

Hemispheric Differences in the Appreciation of the Overall Meaning of Passages

Jason Lloyd

Bachelor of Psychology with Honours

Murdoch University

*This thesis is presented in partial fulfillment of the requirements for the degree of
Bachelor of Psychology (Honours), Murdoch University, 2013.*

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary educational institution.

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Jason Lloyd

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Full Name of Degree: Bachelor of Psychology with Honours

Thesis Title: Hemispheric Differences in the Appreciation of the Overall
Meaning of Passages

Author: Jason Lloyd

Year: 2013

Abstract

This study examined hemispheric differences in processing the overall meaning of passages. Based on past research it was hypothesised that the right hemisphere (RH) would be uniquely involved in processing the overall meaning of passages. A sample of 52 right-handed Murdoch University students participated in a lexical decision task, with reaction time (RT) and error rates recorded. Stories were read between each trial with half of the target words presented in the passages to manipulate the independent variables of: visual field of presentation (left or right), relatedness to the overall meaning of passages (related or unrelated), and presence in passages (in or out). A significant facilitation effect in favour of the LH over the RH was found for words that were not present in the passages, however there was no significant difference in facilitation effects between hemispheres for words in the passages. Further, this LH advantage was found for males but not for females, with females having no significant hemispheric differences for facilitation effects. The results therefore did not replicate the findings of previous studies demonstrating a RH dominance for the appreciation of the overall meaning of stories (Jung-Beeman, 2005). Rather, the presence effect demonstrates a LH dominance for making the inferences necessary for the appreciation of the overall meaning of stories. The results are also consistent with McGlone's (1977) interhemispheric model, claiming that language is predominately processed in the LH for males and bilaterally for females.

Keywords: lexical decision task, hemisphere, visual field, language, overall meaning

Acknowledgments

I would like to thank my supervisor, Jeffrey Coney, for his support and guidance throughout the preparation of this thesis. He has approached my work with great enthusiasm and at times humour. I could not have asked for a better supervisor.

I also wish to thank my friends and colleagues for their support and encouragement throughout this endeavor.

Finally, I would like to give a special thanks to my very understanding and loving partner, Sandy Roberts, for her patience and support. Also, to my family that have had to put up with hearing about my thesis highs and lows throughout the past year.

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Hemispheric Differences in the Appreciation of the Overall Meaning of Passages

The left hemisphere (LH) has been considered the dominant hemisphere for most language processes (for a review, see Vigneau et al., 2006). This however brings into question the functional role of the language areas of the right hemisphere (RH). It has become clear from studies using participants with unilateral brain damage, that the LH is not the only hemisphere involved in the comprehension of language. People with LH brain damage (LHD) do not lose all language abilities, and people with RH brain damage (RHD) do not maintain all language functionality (eg. Jung-Beeman, 2005; Lehman-Blake & Tompkins, 2001; van Lancker & Kempler, 1987). This evidence implicates both hemispheres as having a role in language processing, rather than the RH simply lying dormant while the LH does all the work. It may be the case that the two hemispheres need to collaborate due to the complexity of language processing and the necessity to complete the process at a high frequency, while simultaneously considering the content in depth (Rorden & Karnath, 2004).

As more frequent words receive greater activation over time, it makes sense that they would be activated faster when encountered. However, using the dominant meaning of words cannot always be seen as the goal of language processing. It seems that when the non-dominant meaning of a word is required, the RH may play an important role, such as with sarcasm, metaphors or the punch line of a joke (eg. Briner, Joss, Virtue, 2011; Coulson & Wu, 2005; Vance & Virtue, 2011). In these cases if the dominant meaning was selected and the less dominant meaning was not considered, then one would miss the point.

A theory on hemispheric differences in language processing by Beeman (1998) can help to clear up some of the evidence. Beeman proposes that the LH

activates a smaller semantic field (fine semantic coding) and the RH a wider semantic field (coarse semantic coding). This could allow the LH to process the more frequent meanings of words, while the RH maintains activation of other meanings to later be used depending on the context. This would ensure that language could be processed at a speed that allows fluency, while the RH allows the secondary meanings to be available when needed.

Discourse Level Processing

Beyond the inherent difficulties of processing single words, at another level it is necessary to combine words into meaningful chunks of text to form sentences and paragraphs. This is known as the discourse level (Kintsch & Dijk, 1978). At this level, language processing involves observing a set of syntactical rules. Semantic activation becomes more complex, forcing one to go beyond simply processing the meaning of each single word in isolation, rather one needs to combine these words to create sentences. This process is necessary for language to serve its function, rather than simply being seen as many scrambled bits of information.

Beyond this, sentences need to be considered together in order to make the correct inferences to become paragraphs and narratives. People with RHD seem to have difficulties in drawing inferences required for combining words and sentences to understanding language at a discourse level (Beeman, 1993; Brownell, Potter, Bihrlé, & Gardner, 1986). This may implicate the RH as playing an important role in language processing with the intact brain at the discourse level, while the LH processes language at the word level.

Functional MRI (fMRI) and behavioral studies have further implicated the RH of people with intact brain function, as having a substantial role at the

discourse level (eg. Gouldthorp & Coney, 2009; Robertson et al., 2000; St George, Kutas, Martinez, Sereno, 1999; Virtue & Joss, 2012). The LH seems to predict the most likely words according to the context, while the RH integrates new information with the current context of the text and prior knowledge of the world (Federmeier & Kutas, 1999; Grindrod & Baum, 2003; Weylman, Brownell, Roman, & Gardner, 1989). This line of evidence fits with Beeman's (1998) theory that the RH is involved in coarse semantic processing and the LH is involved in fine semantic processing. The LH appears to be the main processor of language, that comprehends language via the most appropriate path based on the current context. While this occurs, it seems that the RH plays a very important role in combining words into a meaningful coherent story based on inferences with previous words, sentences, experiences and knowledge of the world, along with distantly related meanings of words. In this sense the two hemispheres share the computational load of language processing required at the discourse level. This may be due to the increasing complexity of language at this stage, requiring another processor to reduce the cognitive load and keep up with the high frequency of language while appreciating its overall meaning.

St George et al. (1999) found greater activation in both hemispheres while participants read paragraphs using an fMRI machine. More importantly they found greater activation in the RH when the paragraphs did not have titles. The significance of this finding is that not having a title may have required a greater need to integrate information within the text to gain an overall understanding, as the overall meaning is not directly displayed. Xu, Kemeny, Park, Frattali and Braun (2005) measured activation in the brain in response to written stimuli at different levels of complexity (single words, sentences and narratives). They

found that the RH had greater activation at the narrative level compared to the word level. This seems to show a tendency for the RH to become increasingly activated as the text becomes more complex, showing a tendency for both hemispheres to work together when needed.

To further implicate the RH as having a prominent role in drawing meaning at the discourse level, Graves, Binder, Desai, Conant and Seidenberg (2010) found greater blood flow in the LH in response to reading word pairs without a combined meaning (word-level processing), and increased blood flow to the RH when the words had a unique meaning when combined. The LH was found to be active for all conditions, however the RH showed the greatest activation at the narrative level. Further, people with RHD have been found to have an inhibited ability to retell stories, resulting in disintegrated stories that miss the overall gist (Benowitz, Moya, & Levine, 1990; Joannette, Goulet, Ska, Nespoulous, 1986; Marini, Carlomagno, Caltagirone, & Nocentini, 2005). Wegner, Brookshire, & Nicholas (1984) also found that LHD lead to problems in answering questions related to the details of a story which they had just heard, they were however still able to answer questions about the main ideas of the stories. This shows that the RH may have made it possible to integrate the overall meaning of the story into a global coherence, but not to process details. These studies demonstrate that the RH may play an important role in combining words and sentences at the discourse level. Activation at this level seems to show the RH as dominant for gaining the overall meaning of passages, by integrating single words into a discourse to then have an overall interpretation.

Appreciation of the Overall Meaning

To determine more specifically if the RH has an important role in appreciating the overall meaning of discourse, studies have focused on testing participants with unilateral brain damage (Schneiderman, Murasugi, & Saddy, 1992). Hough (1990) presented participants with LHD, RHD and no brain damage with a set of paragraphs. After the paragraphs were read to participants, they responded to questions that related to the main theme of the story. The sentence that contained the overall theme of the story for each paragraph, was manipulated to be presented at either the end or beginning of each paragraph. RHD participants had more difficulty answering questions related to the overall theme than both the LHD and non-brain damaged participants. Further, the performance of participants with RHD was worse when the theme was presented at the end of the paragraphs, than at the beginning. RHD therefore seemed to disrupt the ability to appreciate the theme of the story. This indicates an important role for the RH in comprehending the overall meaning of stories.

