good idea. Baby Crocodile is saying that he wants to hear the song again about courage again.

HODA: Aahh. Okay, if you would like to hear the song again, Ruby and Baby Crocodile are going to go and sing it in the GREEN room. So if you would rather hear the courage song again, then click the GREEN button. But if you would like to look at pictures of friendliness, then don’t press any buttons. Here we go.

[GREEN: Baby Crocodile and Ruby run into the GREEN room to sing. The music begins, and Ruby sings along, with Baby Crocodile providing a squeaking accompaniment. The RED room appears as a picture in picture, in which you can see Hoda looking at the pictures]
Appendix C

RED:

[Hoda has a brief look at some of the pictures sent in and comments on them. He begins to put Ben’s picture up on the wall also. Faint music is heard emanating from the GREEN room]

HODA: So if you would like to send in your picture of courage, we can put it up on the wall with Ben’s. Okay, if you’re in the GREEN room, it’s now time to come back into the RED room, by pressing the RED button, so press the RED button now!

GREEN:

[Ruby and Baby Crocodile enter.]

RUBY: Okay. Are we ready to sing the song about courage again? Here we go…

[Ruby sings the courage song. Baby Crocodile dances along]

RUBY: Okay. We’re all done, so it’s time to go back into the RED room, so press the RED button to come back with me.

[Ruby and Baby Crocodile exit]

[Baby Crocodile and Ruby return from the GREEN room, as Misha comes in on the slide]

HODA: Hi Misha.

MISHA: Hi, I’m ready to talk about pirates now!

ROGER: Ohh!! Here we go. Places everyone!

[Everyone assembles into a class formation]

BC: [standing at the front like a teacher]

ROGER: Quiet everyone, Baby Crocodile is going to introduce her.

BC: [clears its throat] SQUEAK SQUEAK SQUEAK!!

[Everyone claps]

KAL: Um. I have no idea what Baby Crocodile has just said.

RUBY: Oh! That’s alright. I’ll translate for you.

BC: [squeak]

RUBY: Misha is doing show and tell today about pirates!
BC: [squeak]

RUBY: She brought along a pirate hat that she made at home, and she also wants to tell us some facts about pirates.

BC: [squeak]

RUBY: Please clap for Misha!

[Everyone claps again. Ruby and BC sit down]

MISHA: My name is Misha, and I’m going to talk about pirates. Pirates sail on a big pirate ship. They have to sail over big waves, and through big storms. Pirates always are searching for buried treasure.

Pirates have to show a lot of courage. Because they have to fight other pirates, and stay on the boat even when it’s dark, and sometimes they have to sail through big storms.

The most famous pirate in the world is Captain Hook. He was called Captain Hook because he had a big hook for a hand. This is because a Crocodile bit it off! (BC squeaks). But it wasn’t Baby Crocodile.

[all laugh]

KAL: Ah. Misha that was great. You are going to be great tomorrow. You should take Baby Crocodile along to be the parrot again!

BC: [squeaks]

HODA: Okay, we’ll it looks like it’s time to say goodbye. Goodbye everyone. Good bye Misha, and Ben! At the end, if you would like to see more pictures that everyone has sent in about courage, then click the GREEN button. Good bye!!!

[all wave]

FADE OUT

END
THE MAGIC CUBBY RESPONSE SHEET

1. Who did you see on The Magic Cubby today? (1pt for character. Total=3)
   What is their name? (1pt for name. Total =3)
   [ ] Name
   [ ] Name
   [ ] Name /6

2. In the Magic Cubby there was a story about Jack and the Beanstalk. Can you tell me what happened in the story? (1pt for each relevant event. Total=4)

   -
   -
   -

   /4

3. What were some of the ways that Jack showed courage? (1pt for each idea. Total=3)

   -
   -

   /3

4. Then there was a story about Sally going to her first day of school. What were some of the things that she did to get ready for her first day of school? (1pt each. Total=4)

   -
   -

   /4

5. This is a face of someone who was bored when they watched The Magic Cubby, and this is a face of someone who thought The Magic Cubby was really fun. (etc) Can you show me how much fun you thought it was by pointing to one of the faces?

   Sad 1 2 3 4 5 Happy
Appendix E

Phase 3 Questionnaire

[ Character Pick diagram used in Question 1 ]

[ Face Scale used in Question 5. (Image reproduced from Gibbs, 1995) ]
Appendix F – Phase 3 Statistical Analysis

Comprehension

Effects between Conditions

Descriptive Statistics

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Test of Homogeneity of Variances

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Multiple Comparisons

Dependent Variable: % of Comprehension correct

Tukey HSD

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* The mean difference is significant at the .05 level.

Effects of Gender

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Appendix F  Phase 3 Statistical Analysis

### Independent Samples Test

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#### Effects of Age

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### Multiple Comparisons

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Tukey HSD

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* - The mean difference is significant at the .05 level.
### Detailed Comprehension Analysis

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#### Test of Homogeneity of Variances

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<td>76</td>
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<td></td>
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<td>63</td>
</tr>
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#### Test Statistics

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<th>Asymp. Sig.</th>
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<tr>
<td></td>
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*a. Kruskal Wallis Test  
b. Grouping Variable: Condition

<table>
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<tr>
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<th>Sum of Ranks</th>
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<td>62.76</td>
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### Appendix F

#### Phase 3 Statistical Analysis

**Test Statistics**

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<th>Wilcoxon W</th>
<th>Z</th>
<th>Asymp. Sig. (2-tailed)</th>
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a. Grouping Variable: Condition

**Ranks**

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<td>63.09</td>
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**Test Statistics**

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<th>Wilcoxon W</th>
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a. Grouping Variable: Condition

**Ranks**

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**Test Statistics**

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<th>Wilcoxon W</th>
<th>Z</th>
<th>Asymp. Sig. (2-tailed)</th>
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a. Grouping Variable: Condition

**Attention**

**Effects between Conditions**

**Descriptives**

<table>
<thead>
<tr>
<th></th>
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<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>76</td>
<td>95.8469</td>
<td>4.0231</td>
<td>.4615</td>
<td>94.9275 to 96.7663</td>
<td>79.71</td>
<td>100.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interactive video</td>
<td>63</td>
<td>93.6398</td>
<td>4.1591</td>
<td>.5240</td>
<td>92.5924 to 94.6873</td>
<td>82.76</td>
<td>98.62</td>
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</tr>
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<td>Interactive stills</td>
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<td>94.1149</td>
<td>5.5601</td>
<td>.7178</td>
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<td>98.62</td>
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<td>94.6260</td>
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<td>100.00</td>
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</table>
Appendix F  Phase 3 Statistical Analysis

Test of Homogeneity of Variances

% of intervals where participant was attending

<table>
<thead>
<tr>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
<td>1.569</td>
<td>2</td>
<td>196</td>
<td>.211</td>
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</table>

ANOVA

% of intervals where participant was attending

<table>
<thead>
<tr>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>190.232</td>
<td>2</td>
<td>95.116</td>
<td>4.536</td>
</tr>
<tr>
<td>Within Groups</td>
<td>4110.381</td>
<td>196</td>
<td>20.971</td>
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<tr>
<td>Total</td>
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</tbody>
</table>