Wapner, Hamby and Gardner (1981) support these results using a similar method using a brain damage population. They however emphasize problems with presenting stories, then later asking participants to recall them. This type of task does require processing the overall meaning of the story, however results could be confounded due to memory effects. This makes it difficult to determine what can be attributed to memory effects and what can be attributed to language processing. To reduce this confounding variable, Wapner et al. (1981) supplemented the recall task with a story arrangement task. This required participants to arrange a set of randomly displayed sentences into a coherent story. They found that RHD participants were diminished in their ability to arrange sentences into a coherent narrative, showing a general problem with

discourse comprehension. They further showed problems in reporting the moral of fable-like stories. RHD participants reported literal parts of the story, rather than an integrated overall meaning.

Schneiderman et al. (1992) conducted a story arrangement task, with the addition of presenting a sentence that represented the theme of the story at the beginning of half the trials and not presenting the theme in the other trials. Participants were informed that the theme sentences provided a summary of the story. This task therefore eliminated confounds due to memory problems and tested the ability of LHD, RHD and non-brain-damaged participants performance with and without an overall theme presented. The LHD and non-brain damaged participants performed significantly better at the task when presented with the theme sentence rather than without it. RHD participants did not differ significantly between the two conditions. This shows more clearly a reduced ability for RHD participants to appreciate the overall theme of a narrative.

Inconsistencies

The conclusion that the RH plays an important role in the global coherence of discourse and the resulting appreciation of the overall meaning is not without controversy. Ferstl and von Cramon (2001) did not find a significant involvement of the RH in making inferences necessary to build coherence in text using an fMRI methodology. Rather, they implicate the LH as the dominant processor at all levels of processing, with the RH only playing a non-dominant role at all stages. Further, Maguire, Frith, and Morris (1999) used a positron emission topography (PET) study with participants reading passages, therefore directly testing discourse processing. Their findings support the evidence that the LH is likely the dominant processor at this level not the RH. Both these studies

run counter to the conclusion that the RH is dominant in processing at the discourse level.

Looking specifically at processing the overall meaning of passages, Brookshire and Nicholas (1984) tested participants by asking them to answer true or false questions about passages they just read. Half of the questions were related to the 'main idea' of these passages and half were related to specific details of the story. People with RHD did not differ significantly from non-brain damaged participants, however people with LHD performed significantly worse than other participants. Rehak et al. (1992) found that RHD participants only had a reduced ability to respond to questions related to stories when they were not 'interesting', which may account for some of the evidence suggesting a RH dominance. Overall, these studies demonstrate that the LH may have a critical role in processing language at the discourse level and appreciating the overall meaning of passages, with the RH only playing a secondary role.

These different findings between studies may be due to a few possibilities. Ferstl and von Cramon's (2001) study involved reading two short sentences ($M=6.9$) at a time, opposed to St George et al. (1999) and Xu et al. (2005) using longer narrative style text in the form of paragraphs. It may be that the RH is utilized to a greater degree as text becomes more complex and provides greater context (Federmeier & Kutas, 1999; Grindrod & Baum, 2003; Gouldthorp & Coney, 2009). The RH may only be required at this stage to reduce the cognitive load by processing the overall meaning of the passages, to allow the LH to keep up with the high frequency of processing required with natural language.

Limitations in using populations with brain damage also need to be considered. Due to neuroplasticity, the brain may have compensated for a loss of

function by using other areas, therefore a loss of function in one hemisphere may result in other areas compensating (Cohen et al., 2004; Stern, 2002). Therefore, results could not be taken as evidence for isolated functioning in brain areas when compared to healthy participants. Another possible limitation may be that areas that seem to be functioning normally may be impaired by disconnection or disruption to other brain areas required for earlier stages of processing (Rorden & Karnath, 2004). It would therefore seem possible that the function of each hemisphere could vary, depending on whether it was receiving the appropriate information from the other hemisphere or surrounding areas (Mohr, Pulvermüller & Zaidel, 1994). The true functions of brain parts could therefore be obscured.

The present study

The aim of the present study is to determine if there are hemispheric differences in processing the overall meaning of passages. Previous studies have focused primarily on determining this using small sample sizes with unilateral brain damage (Hough, 1990; Schneiderman et al., 1992; Wapner et al., 1981). A lexical decision task (LDT) will be used to determine if these findings can be demonstrated with normal functioning in people that do not have brain damage. This will help eliminate the limitations inherent in brain damage studies (Rorden & Kardath, 2004) and help clear up an inconsistency in the literature over the role of the RH in the comprehension of the overall meaning of narratives (Brookshire & Nicholas, 1984; Ferstl & von Cramon, 2001). The present study also aims to extend the findings that suggest a RH role in processing language at the discourse level, as this would seem to be necessary to obtain an overall meaning of the passage (Gouldthorp & Coney, 2009; St George et al., 1999; Virtue & Joss, 2012). It is expected that the outcome of this study will help to

contribute to the understanding of the neurological processes of higher order language processing, by further exploring the role of the RH in language processing.

To support this, it was hypothesised that words related to the overall meaning of passages would result in faster reaction times during a LDT, than words that were not related to the overall meaning of passages when presented to the left visual field/RH (LVF/RH). It was also hypothesised that this facilitation effect for words related to the overall meaning of passages, would be significantly greater for the LVF/RH than the right visual field/LH (RVF/LH).

Methodological Difficulties

LDTs are commonly used to test for hemispheric differences in language processing with non-brain damaged participants (eg. Briner et al., 2011; Faust & Babkoff, 1997; Vance & Virtue, 2011). This method presents some difficulties for determining hemispheric differences in priming effects to overall meaning of stories. Previous studies testing hemispheric differences in processing the overall meaning of passages have used populations with unilateral brain damage. They have manipulated the theme of a story by inserting and changing sentences that encompass the theme or asked participants questions in relation to the theme (Brookshire & Nicholas, 1984; Schneiderman et al., 1992; Wapner et al., 1981). A LDT would involve using clear singular words that encompass the overall meaning of each passage, rather than asking questions. With other language processes, this is often accomplished by first employing a pilot study, to ensure that the target words are sufficient primes in relation to the text used, such as for priming for sarcasm, metaphors and inferences between sentences (eg. Briner et al., 2011; Faust & Kahana, 2002; Kacinik & Chiarello, 2007). Priming to the

overall meaning of stories and subsequent testing with a LDT task, would require passages to be created that are long enough to facilitate discourse processing and have clear identifiable singular words associated to them.

Studies focusing on hemispheric differences have demonstrated some characteristics of words that seem to limit the ability of the RH to process them, leading to biases due to earlier processing. Hemispheric differences may be biased due to word length effects, with longer words increasing the response time of the LVF/RH and remaining stable in the RVF/LH (Ellis, Young, & Anderson, 1988). This effect may be greater for words that are lower in concreteness ratings (Bub & Lewine, 1988) and frequency (Young & Ellis, 1985). The ability to have more concrete and frequent words depends on the words obtained by a panel, but it seems unlikely that words will have a high concreteness rating or frequency, due to the nature of words used to express the overall meaning of stories (eg. selfishness or laziness). With the present difficulties, it is unclear if a LDT can be completed. However, if a LDT could be used, it would be beneficial in reducing confounding variables due to memory problems inherent in brain damage studies (Schneiderman et al., 1992). It would also reduce confounds due to more general disruptions from brain damage (Mohr et al., 1994). Beyond this it will help to resolve inconsistencies in the literature over the role of the RH in the appreciation of the overall meaning of passages.

Method

Participants

The participants were 52 undergraduate students from Murdoch University, with the majority receiving course credit in return. They consisted of 20 males and 32 females with a mean age of 24.21 years ($SD=7.29$ years). All participants

were native English speakers and had normal or corrected-to-normal vision. Handedness was assessed using Bryden's Simplified Hand Preference Questionnaire (Bryden, 1982; see Appendix A). The mean handedness scale rating for the sample was 0.89 ($SD=0.14$), on a scale from +1.00 (extreme right-handedness) to -1.00 (extreme left-handedness). This demonstrates a clear right-handed preference.

Design and Stimulus Materials

A 2x2x2 repeated measures design was implemented to manipulate the independent variables: visual field of presentation (left or right), relatedness to the overall meaning of the passages (related or unrelated), and presence in the passage (in or out). The dependent variables were reaction time (RT) and error rates, with RT as the primary measure.

Passages. Passages were designed to be between 150-200 words and have a clear overall message that could be described with single words. This was to ensure that clear single words related to the overall meaning of each passage could be obtained, which could then be used in a LDT. Some passages were created specifically for this study, while others were obtained online and modified to meet the specifications outlined (<http://www.aesopfables.com/>; <http://www.parablesite.com/>; <http://www.rc.net/wcc/parables.htm>). A total of 30 passages were developed without informative titles, to ensure the overall meaning of the story was not given away at the beginning. Passages had the titles 'Story 1-30' corresponding with the order in which they were presented. Each passage was printed on a separate A4 page in a bound book with size 12, Verdana font, white background and black text. Although 30 passages were created, only the 24 providing four clear words related to the overall meaning

without duplication across passages were used (see Appendix B for full range of passages). This was determined using a panel of 11 participants, who were asked to write as many single words as possible that were related to the overall meaning of each passage.