Multiple Comparisons

Dependent Variable: % of intervals where participant was attending

Tukey HSD

<table>
<thead>
<tr>
<th>(I) Condition</th>
<th>(J) Condition</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
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</thead>
<tbody>
<tr>
<td>Linear</td>
<td>Interactive video</td>
<td>2.2071*</td>
<td>.7803</td>
<td>.013</td>
<td>.3784 - 4.0358</td>
</tr>
<tr>
<td></td>
<td>Interactive stills</td>
<td>1.7320</td>
<td>.7909</td>
<td>.073</td>
<td>-.1215 - 3.5855</td>
</tr>
<tr>
<td>Interactive video</td>
<td>Linear</td>
<td>-2.2071*</td>
<td>.7803</td>
<td>.013</td>
<td>-4.0358 - .3784</td>
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<tr>
<td></td>
<td>Interactive stills</td>
<td>-.4751</td>
<td>.8261</td>
<td>.833</td>
<td>-2.4112 - 1.4610</td>
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<tr>
<td>Interactive stills</td>
<td>Linear</td>
<td>-1.7320</td>
<td>.7909</td>
<td>.073</td>
<td>-3.5855 - .1215</td>
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<tr>
<td></td>
<td>Interactive video</td>
<td>.4751</td>
<td>.8261</td>
<td>.833</td>
<td>1.4610 - 2.4112</td>
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</table>

*: The mean difference is significant at the .05 level.

Effects of Gender

Group Statistics

<table>
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<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
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<tbody>
<tr>
<td>Male</td>
<td>100</td>
<td>94.5391</td>
<td>4.2594</td>
<td>.4259</td>
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<tr>
<td>Female</td>
<td>99</td>
<td>94.7138</td>
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<td>.5079</td>
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</table>

Independent Samples Test

<table>
<thead>
<tr>
<th>% of intervals where participant was attending</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>.185</td>
<td>.668</td>
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Appendix F
Phase 3 Statistical Analysis

Effects of Age

Descriptives

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<thead>
<tr>
<th>Age</th>
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<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>97.2414</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>97.24</td>
<td>97.24</td>
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<tr>
<td>4</td>
<td>91</td>
<td>94.7662</td>
<td>4.6018</td>
<td>.4824</td>
<td>93.8079</td>
<td>95.7246</td>
<td>65.52</td>
</tr>
<tr>
<td>5</td>
<td>105</td>
<td>94.5286</td>
<td>4.6693</td>
<td>.4557</td>
<td>93.6250</td>
<td>95.4322</td>
<td>79.71</td>
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<tr>
<td>6</td>
<td>2</td>
<td>92.0515</td>
<td>10.2161</td>
<td>7.2239</td>
<td>.2633</td>
<td>183.8397</td>
<td>84.83</td>
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<tr>
<td>Total</td>
<td>199</td>
<td>94.6260</td>
<td>4.6605</td>
<td>.3304</td>
<td>93.9745</td>
<td>95.2775</td>
<td>65.52</td>
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</table>

Test of Homogeneity of Variances

<table>
<thead>
<tr>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
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<tr>
<td>1.991</td>
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<td>.117</td>
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ANOVA

<table>
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<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>22883</td>
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<td>7.628</td>
<td>.348</td>
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<tr>
<td>Within Groups</td>
<td>4277730</td>
<td>195</td>
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<td>.791</td>
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<td>Total</td>
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Effects of Choice of Character

Descriptives

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<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>53</td>
<td>93.6630</td>
<td>5.56027</td>
<td>.76376</td>
<td>92.1304</td>
<td>95.1956</td>
<td>65.52</td>
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<tr>
<td>2.00</td>
<td>47</td>
<td>93.6170</td>
<td>4.56440</td>
<td>.66579</td>
<td>92.2769</td>
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<td>82.76</td>
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<tr>
<td>Total</td>
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<td>.50912</td>
<td>92.8312</td>
<td>94.8516</td>
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</tbody>
</table>

Note: ‘1.00’ and ‘2.00’ denote choice of character. 1.00 = Roger. 2.00 = Baby Crocodile.

Test of Homogeneity of Variances

<table>
<thead>
<tr>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
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<td>.158</td>
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<td>.692</td>
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ANOVA

<table>
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<th>F</th>
<th>Sig.</th>
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</thead>
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<tr>
<td>Between Groups</td>
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<td>.053</td>
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Appendix F

Phase 3 Statistical Analysis

### Group Statistics

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<th>char_choice</th>
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<th>Std. Error</th>
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<td>1.00</td>
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<td>93.6630</td>
<td>5.56027</td>
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<tr>
<td>2.00</td>
<td>47</td>
<td>93.6170</td>
<td>4.56440</td>
<td>.66579</td>
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### Independent Samples Test

<table>
<thead>
<tr>
<th>% of intervals where participant was attending</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>F = .158, Sig. = .692, df = 98</td>
<td>t = .045, Sig. (2-tailed) = .964</td>
<td>Mean Difference = .04596, Std. Error Difference = 1.02525, Lower = -1.98862, Upper = 2.08053</td>
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<tr>
<td>Equal variances not assumed</td>
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### Between-Subjects Factors

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<td>Interactive Video</td>
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</tr>
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<td>2.00</td>
<td>Interactive Stills</td>
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### Tests of Between-Subjects Effects

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<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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<tr>
<td>Corrected Model</td>
<td>.279</td>
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<td>.093</td>
<td>.003</td>
<td>1.000</td>
</tr>
<tr>
<td>Intercept</td>
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<td>1</td>
<td>869854.508</td>
<td>.0355</td>
<td>.000</td>
</tr>
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<td>.059</td>
<td>.002</td>
<td>.963</td>
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<tr>
<td>conditio</td>
<td>.224</td>
<td>1</td>
<td>.224</td>
<td>.008</td>
<td>.927</td>
</tr>
<tr>
<td>char_choice * conditio</td>
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<td>1</td>
<td>.005</td>
<td>.002</td>
<td>.963</td>
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<tr>
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<tr>
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</table>

R Squared = .000 (Adjusted R Squared = -.031)

### Attention by Interactive Segment

#### Interactive Segment 1

### Group Statistics

<table>
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<tr>
<th>Condition</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Score</td>
<td>31</td>
<td>95.7556</td>
<td>2.93631</td>
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<td>95.0044</td>
<td>3.83044</td>
<td>.68797</td>
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</tbody>
</table>

### Independent Samples Test

<table>
<thead>
<tr>
<th>Score</th>
<th>Levene’s Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal variances assumed</td>
<td>F = 1.567, Sig. = .216, df = 60</td>
<td>t = .774, Sig. (2-tailed) = .442</td>
<td>Mean Difference = .67119, Std. Error Difference = .86685, Lower = -1.06277, Upper = 2.40514</td>
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<tr>
<td>Equal variances not assumed</td>
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447
### Interactive Segment 2

**Group Statistics**

<table>
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<tr>
<th>Condition</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
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</thead>
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<tr>
<td>Score</td>
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<td>3.11901</td>
<td>1.17888</td>
</tr>
<tr>
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</tbody>
</table>

**Independent Samples Test**

<table>
<thead>
<tr>
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<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>2.017</td>
<td>.181</td>
<td>-3.017</td>
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<tr>
<td>Equal variances not assumed</td>
<td>2.017</td>
<td>.181</td>
<td>-3.017</td>
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### Interactive Segment 3

**Group Statistics**

<table>
<thead>
<tr>
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<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
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<tbody>
<tr>
<td>Score</td>
<td>5</td>
<td>97.1052</td>
<td>.58839</td>
<td>.26314</td>
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<tr>
<td>Interactive Video</td>
<td>5</td>
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<td>6.44765</td>
<td>2.88348</td>
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**Independent Samples Test**

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
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<tbody>
<tr>
<td>Scores</td>
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</table>

**Descriptive Statistics**

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<td>2.00</td>
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**Ranks**

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Appendix F  
Phase 3 Statistical Analysis

### Test Statistics

<table>
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<tr>
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<tr>
<td>Mann-Whitney U</td>
<td>.000</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>15.000</td>
</tr>
<tr>
<td>Z</td>
<td>-2.652</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.008</td>
</tr>
<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
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**a.** Not corrected for ties.