Target Words. Four target word conditions were necessary for the manipulation of the independent variables of words: (a) related to the overall meaning and not in the passage, (b) related to the overall meaning and in the passage, (c) unrelated to the overall meaning and not in the passage, and (d) unrelated to the overall meaning and in the passage. This was to allow measurement of RTs for participants on a LDT for the overall meaning of stories and to show if this effect was moderated by presence in the passages. For each condition, two target words were created, resulting in a total of 192 target words. Words related to the overall meaning of the passages were created using a pilot study with a panel of 11 participants. They were asked to read each passage, while thinking about the overall meaning it conveyed. After reading each passage they were asked to write down as many single words that encompass the overall meaning, without re-reading the passage (see Appendix C for instructions to the panel). The most frequent four words between participants were selected for each passage. From the 30 passages presented, the 24 with the greatest frequency between participants with four words were chosen for the final presentation. Where the most frequent words resulted in repetition across passages, the next most frequent word was selected. This was to ensure that results were not confounded due to a word being presented twice in the LDT. Due to the difficulty in obtaining four single words for each passage that encompassed the overall message, it was not feasible to put restrictions on words

to make them standardised. Therefore, the panel were not instructed to limit the words they used, but shorter words were selected where possible and verbs were avoided.

The related words were used to create the unrelated words, by matching them with unrelated words based on length, grammatical category and word frequency. To ensure unrelated words could be used for the condition of presence in the passage, they were required to be able to fit into the story they were created for. The final set of probes had a mean length of 6.94 letters ($SD = 2.18$) and a mean frequency of 68.23 occurrences per million ($SD = 134.67$; Kucera & Francis, 1967). Each target word was used to generate 192 non-words by changing 1-3 letters in the middle to still be orthographically legal and pronounceable. Half of the unrelated and related words were inserted into the relevant passages, while ensuring that the other half were not in the passages. An example of a passage used in the current study is “There once was a little boy who had a temper. His father gave him a bundle of nails and made a contract stating that every time he lost his temper, he must hammer a nail into the backyard fence. The first day the boy drove 37 nails into the fence. Over the weeks, as he learned to regulate these feelings, the number of nails gradually dwindled down. He found it easier to handle his temper than to drive nails into the fence. His father suggested the boy pull out one nail for each day he could handle his temper to continue teaching the lesson. Eventually the young boy told his father all the nails were gone. The father led his son to the fence and said, “Now look at the holes in the fence. The fence will never be the same. When you say things or do things from losing your temper, they leave a scar just like those holes. You can put a knife in a man and draw it out. It won’t matter how much

regret you have or how many times you say, ‘I’m sorry,’ the wound is still there.” An example of the accompanying target words related to the overall meaning of the story is: ‘control’ and ‘regret’ (for the full list of target stimuli see Appendix D).

Counterbalancing. The primary objective of counterbalancing was to ensure the results could be attributed to the condition the words appeared in, rather than simply to differences between sets of words. Counterbalancing the condition of field of presentation was achieved by creating two sequence lists, to ensure that each word was presented to both visual fields.

To counterbalance the condition of presence in the passage, two further sequence lists were created based on the first two. These lists differed in relation to presence in the passage, to ensure that each word was tested in and out of the passage. Changing this condition required two sets of passages to be created. The same passages were used with the difference of alternating the presence of words in the passages. This was achieved by changing the passages with as few words as possible to insert and remove words.

The condition of relatedness was counterbalanced, by matching related words obtained from the pilot panel with unrelated words on length, grammatical category and word frequency. This method was preferred, as changing the passages to alternate the overall meaning of the story would require extensive piloting and changing the passages considerably. This task may not be possible due to the inherent difficulties in creating passages to have a clear message and in obtaining the related words to be used in the LDT.

The four sequence lists were alternated between participants, ensuring that an equal number of male and female participants completed each one. The order

of presentation for each sequence list was randomised, resulting in stimuli being presented in a unique sequence for each participant.

Apparatus

The LDT was run on an Intel Pentium 4 processor with a Windows 98 operating system and 258 Mb ram. This was displayed on a Samsung SyncMaster 931c monitor with a 1280x1024 pixel resolution, 32-bit colour and a refresh rate of 75 hertz. Responses were recorded on a 2-button (left/right) microswitch attached to the serial port. To ensure a standardised distance was maintained when presented with the strings of letters, participants remained on a chin rest set at 60cm away from the monitor and individually adjusted for height. To remove distractions due to extraneous noises, participants used the ear defenders that were provided. A CCTV system was used to ensure that the gaze of participants was centrally fixated throughout the LDT.

Procedure

Participants attended a one and a half hour session. All participants were individually tested in the Murdoch University Cognitive Psychology Laboratory, which was illuminated by fluorescent lighting. Before testing began participants were presented with an information sheet (see Appendix E), were instructed on what was expected for testing (see Appendix F) and signed a consent form if they were still willing to continue (see Appendix G). Participants also completed Bryden's Simplified Hand Preference Questionnaire (1982) and any questions or concerns were answered.

Participants were tested in separate cubicles. They were requested to sit at the testing cubicle and put on the ear defenders provided. They then completed a randomized practice trial with 16 strings of letters, with stimuli that did not

appear in the main trials. They were asked if they had any further questions or concerns. Their age and sex was then recorded on the computer and they were allocated a stimulus file that corresponded with the set of passages they were given. Participants were then ready to start by reading parables one at a time before each trial, corresponding with the passage indicated on the screen.

Participants were asked to think of the overall meaning of the story as they read, to ensure that they engaged with the material, rather than reading passively and not integrating the overall meaning. Participants started each trial by pressing the 'enter' key on the keypad after reading each passage and placing their head on the chinrest. They therefore had time to have a short break between trials if required.

After participants pressed the 'enter' key a cross appeared in the centre of the screen. After 700ms the cross was replaced with a string of letters on either the left or right side of the screen (LVF/RH or RVF/LH). The string of letters were black uppercase letter in Verdana font size 26, set at 2.1° from the centre of the screen. The task was to press both microswitches simultaneously if the string of letters were words and withhold from responding if they were non-words. If responses to words were not made within 1500ms, this resulted in a false response. Participants were asked to complete this as fast as possible, while making as few errors as possible. Participants were asked to maintain central vision at all times. Eye movements were monitored by the experimenter using a CCTV system in an adjacent room. False responses resulted in the word 'ERROR' in red uppercase letters, size 26 Veranda font, to be displayed on the centre of the screen. After each trial, mean RT and error rates were displayed on the screen along with instructions of which passage to read.

Results

Reaction Time Analyses

The data was screened for outliers exceeding a total mean RT of more than 2 standard deviations. This resulted in the removal of the data from one participant. The RT data was further screened for outliers using a customized program utilizing a deletion criteria of +/- 2.5 standard deviations for mean RT for each trial. This resulted in the removal of 2% of the total number of trials ($N=9,792$). An alpha level of .05 was utilized for all analyses.

A mixed-model analysis of variance (ANOVA) was conducted to assess the mean RT scores on the independent variables of: visual field of presentation (left or right), relatedness to the overall meaning of the passages (related or unrelated), and presence in the passage (in or out), with sex as a between-subjects variable (male or female). The mean RT and standard errors are summarised in Table 1.

Table 1

Mean reaction times for the conditions of relatedness, presence and visual field

	<i>M</i>	<i>SE</i>
Related	598	12
Unrelated	618	12.34
In	584	11.76
Out	632	12.62
RVF/LH	590	12.9
LVF/RH	625	11

The mixed-model ANOVA revealed a significant main effect for mean RT scores for visual field of presentation, $F(1, 49) = 29.38, p < .001, \eta^2 = .38$, for the main effect of relatedness, $F(1, 49) = 28.24, p < .001, \eta^2 = .37$, and a main effect for presence in the passage, $F(1, 49) = 143.38, p < .001, \eta^2 = .75$. This indicates that the greater mean RT scores for words presented to the RVF/LH compared to the LVF/RH is significant. This finding is common in lateralized LDTs, therefore it suggests that participants maintained central fixation (eg. Chiarello, 1998).

The results also indicate that the greater mean RT for words related to the overall meaning of the passages compared to words unrelated to the overall meaning is significant. This finding is expected for successful manipulation of relatedness to the overall meaning of the passage. The main effect of presence indicates that the greater mean RT for words present in the passages were significantly faster compared to words not present in the passages. This reveals that there was a priming effect for presence in the passage.