**b.** Grouping Variable: Condition

---

### Engagement

**Effects between Conditions**

#### Descriptives

<table>
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<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
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<th>Maximum</th>
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<tr>
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<td>Interactive stills</td>
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<td>.9655</td>
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#### Test of Homogeneity of Variances

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<th></th>
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<tr>
<td>Levene Statistic</td>
<td>df1</td>
<td>df2</td>
<td>Sig.</td>
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<td></td>
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<td>7.059</td>
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#### ANOVA

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<th>Sig.</th>
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<tr>
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#### Non-Parametric Tests

<p>| | | |</p>
<table>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Condition</td>
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<td>Mean Rank</td>
</tr>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
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<td></td>
</tr>
<tr>
<td>Linear</td>
<td>76</td>
<td>91.21</td>
</tr>
<tr>
<td>Interactive video</td>
<td>63</td>
<td>96.32</td>
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<tr>
<td>Interactive stills</td>
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<td>115.00</td>
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<tr>
<td>Total</td>
<td>199</td>
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### Appendix F

#### Phase 3 Statistical Analysis

<table>
<thead>
<tr>
<th>Test Statistics&lt;sup&gt;a,b&lt;/sup&gt;</th>
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</thead>
<tbody>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
</tr>
<tr>
<td>Chi-Square df</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
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</tbody>
</table>

<sup>a</sup> Kruskal Wallis Test  
<sup>b</sup> Grouping Variable: Condition

### Ranks

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<th>Condition</th>
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<tbody>
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<table>
<thead>
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</thead>
<tbody>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
</tr>
<tr>
<td>Mann-Whitney U</td>
</tr>
<tr>
<td>Wilcoxon W</td>
</tr>
<tr>
<td>Z</td>
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<tr>
<td>Asymp. Sig. (2-tailed)</td>
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<sup>a</sup> Grouping Variable: Condition

### Ranks

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<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
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<td>Interactive stills</td>
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<table>
<thead>
<tr>
<th>Test Statistics&lt;sup&gt;a&lt;/sup&gt;</th>
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<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
</tr>
<tr>
<td>Mann-Whitney U</td>
</tr>
<tr>
<td>Wilcoxon W</td>
</tr>
<tr>
<td>Z</td>
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<td>Asymp. Sig. (2-tailed)</td>
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<sup>a</sup> Grouping Variable: Condition

### Ranks

<table>
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<th>Condition</th>
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<th>Mean Rank</th>
<th>Sum of Ranks</th>
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<tr>
<td>Interactive video</td>
<td>63</td>
<td>56.51</td>
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Appendix F

Phase 3 Statistical Analysis

**Effects of Gender**

<table>
<thead>
<tr>
<th>Group Statistics</th>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
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</thead>
<tbody>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>Male</td>
<td>100</td>
<td>5.3352</td>
<td>6.9523</td>
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<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>Female</td>
<td>99</td>
<td>4.1206</td>
<td>4.1139</td>
<td>.4135</td>
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**Independent Samples Test**

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>Equal variances assumed</td>
<td>7.808</td>
</tr>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>Equal variances not assumed</td>
<td>1.502</td>
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**Non-Parametric Tests**

<table>
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<th>Ranks</th>
<th>Gender</th>
<th>N</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>Male</td>
<td>100</td>
<td>101.03</td>
</tr>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>Female</td>
<td>99</td>
<td>98.96</td>
</tr>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>Total</td>
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<td>99.96</td>
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**Test Statistics**

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<thead>
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<th>Asymp. Sig.</th>
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<td>.064</td>
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**Effects of Age**

<table>
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<th>Age in years</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>4</td>
<td>91</td>
<td>3.3327</td>
<td>3.4436</td>
<td>.3610</td>
</tr>
<tr>
<td>% of intervals with Verbal or Nonverbal Engagement</td>
<td>5</td>
<td>105</td>
<td>5.8769</td>
<td>6.9952</td>
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Appendix F

Phase 3 Statistical Analysis

Non-Parametric Tests

Ranks

<table>
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<th>Age in years</th>
<th>N</th>
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<th>Sum of Ranks</th>
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</thead>
<tbody>
<tr>
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<td>87.15</td>
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<td>Total</td>
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Test Statistics

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<tr>
<th>% of intervals with Verbal or Nonverbal Engagement</th>
<th>Mann-Whitney U</th>
<th>Wilcoxon W</th>
<th>Z</th>
<th>Asymp. Sig. (2-tailed)</th>
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<tbody>
<tr>
<td>4</td>
<td>3744.500</td>
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a. Grouping Variable: Age in years

Detailed Analyses

Correlations between Attention and Comprehension

% of Comprehension correct

% of intervals where participant was attending

0 20 40 60 80 100 120

% of Comprehension correct
### Correlations with Enjoyment Levels

#### Enjoyment and Condition

<table>
<thead>
<tr>
<th>% of Intervals where participant was attending</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>% of Comprehension correct</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Intervals where participant was attending</td>
<td></td>
<td>N</td>
<td>1.000</td>
<td>.120</td>
<td>.091</td>
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<td>% of Comprehension correct</td>
<td></td>
<td>N</td>
<td>120</td>
<td>1.000</td>
<td>.091</td>
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</table>

#### Descriptives

**Enjoyment**

<table>
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<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
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</thead>
<tbody>
<tr>
<td>Linear</td>
<td>76</td>
<td>4.3816</td>
<td>1.0579</td>
<td>.1213</td>
<td>4.1398 to 4.6233</td>
</tr>
<tr>
<td>Interactive video</td>
<td>63</td>
<td>4.4127</td>
<td>1.0570</td>
<td>.1332</td>
<td>4.1465 to 4.6799</td>
</tr>
<tr>
<td>Interactive stills</td>
<td>60</td>
<td>4.3833</td>
<td>1.1511</td>
<td>.1486</td>
<td>4.0860 to 4.6807</td>
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<tr>
<td>Total</td>
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<td>4.3920</td>
<td>1.0811</td>
<td>.1213</td>
<td>4.2408 to 4.5431</td>
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</table>

#### Test of Homogeneity of Variances

**Enjoyment**

<table>
<thead>
<tr>
<th>Levene Statistic</th>
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<th>df2</th>
<th>Sig.</th>
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<tr>
<td>.135</td>
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#### ANOVA

**Enjoyment**

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<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3.975E-02</td>
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</tr>
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<td>Within Groups</td>
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<td>1.181</td>
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<td>1.181</td>
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#### Group Statistics

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<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
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</thead>
<tbody>
<tr>
<td>Male</td>
<td>100</td>
<td>4.3200</td>
<td>1.1796</td>
<td>.1180</td>
</tr>
<tr>
<td>Female</td>
<td>99</td>
<td>4.4646</td>
<td>1.1796</td>
<td>.1180</td>
</tr>
</tbody>
</table>
Appendix F

Phase 3 Statistical Analysis

Independent Samples Test

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>df</td>
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<tr>
<td>Enjoyment</td>
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<td></td>
<td>Equal variances not assumed</td>
<td>-2.371</td>
<td>.125</td>
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</tbody>
</table>

Enjoyment and Age

Descriptives

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
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<td>4</td>
<td>91</td>
<td>4.2857</td>
<td>1.1859</td>
<td>.1243</td>
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<td>6</td>
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<td>.0000</td>
<td>0.0000</td>
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<tr>
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<td>4.4091</td>
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<td>7.508E-02</td>
<td>4.2610</td>
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Test of Homogeneity of Variances

<table>
<thead>
<tr>
<th></th>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
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ANOVA

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<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3.045</td>
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<td>1.369</td>
<td>.257</td>
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<td>Within Groups</td>
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<td>1.112</td>
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<td></td>
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<tr>
<td>Total</td>
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### Enjoyment and Comprehension

<table>
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<tr>
<th>% of Comprehension correct</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
<th>Enjoyment</th>
</tr>
</thead>
<tbody>
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<td>% of Comprehension correct</td>
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<td>199</td>
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<td>.493</td>
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### Enjoyment and Attention

<table>
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<th>% of intervals where participant was attending</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
<th>Enjoyment</th>
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<td>Enjoyment</td>
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<td>.034</td>
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<tr>
<td>% of intervals where participant was attending</td>
<td>.034</td>
<td>.634</td>
<td>199</td>
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