Facilitation Effects

An analysis of facilitation effects was conducted to allow a direct comparison between hemispheres for the variable of relatedness to the overall meaning of passages. Mean difference scores were calculated by subtracting the mean scores of related conditions by the corresponding unrelated conditions for each participant (eg. RVF/LH, related, out of passage conditions subtracted by RVF/LH, unrelated, out of passage conditions). A mixed-model ANOVA was then conducted on the facilitation scores with the resulting variables of: visual field of presentation (left or right), presence in the passage (in or out), with sex as a between-subjects variable (male or female). The mean RT and standard errors are summarised in Table 2.

Table 2

Mean facilitation scores for reaction times as a function of visual field and presence

	LVF/RH		RVF/LH	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
In	47	7.32	47	5.3
Out	31	8.54	67	8.83

The mixed-model ANOVA revealed a significant main effect for visual field of presentation, $F(1, 49) = 4.63, p = .036, \eta^2 = .09$ and a significant three way interaction between field of presentation, presence in the passage and sex, $F(1, 49) = 9.05, p = .004, \eta^2 = .16$.

To investigate this effect more closely planned comparisons were conducted on facilitation scores (paired samples t-tests). Facilitation effects for words not present in the passages were significantly greater when presented to the RVF/LH ($M=67, SE=8.83$) compared to the LVF/RH ($M=31.08, SE=8.54$), $t(50)=2.69, p=.01$. This shows that there was a significant difference between the amount of facilitation between hemispheres. In regards to words present in the passages, a significant difference was not found between the visual fields of presentation.

Sex Differences

To determine the impact of sex differences on facilitation effects, repeated measures ANOVAs were conducted separately for females and males. The mean RT and standard errors are summarised in Table 3.

Table 3

Mean facilitation scores for reaction times as a function of visual field and presence for males and females

Sex		LVF/RH		RVF/LH	
		<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
Male					
	In	49	12.54	42	7.41
	Out	16	15.42	89	16.55
Female					
	In	46	9.09	50	7.34
	Out	41	9.73	53	9.17

No significant main effects or interactions were found for females. For males, a significant two-way interaction was found between visual field of presentation and presence in the passage, $F(1, 19) = 12.24, p = .002, \eta^2 = .39$ (see Figure 1).

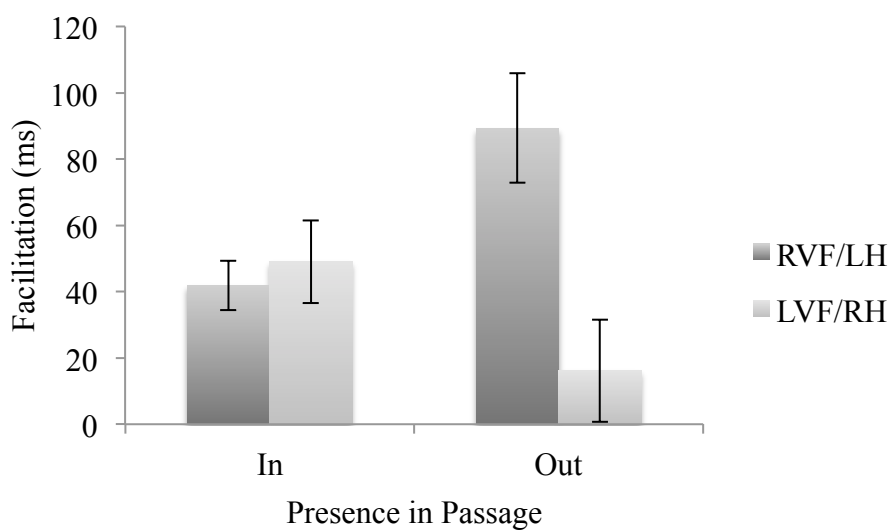


Figure 1. Mean facilitation (ms) of each visual field/hemisphere of presentation, as a function of presence in the passage (in/out). Error bars represent +/- 1 standard error.

To investigate this effect more closely planned comparisons were conducted for males (paired samples t-tests). Facilitation effects when words were not present in the passages were significantly greater when presented to the RVF/LH ($M=89.35$, $SE=16.55$) compared to the LVF/RH ($M=16.15$, $SE=15.42$), $t(19)=2.69$, $p=.014$. This shows a clear facilitation effect for words related to the overall meaning of the passages in the RVF/LH, when words were not present in the passages for males. This demonstrates a lateralization effect for males not demonstrated in females, for words not present in the passages.

Error Rate Analyses

A mixed-model ANOVA was conducted on error rates for the independent variables of: visual field of presentation (left or right), relatedness to the overall meaning of the passages (related or unrelated), and presence in the passage (in or out), with sex as a between-subject variable (male or female). The mean RT and standard errors are summarised in Table 4.

Table 4

Mean error rates for the conditions of relatedness, presence and visual field

	<i>M</i>	<i>SE</i>
Related	11.5	1.06
Unrelated	26.5	1.88
In	14.6	1.16
Out	23.4	1.72
RVF/LH	13.9	1.26
LVF/RH	24.1	1.96

A significant main effect was found for visual field of presentation, $F(1, 49) = 32.35, p < .001$, a main effect of relatedness, $F(1, 49) = 139.5, p < .001$, and a main effect for presence in the passage, $F(1, 49) = 87.74, p < .001$. These results suggest that the lower mean error rates for words presented to the RVF/LH compared to the LVF/RH were significant. They also reveal that the lower mean error rates for words present in the passages compared to words not present in the passages was significant. Finally, they reveal that the lower mean error rate for words related to the overall meaning of the passages compared to words unrelated was significant. These findings are consistent with results found for mean RT scores. They therefore support the stimuli for the manipulation of priming to the overall meaning of the passages and suggest participants attended to the task.

Discussion

The main focus of this study was to investigate if there are hemispheric differences in processing the overall meaning of passages. It has been suggested that the RH is the dominant processor in comprehending the overall meaning of passages, as explained with the coarse coding theory (Jung-Beeman, 2005). This theory posits that the LH activates a smaller semantic field (fine semantic coding) and the RH a wider semantic field (coarse semantic coding). This would allow the LH to process the more frequent meanings of words, while the RH maintains activation of other meanings to later be used depending on the context. Previous studies have focused primarily on determining this using small sample sizes with unilateral brain damage, with varied conclusions over which hemisphere is dominant for this process (Hough, 1990; Schneiderman et al., 1992; Wapner et al., 1981). Therefore the current study set out to test this with a

behavioural study (LDT) to eliminate possible limitations inherent in brain damage studies (Rorden & Kardath, 2004) and help clear up the inconsistency in the literature over the role of the RH in the comprehension of the overall meaning of passages (Brookshire & Nicholas, 1984; Ferstl & von Cramon, 2001).

The current study supported the hypothesis that words related to the overall meaning of passages would result in faster reaction times during a LDT, than words that were not related to the overall meaning of passages when presented to the LVF/RH. However, the hypothesis that this facilitation effect for words related to the overall meaning of passages would be significantly greater for the LVF/RH, than the RVF/LH was not supported. Rather, there was an unexpected finding between hemispheres in regards to facilitation effects from the manipulation of relatedness to the overall meaning of the passages. A significant facilitation effect in favour of the LH over the RH was found for words that were not present in the passage, however there was no significant difference in facilitation effects between hemispheres for words in the passages. Further, this LH advantage was found for males but not for females, with females having no significant hemispheric differences for facilitation effects.

The results therefore did not replicate the findings of previous studies demonstrating a RH dominance for the appreciation of the overall meaning of stories (Benowitz, et al., 1990; Hough, 1990; Joannette et al., 1986; Schneiderman et al., 1992; St George et al., 1999; Wegner et al., 1984). It also does not give support to Jung-Beeman's (2005) course coding theory as an explanation for the appreciation of the overall meaning of passages. Some studies testing hemispheric differences at the discourse level have not found a RH dominance,

rather they have found a LH dominance (Brookshire and Nicholas, 1984; Ferstl & von Cramon, 2001; Maguire et al., 1999; Rehak et al., 1992). These findings are supported with the current study, however this is isolated to males with target words not present in the passages. Words present in the passages for males did not support dominance for either hemisphere. However for females, both words present and not present in the passages, did not support dominance for either hemisphere.

Presence Effect

Looking closely at the stimuli in the present study, the four stimuli required to manipulate the independent variables were target words: (a) related to the overall meaning and not in the passage, (b) related to the overall meaning and in the passage, (c) unrelated to the overall meaning and not in the passage, and (d) unrelated to the overall meaning and in the passage. The stimuli that were not present in the passages (a and c) only have the difference of relatedness to the overall meaning, therefore looking more directly at the effect of relatedness. The stimuli present in the passages (b and d) may be confounded due to being primed from their presence in the passages, rather than simply primed due to relatedness. Inserting the words into the stories may have resulted in them becoming salient in the passages. This may construe hemispheric differences in higher level processing, such as to the overall meaning of passages, as the non-dominant hemisphere may already be activated due to earlier processing mechanisms.

This presence effect may also demonstrate LH dominance in making predictions based on the context of preceding text. In contrast to words present in the passages, words not present may require forming more inferences based on the context of the story, to determine the overall meaning. Participants may have

attended to the words related to the overall meaning of the stories as they read them in the passages, therefore reducing the necessity to make inferences. As the LH has been demonstrated to play a crucial role in utilizing sentence constraint to select and integrate contextually relevant meanings (Kacinik & Chiarello, 2007; Kandhadai & Federmeier, 2010), this may explain the presence effect in the current study. The LH may have been required to infer from the stories information to determine their overall meaning, when the words were not explicitly in the passages. Further, this process of attending to the related words would have been initiated in the present study, as participants were asked to think of the overall meaning of the stories as they were reading.

Participants may have identified the words related to the overall meaning of the passages, but for this to affect RTs in the LDT, words would be required to stay in memory for a period of time (either implicit or explicit). This effect itself may have a significant impact on the lateralisation of language processing, as words presented to the LVF/RH have been shown to be remembered faster compared to words presented to the RVF/LH (Evans & Federmeier, 2007; Federmeier & Benjamin, 2005). These studies also demonstrate that this effect becomes more pronounced for the LVF/RH over the RVF/LH as the time between presentation and recall is lengthened.

It may be that in the current study, the RVF/LH was dominant for processing the overall meaning of stories due to the ability to make inferences, as determined by the words that were not present in the passages. However, the LVF/RH may have been faster at remembering target words after they had been identified in the passages, resulting in faster mean RTs for the LVF/RH. As these two processes worked in parallel, differences between hemispheres may have

become less pronounced. This may explain the reason why hemispheric differences in favour of the RVF/LH were isolated to words not present in the passages.

It would be of interest for future studies to investigate this presence effect further at different timeframes after reading stories. This would help to ascertain if this effect becomes more pronounced, as time between stimuli presentation and the LDT is increased.

Sex Differences

The sex differences in the present study is consistent with McGlone's (1977) interhemispheric model claiming that language is predominately processed in the LH for males and bilaterally for females. This theory is based on observations that LH damage more often results in aphasia for males than for females. This conclusion is supported by recent studies finding a LH lateralization effect only for males when testing at the discourse level, but no lateralization effect for either sex when testing at the word level (for a review see Kansaku & Kitazawa, 2001). Further, Kansaku, Yamaura and Kitazawa (2000) tested for sex differences using an fMRI study with narratives and scrambled versions of the narratives. They found LH lateralization for males during narrative processing and bilateral activation for the scrambled condition, with bilateral activation found for females for both tasks. This demonstrates that sex differences may only become apparent when language processing requires overall comprehension at a higher level of processing. As mentioned earlier, words not present in the passages of the current study may rely on higher level processing than words present in the passages, therefore showing consistency with previous research.

These findings suggest that studies testing for hemispheric differences in language processing should examine the data for sex differences in lateralization. Many studies testing for hemispheric differences at the discourse level have not reported testing for sex differences (Brownell & Stringfellow, 1999; Joannette et al., 1986; St George et al., 1999), with some not reporting sex ratios for participants in their study (Hough, 1990; Marini et al., 2005). Sex differences in language processing are uncertain at present (Wallentin, 2009) and may be largely ignored due to a lack of evidence found at the word level (Kansaku & Kitazawa, 2001). Further research should demonstrate the precise nature of this effect and establish if this is a robust finding.

Limitations

Limitations in the current study should be considered with the findings. Factors in the current study not present in other LDTs may have resulted in an overall higher RT than usual, including words longer than commonly used, lower in frequency ratings and lower in concreteness ratings. Possible implications of this effect include: longer words increasing the response time of the LVF/RH and remaining stable in the RVF/LH (Ellis et al., 1988), which may be greater for words that are lower in concreteness ratings (Bub & Lewine, 1988) and frequency (Young & Ellis, 1985).

Due to the complex nature of the present study in obtaining clear single words related to the overall meaning of the passages and subsequently in participants interpreting these words, target words were obtained from a panel requested to determine as many single words related to the overall meaning of the passages. The most frequent words reported between participants were used as target words. To ensure words consistently related to the overall meaning of

the passages, words were not restricted to be concrete or short in length. Doing so may have reduced the frequency of the same words used to describe the overall meaning of each passage between each panel participant, therefore reducing the chance that words could be obtained to prime the participants in the main study to the relatedness to this condition.

The current study supports the assumption that the words obtained for relatedness to the overall meaning of the passages were effective primes. It would however, be of benefit if future studies could find a way to obtain words for this priming that are shorter in length and higher in frequency ratings. It may be possible that these could be obtained with a search of words related to or synonymous with words obtained from the panel. This could be retested with a separate panel to determine whether these words appropriately represent the overall meaning of the passages.

Despite these limitations, a LDT is beneficial for reducing confounding variables, due to memory problems inherent in brain damage studies testing for hemispheric differences in processing the overall meaning of passages (Schneiderman et al., 1992). It would also reduce confounds due to more general disruptions from brain damage, by using a sample without brain damage (Mohr et al., 1994). This is beneficial to resolve inconsistencies in the literature over hemispheric differences in the appreciation of the overall meaning of passages. Further, the current study may be used as a pilot to be developed further, to better determine behavioral methods for investigating the hemispheric differences in the appreciation of the overall meaning of passages.

Conclusion

In summary, this study adds to the current literature on hemispheric differences at the discourse level, specifically in the processing of the overall meaning of passages. Using a LDT has helped to determine if previous findings could be demonstrated with people that do not have brain damage. This is important to eliminate the limitations inherent in brain damage studies (Rorden & Kardath, 2004) and help clear up an inconsistency in the literature over the role of the RH in the comprehension of the overall meaning of passages (Brookshire & Nicholas, 1984; Ferstl & von Cramon, 2001). The results support the hypothesis that words related to the overall meaning of passages would result in faster reaction times during a LDT, than words that were not related to the overall meaning of passages when presented to the LVF/RH. However, the hypothesis that this facilitation effect for words related to the overall meaning of passages, would be significantly greater for the LVF/RH than the RVF/LH, was not supported. Demonstrating that the RH was not dominant in processing the overall meaning of passages. The current study therefore does not give support to Jung-Beeman's (2005) course coding theory as an explanation for the appreciation of the overall meaning of stories.

The opposite to this prediction was found, with a significant facilitation effect in favor of the LH over the RH found for words that were not present in the passage, however there was no significant difference in facilitation effects between hemispheres for words in the passages. This may be due to a RH memory advantage for repeated words (Evans & Federmeier, 2007; Federmeier & Benjamin, 2005). Further, this LH advantage was found for males but not for females, with females having no significant hemispheric differences for facilitation effects. This result is consistent with McGlone's (1977)

interhemispheric model claiming that language is predominately processed in the LH for males and bilaterally for females.

Future studies should aim to determine more precisely hemispheric differences in processing the overall meaning of passages. In particular, they should investigate the effect of presence in the passage, as it is unclear from the present study exactly why this effect occurred. Future studies should develop words for priming relatedness to the overall meaning of passages that are shorter in length and higher in frequency ratings. This could be achieved with a search of words related to or synonymous with words obtained from the panel. Which could then be retested with a separate panel to determine if these appropriately represent the overall meaning of the stories. It would be of interest in future studies, to determine hemispheric differences for processing the overall meaning of passages, both present and not present in the passages at different lag times. This would help to ascertain if this effect becomes more pronounced, as time between stimuli presentation and the LDT is increased.

References

- Beeman, M. (1993). Semantic processing in the right hemisphere may contribute to drawing inferences from discourse. *Brain and Language, 44*, 80-120. doi: 10.1006/brln.1993.1006
- Beeman, M. (1998). Course semantic coding and discourse comprehension. In M. Beeman & C. Chiarello (Eds.), *Right hemisphere language comprehension: Perspectives from cognitive neuroscience* (pp. 255-284). Mahwah, New Jersey: Lawrence Erlbaum.
- Benowitz, L. I., Moya, K. L., & Levine, D. N. (1990). Impaired verbal reasoning and constructional apraxia in subjects with right hemisphere damage. *Neuropsychologia, 28*, 231-241. doi: 10.1016/0028-3932(90)90017-I
- Briner, S. W., Joss, L. M., & Virtue, S. (2011). Hemispheric processing of sarcastic text. *Journal of Neurolinguistics, 24*, 466-475. doi: 10.1016/j.jneuroling.2011.02.001
- Brookshire, R. H., & Nicholas, L. E. (1984). Comprehension of directly and indirectly stated main ideas and details in discourse by brain-damaged and non-brain-damaged listeners. *Brain and Language, 21*, 21-36. doi: 10.1016/0093-934X(84)90033-6
- Brownell, H. H., Potter, H. H., Bihrlé, A. M., & Gardner, H. (1986). Inference deficits in right brain-damaged patients. *Brain and Language, 27*, 310-321. doi: 10.1016/0093-934X(86)90022-2
- Brownell, H., & Stringfellow, A. (1999). Making requests: Illustrations of how right-hemisphere brain damage can affect discourse production. *Brain and Language, 68*, 442-465. doi:

- Bryden, M. P. (1982). *Laterality: Functional asymmetry in the intact brain*.
New York: Academic Press.
- Bub, D. N., & Lewine, J. (1988). Different modes of word recognition in the left and right visual fields. *Brain and Language*, 33, 161-188. doi: 10.1016/0093-934X(88)90060-0
- Chiarello, C. (1998). On codes of meaning and the meaning of codes: Semantic access and retrieval within and between hemispheres. In M. Beeman & C. Chiarello (Eds.), *Right hemisphere language comprehension: Perspectives from cognitive neuroscience* (pp. 141-160). Mahwah, New Jersey: Lawrence Erlbaum.
- Cohen, L., Lehericy, S., Henry, C., Bourgeois, M., Larroque, C., Sainte-Rose, C., ... & Hertz-Pannier, L. (2004). Learning to read without a left occipital lobe: Right-hemispheric shift of visual word form area. *Annals of Neurology*, 56, 890-894. doi: 10.1002/ana.20326
- Coulson, S., & Wu, Y. C. (2005). Right hemisphere activation of joke-related information: An event-related brain potential study. *Journal of Cognitive Neuroscience*, 17, 494-506. doi: 10.1162/0898929053279568
- Ellis, A. W., Young, A. W., & Anderson, C. (1988). Modes of word recognition in the left and right cerebral hemispheres. *Brain and Language*, 35, 254-273. doi: 10.1016/0093-934X(88)90111-3
- Evans, K. M., & Federmeier, K. D. (2007). The memory that's right and the memory that's left: Event-related potentials reveal hemispheric asymmetries in the encoding and retention of verbal information. *Neuropsychologia*, 45, 1777-1790. doi: 10.1016/j.neuropsychologia.2006.12.014

- Faust, M., & Babkoff, H. (1997). Script as a priming stimulus for lexical decisions with visual hemifield stimulation. *Brain and Language*, *57*, 423-437. doi: 10.1006/brln.1997.1758
- Faust, M., & Kahana, A. (2002). Priming summation in the cerebral hemispheres: Evidence from semantically convergent and semantically divergent primes. *Neuropsychologia*, *40*, 892-901. doi: 10.1016/S0028-3932(01)00174-9
- Federmeier, K. D., & Benjamin, A. S. (2005). Hemispheric asymmetries in the time course of recognition memory. *Psychonomic Bulletin & Review*, *12*, 993-998. doi: 10.3758/BF03206434
- Federmeier, K. D., & Kutas, M. (1999). Right words and left words: Electrophysiological evidence for hemispheric differences in meaning processing. *Cognitive Brain Research*, *8*, 373-392. doi: 10.1016/S0926-6410(99)00036-1
- Ferstl, E. C., & von Cramon, D. Y. (2001). The role of coherence and cohesion in text comprehension: An event-related fMRI study. *Cognitive Brain Research*, *11*, 325-340. doi: 10.1016/S0926-6410(01)00007-6
- Gouldthorp, B., & Coney, J. (2009). Message-level processing of contextual information in the right cerebral hemisphere. *Neuropsychologia*, *47*, 473-480. doi: 10.1016/j.neuropsychologia.2008.10.001
- Gouldthorp, B., & Coney, J. (2009). The sensitivity of the right hemisphere to contextual information in sentences. *Brain and Language*, *110*, 95-100. doi: 10.1016/j.bandl.2009.05.003
- Graves, W. W., Binder, J. R., Desai, R. H., Conant, L. L., & Seidenberg, M. S. (2010). Neural correlates of implicit and explicit combinatorial semantic

processing. *Neuroimage*, 53, 638-646. doi:

10.1016/j.neuroimage.2010.06.055

Grindrod, C. M., & Baum, S. R. (2003). Sensitivity to local sentence context information in lexical ambiguity resolution: Evidence from left-and right-hemisphere-damaged individuals. *Brain and Language*, 85, 503-523. doi: 10.1016/S0093-934X(03)00072-5

Hough, M. S. (1990). Narrative comprehension in adults with right and left hemisphere brain-damage: Theme organization. *Brain and Language*, 38, 253-277. Doi: 10.1016/0093-934X(90)90114-V

Joanette, Y., Goulet, P., Ska, B., & Nespoulous, J. L. (1986). Informative content of narrative discourse in right-brain-damaged right-handers. *Brain and Language*, 29, 81-105. doi: 10.1016/0093-934X(86)90035-0

Jung-Beeman, M. (2005). Bilateral brain processes for comprehending natural language. *Trends in Cognitive Sciences*, 9, 512-518. doi: 10.1016/j.tics.2005.09.009

Kacirik, N. A., & Chiarello, C. (2007). Understanding metaphors: Is the right hemisphere uniquely involved?. *Brain and Language*, 100, 188-207. doi: 10.1016/j.bandl.2005.10.010

Kandhadai, P., & Federmeier, K. D. (2010). Hemispheric differences in the recruitment of semantic processing mechanisms. *Neuropsychologia*, 48, 3772-3781. doi: 10.1016/j.neuropsychologia.2010.07.018

Kansaku, K., & Kitazawa, S. (2001). Imaging studies on sex differences in the lateralization of language. *Neuroscience Research*, 41, 333-337. doi: 10.1016/S0168-0102(01)00292-9

- Kansaku, K., Yamaura, A., & Kitazawa, S. (2000). Sex differences in lateralization revealed in the posterior language areas. *Cerebral Cortex*, *10*, 866-872. doi: 10.1093/cercor/10.9.866
- Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review*, *85*, 363-394. doi: 10.1037/0033-295X.85.5.363
- Kucera, H., & Francis, W. N. (1967). Computational analysis of present-day American English. Providence: Brown University Press.
- Lehman-Blake, M. T., & Tompkins, C. A. (2001). Predictive inferencing in adults with right hemisphere brain damage. *Journal of Speech, Language and Hearing Research*, *44*, 639-654. doi:10.1044/1092-4388(2001/052)
- Long, J. R. (2011). *Aesop's fables: Online collection*. Retrieved from <http://www.aesopfables.com>
- Maguire, E. A., Frith, C. D., & Morris, R. G. M. (1999). The functional neuroanatomy of comprehension and memory: The importance of prior knowledge. *Brain*, *122*, 1839-1850. doi: 10.1093/brain/122.10.1839
- Marini, A., Carlomagno, S., Caltagirone, C., & Nocentini, U. (2005). The role played by the right hemisphere in the organization of complex textual structures. *Brain and Language*, *93*, 46-54. doi: 10.1016/j.bandl.2004.08.002
- Mohr, B., Pulvermüller, F., & Zaidel, E. (1994). Lexical decision after left, right and bilateral presentation of function words, content words and non-words: Evidence for interhemispheric interaction. *Neuropsychologia*, *32*, 105-124. doi: 10.1016/0028-3932(94)90073-6

Parables and other life lessons. (n.d.). Retrieved from The Parable Site website:

<http://www.parablesite.com>

Rehak, A., Kaplan, J. A., Weylman, S. T., Kelly, B., Brownell, H. H., & Gardner, H. (1992). Story processing in right-hemisphere brain-damaged patients. *Brain and Language*, *42*, 320-336. doi: 10.1016/0093-934X(92)90104-M

Robertson, D. A., Gernsbacher, M. A., Guidotti, S. J., Robertson, R. R., Irwin, W., Mock, B. J., & Campana, M. E. (2000). Functional neuroanatomy of the cognitive process of mapping during discourse comprehension. *Psychological Science*, *11*, 255-260. doi: 10.1111/1467-9280.00251

Rorden, C., & Karnath, H. O. (2004). Using human brain lesions to infer function: A relic from a past era in the fMRI age? *Nature Reviews Neuroscience*, *5*, 812-819. doi:10.1038/nrn1521

Schneiderman, E. I., Murasugi, K. G., & Saddy, J. D. (1992). Story arrangement ability in right brain-damaged patients. *Brain and Language*, *43*, 107-120. doi: 10.1016/0093-934X(92)90024-9

Schwager, D. (2007). *The parables of Jesus*. Retrieved from <http://www.rc.net/wcc/parables.htm>

Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. *Journal of the International Neuropsychological Society*, *8*, 448-460. doi: 10.1017/S1355617702813248

St George, M., Kutas, M., Martinez, A., & Sereno, M. I. (1999). Semantic integration in reading: Engagement of the right hemisphere during discourse processing. *Brain*, *122*, 1317-1325. doi: 10.1093/brain/122.7.1317

- Vance, K., & Virtue, S. (2011). Metaphoric advertisement comprehension: The role of the cerebral hemispheres. *Journal of Consumer Behaviour, 10*, 41–50. doi: 10.1002/cb.345
- Van Lancker, D. R., & Kempler, D. (1987). Comprehension of familiar phrases by left-but not by right-hemisphere damaged patients. *Brain and Language, 32*, 265-277. doi: 10.1016/0093-934X(87)90128-3
- Vigneau, M., Beaucousin, V., Herve, P. Y., Duffau, H., Crivello, F., Houde, O., ... & Tzourio-Mazoyer, N. (2006). Meta-analyzing left hemisphere language areas: Phonology, semantics, and sentence processing. *Neuroimage, 30*, 1414-1432. doi: 0.1016/j.neuroimage.2005.11.002
- Virtue, S., & Joss, L. M. (2012). Hemispheric processing of inferences during text comprehension: The role of consistency and task difficulty. *Laterality, 17*, 549-564. doi: 10.1080/1357650X.2011.586781
- Wallentin, M. (2009). Putative sex differences in verbal abilities and language cortex: A critical review. *Brain and Language, 108*, 175-183. doi: 10.1016/j.bandl.2008.07.001
- Wapner, W., Hamby, S., & Gardner, H. (1981). The role of the right hemisphere in the apprehension of complex linguistic materials. *Brain and Language, 14*, 15-33. doi: 10.1016/0093-934X(81)90061-4
- Wegner, M. L., Brookshire, R. H., & Nicholas, L. E. (1984). Comprehension of main ideas and details in coherent and noncoherent discourse by aphasic and nonaphasic listeners. *Brain and Language, 21*, 37-51. doi: 10.1016/0093-934X(84)90034-8
- Weylman, S. T., Brownell, H. H., Roman, M., & Gardner, H. (1989).
Appreciation of indirect requests by left-and right-brain-damaged

patients: The effects of verbal context and conventionality of wording.

Brain and Language, 36, 580-591. doi: 10.1016/0093-934X(89)90087-4

Xu, J., Kemeny, S., Park, G., Frattali, C., & Braun, A. (2005). Language in

context: Emergent features of word, sentence, and narrative

comprehension. *Neuroimage*, 25, 1002-1015. doi:

10.1016/j.neuroimage.2004.12.013

Young, A. W., & Ellis, A. W. (1985). Different methods of lexical access for

words presented in the left and right visual hemifields. *Brain and*

Language, 24, 326-358. doi: 10.1016/0093-934X(85)90139-7

Appendix A

Bryden's (1977) Simplified Hand Preference Questionnaire.

Instructions:

For each of the activities listed below, indicate with a + which hand you normally use to perform the activity.

If you would only use the other hand, when forced to, mark a ++

If you would use both hands equally often, place a + in each column.

	LEFT	RIGHT
Writing a message	_____	_____
Drawing a picture	_____	_____
Using a toothbrush	_____	_____
Throwing a ball	_____	_____
Using a pair of scissors	_____	_____

Appendix B

Passages presented in booklets.

Booklet one

Story 1

Ten women took their lamps and went out to meet the bridegroom. Five of the women were thoughtless, and five were wise. When the foolish ones took their lamps, they did not take extra olive oil with them to be prepared. But the wise ones took flasks of olive oil with their lamps. When the bridegroom was delayed a long time, they all passed the time by talking of the marvels of the universe, then became drowsy and fell asleep. At midnight there was a shout, 'Look, the bridegroom is here! Come out to meet him.' Then all the women woke up and trimmed their lamps. The foolish ones said to the wise, 'Give us some of your oil, because our lamps are going out.' 'No,' they replied. 'There won't be enough for you and for us. Go instead to those who sell oil and buy some for yourselves.' But while they had gone to buy it they got thirsty and had to stop for water taking more time than thought. Then the bridegroom arrived, and those who were ready went inside at the final call to the wedding banquet. Then the door was shut and the foolish women could not get in.

Story 2

There were once two brothers, one called Eyes and one called No-eyes. Despite being brothers they were completely opposite. Eyes a lean young man, was always taking notice of things around him, whereas No-eyes a lazy young man kept to himself, staring only at the ground as they walked to school every morning together. One morning Eyes noticed there was no smoke coming out of Mrs May's chimney. 'Look!' exclaimed Eyes, 'Mrs May's chimney is on every morning' hoping that no eyes would suddenly be more thoughtful, as Mrs May had to open the gate for the train to pass through at 8.00am every day. No-eyes thought it was irrelevant and mumbled like he was drunk something about her sleeping in as he carried on to school. Eyes, suddenly alert, ran over to her house and looked in the window. She was passed out on the ground. He quickly broke in and tended to her – just then he heard the train and quickly opened the gate for it to pass, before calling the hospital, saving her just in time.

Story 3

There was a boy that was hired to tend the sheep that would cluster near a forest. This boy was good at his job, however he would continually go up to the embankment and shout, "Help, there's a wolf!", causing alarm among the farmers. They would come running ready to ward off this hungry wolf, only to find out that what the boy said was not true. Then one day the boy was pretending he was flying the planes overhead, when he was startled by a noise in the forest. The boy kept his distance, keeping an eye on the movement of the forest. Suddenly appeared a wolf, approaching the sheep, keeping low to the ground and ready to pounce. The boy at once ran to the embankment so fast that he almost tripped on a plant and shouted "Help, there's a wolf!" to alert the farmers to save the sheep. The farmers heard the boy, however they didn't believe he was telling the truth so no one came to his aid. The whole flock was eaten by the wolf, teaching him a valuable lesson. The boy was then docked his pay for each sheep that was eaten.

Story 4

A long time ago Jesus was having a feast with many scholastic men. One man asked him to tell them a parable, Jesus thought for a while then said, "Suppose you have a friend, and you go to his home in the middle of the night and ask him, 'Friend, lend me three loaves of bread; a friend of mine on a journey has made my house his destination for a couple nights, and I have no food to offer him during his stay.' Suppose the one inside answers in a disgruntled voice, 'Don't bother me. The door is already locked and my children and I are in bed. I can't get up and give you anything at this time.' I tell you, that even though he will not get up and give you hospitality because of your friendship. If you are persistent, he will surely get up and give you as much as you need.

Story 5

A man had a fig tree growing in his vineyard, and he went to look for fruit on it but did not find any. So he went inside the office on the vineyard and said to the gardener, 'For three years now I've been coming to look for fruit on this fig tree and haven't found any. Get your staff to cut it down! Why should it use up the soil?' "Sir", the man replied, "Have faith in my talent and leave it alone for one more year, and I'll dig around it and fertilize it. If it bears fruit, fine! If not, then cut it down." The man agreed to these terms and left the fig tree, but kept a very good eye on it, as he was determined to get rid of the fruitless tree. The first few months he was tempted to just chop it down and plant a new tree. Just as the year was approaching an end, nature took its course and the fig tree had more fruit than any other he had seen before.

Story 6

A wolf found great difficulty in getting at a sizable sheep owing to the vigilance of the shepherd and his dogs. So often the wolf would try to simply sneak up to the sheep, to then simply be chased away by the dogs. But one day it found the skin of a sheep that had been flayed and thrown aside, so it put it on over its own pelt and strolled down among the sheep. The wolf did this rather ungracefully, yet he seemed to be doing it without scaring the foolish sheep or sparking an interest in the dogs. The lamb that was the kin of the sheep whose skin the wolf was wearing, began to follow the wolf in the sheep's clothing, leading the lamb a little apart from the sheep. He soon made a meal off her. For some time he used this sly act as his way to enjoying hearty meals.

Story 7

Once there was a hungry dog walking near a river looking for food. After his legs became numb from all the searching he gave up. Just as he was leaving the river he came across a large bone. He was so happy with his find that he could not hide his joy. His tail wagged harder than ever before. He then decided to go down by the river and enjoy his great find. While he was chewing his bone, he looked down over the bridge, seeing that there was a dog with an even bigger bone than his! This made him feel as if his bone was now just mediocre. He had never felt so much envy in his life. As he lent closer to the other dog he realised that if he was quick enough he could drop his bone and grab the other dog's bone. He quickly dropped his bone, and to his surprise the other dog dropped his at the same time! And then with a splosh, both the bones were gone and he was left with nothing but to think about how his own jealousy had sabotaged him.

Story 8

This is the story of a man who had two sons. The younger son sat his father down in his office and asked for his portion of the family estate as an early

inheritance. Once received, the son set off on a journey to a distant land and began to waste his fortune on wild living. When the money ran out, a famine hit the country and the son found himself in dire circumstances. One day he found himself in trouble with an inspector for breaking into a barn and sleeping in it for days. The young man finally came to his senses, recognizing his foolishness and decided to return to his father and ask for mercy. The father, who had been watching and waiting, received his son back with open arms. He is overjoyed by the return of his lost son! Immediately the father turns to his servants and asks them to prepare a giant feast in celebration. The other son who always lived rightly was not impressed at the level of tolerance the father possessed for the other son, but the father told him that he should be glad instead that his reckless brother had returned.

Story 9

Long, long ago a proud Viking that considered himself a mighty war hero, decided to take a break along the countryside. He came upon a speckled farmhouse that he thought would serve as a retreat. He enquired with the farmer that owned the land about spending a few nights. Upon agreeing the farmer said, "It is very cold tonight. Please cover yourself with this blanket." The Viking said in a boastful manner "I have gone to battle time after time, and when I slept in the open, I never needed anything over me". He lay down to sleep on the bare floor of the farmhouse. In the night it became very cold and he was uncomfortable, turning often and having a rough sleep. The next night he asked the farmer for the blanket, however the farmer replied "I am terribly sorry, but since you did not need it, I have given it to another guest that is not as used to the cold."

Story 10

There was once a very poor young man called Stan. He worked in a brewery with a wage that was barely enough to pay for the interest on his house. After paying all the bills he struggled to afford enough food to survive. At lunchtime he noticed a peculiar looking man in torn clothes and without food. This poor man looked very skinny and frail. He could not believe that this man looked in a worse condition than himself. Upon seeing this he felt a great sense of empathy and decided that he could afford to give the man a portion of his own food. As time went by the man started to become a normal weight. After a year the man suddenly stopped working with Stan. Stan was saddened to lose a friend. A week later the man appeared at Stan's door dressed in a fine suit and holding a briefcase. He told Stan that he inherited a large sum of money from a wealthy uncle. He explained how grateful he was towards Stan and that he would like to buy him a house and give him enough money to live comfortably for a year.

Story 11

This story is about a man called Ben, who lost a great deal of money. This caused much hardship on his family. One day while Ben was going about his routine he came across an old man singing in the street. He asked Ben why he was so grim. Ben replied "Old man I have lost more money than you could ever dream of." The old man asked "Can you afford to eat?" "Yes", replied Ben. "Can you afford a home?" "Yes" replied Ben. The old man then stated "I may never have had as much money as you lost, but I am rich in happiness, therefore I am never poor. The difference between you and me is that I have chosen today to be happy and to look not at what I do not have, but at what I do have." Ben thought the old man was just senile, but decided to change his outlook, to not see life

simply as one campaign after another. He relished what he had, not what he lost and became more positive and noticed his family became much happier.

Story 12

During the wintertime, an ant was living off the grain that he had stored up for himself during the summer. The grain took some time to gather, but it was crucial for him to survive, to not do so would be the equivalent of jumping to his death. In the end it was a good investment, in fact a crucial investment. The cricket came to the ant and asked him to share some of his nice peppery grain, as he had not gone through the hard work like the ant had before winter came. The ant said to the cricket, 'And what were you doing all summer long, since you weren't gathering grain to eat?' The cricket was stunned, hoping that not even an ant could be selfish enough to not share his food. So he replied, 'because I was busy singing I didn't have time for the harvest.' The ant laughed at the cricket's reply, and hid his heaps of grain deeper in the ground. 'Since you sang like a fool in the summer,' said the ant, 'you deserve to dance the winter away!'

Story 13

Some field mice were playing in the woods where a lion was sleeping, when one of the mice accidentally ran over the lion. The lion woke up and immediately grabbed the little mouse with his paw. The mouse begged for mercy, since he had not meant to do the lion any harm. The lion decided that to kill such a tiny creature would be a cause for reproach rather than glory, so he forgave the mouse for the mishap and let him go. A few days later, the lion fell into a pit set by a hunter. He started to roar, and when the mouse heard him, he came running. Recognizing the lion in the trap, the mouse began to gnaw at the cords binding the lion, cutting through the strands. The mouse was thus able to restore the lion to the woods, a simple reward for the favour he gave them.

Story 14

Once there was a Greek ship with affluent men bound for Athens. Eventually it was wrecked off the coast. Had it not been for the dolphins that swam past this spot monthly, all would have perished. But the dolphins took the shipwrecked people and swam them to shore. Now it was the custom among the Greeks to take their pet monkeys and dogs with them whenever they went on a voyage. So when one of the dolphins saw a monkey struggling in the water, he thought it was a man, and made the monkey climb up on his back. Lucky for the monkey, as he did not know how to swim. The dolphin asked if he lived nearby. The monkey told him that he did, even though he did not live nearby. "Do you know Seriphos?" asked the dolphin. The monkey, thinking Seriphos was a person's name, boasted that it was his best friend. As Seriphos was a town, the dolphin knew the monkey in fact was not being truthful. This infuriated the dolphin after he had been so helpful to the monkey, so he took off, leaving the monkey to struggle in the water.

Story 15

A lion that had grown too old and weak to hunt pretended to be sick. All the other animals felt so sorry for the lion. They thought it was bizarre that such a mighty beast could be so stricken by sickness that he could not leave his cave. They decided they would come in the cave to pay their respects to the poor lion. An owl was watching the cave curiously, as a large mouse wondered through the doorway happy to pay his respects. He waited some time for the mouse to come out, however it did not seem like he would emerge from the cave. Then in went a monkey. He also did not come out. He noticed that this went on for some time,

animals would go in, but they would not come back out. The Owl came to greet him from outside the cave with caution. When the lion asked the Owl why he did not come in the cave to visit, the Owl replied, "Because I can only see the tracks going in, but none coming out you cunning beast."

Story 16

A professor stood before his class of 20 marine biology students, about to hand out the final exam. "I want to say that it's been a pleasure teaching you this semester. I know you've all worked extremely hard and many of you are off to medical school after summer. So that no one gets their GP messed up because they might have been celebrating a bit too much this week, any honest people that would like to opt out of the final exam today will receive a "B" for the course." There was much rejoicing amongst the class as students got up, passed by the professor to thank him and sign out on his offer. As the last taker left the room, the professor looked out over the handful of remaining students and asked, "Anyone else? This is your last chance." One final student rose up and took the offer. The professor closed the door and took attendance of the students remaining in silence. "I'm glad to see you believe in yourself to achieve" he said. "You all have A's."

Story 17

Snow was falling from the sky. Seeking shelter from the storm, an unwed goat herder drove his goats all covered with white from the thickly falling snow into a cave. He had thought the cave was empty, but he soon discovered that there were some wild horned goats that had already taken shelter there. The wild goats were far more numerous than his own and they were also bigger and stronger. The goat herder therefore tossed the greasy fodder he had brought from the woods to the wild goats, while he let his own goats go hungry. When the weather cleared, he found that his own goats had died, while the wild goats had already gone away and were tramping their way through the untrodden thickets upon the mountains where animals had not yet grazed. The goat herder went back home without any goats at all and feeling very cruel. Hoping for a larger flock he did not even profit from the goats that were his to begin with. All he could think about was why he was not more caring to his own goats.

Story 18

There once was a wolf called Sam. He had grown so much stouter than the other wolves of his generation that they started calling him a lion. This made him feel very mighty indeed. This satisfied him for a while, however he soon felt he deserved more than this. He thought he could actually be a majestic lion if he wished. So one day he felt he would take what he deserved, that he would show just how mighty he really was. So he left the pack and began to consort with the lions instead. As he could feel no better place for himself than among the large powerful lions. A fox made fun of him for being ignorant and said, 'I hope that I never get such an inflated idea of myself as you now have of yourself: you may seem like a lion in comparison to the wolves, but when the lions take your measure, you'll go back to being nothing but a wolf!'

Story 19

There once was a little boy who had a temper. His father gave him a bundle of nails and made a contract stating that every time he lost his temper, he must hammer a nail into the backyard fence. The first day the boy drove 37 nails into the fence. Over the weeks, as he learned to regulate these feelings, the number of nails gradually dwindled down. He found it easier to handle his temper than to

drive nails into the fence. His father suggested the boy pull out one nail for each day he could handle his temper to continue teaching the lesson. Eventually the young boy told his father all the nails were gone. The father led his son to the fence and said, "Now look at the holes in the fence. The fence will never be the same. When you say things or do things from losing your temper, they leave a scar just like those holes. You can put a knife in a man and draw it out. It won't matter how much regret you have or how many times you say, 'I'm sorry,' the wound is still there."

Story 20

One night a monkey was sitting around a fire with a gathering of animals. He decided the party would become much livelier if he would dance around the fire. As he fancied himself a bit of a dancer, or at least the life of the party, he got up in front of the gathering of animals and began to dance. His audience clapped loudly. As he became exhausted and ready to collapse he sat down to talk to the animals. They were all so delighted over the show and were paying him so many compliments. A camel that was at the party could not believe this, usually he was the life of the party, he never danced but he was an excellent storyteller due to his many adventures. Thinking that he could pull another trick out of his pocket and get just as much attention, the camel went out with a lack of humility in front of the crowd and tried to dance like the monkey. But the clumsy camel without the same talent looked silly as he shuffled around and the crowd booed him and sent him away.

Story 21

A man found a cocoon of an emperor moth. He took it home so that he could watch the moth come out of the cocoon. A small opening appeared. He watched the moth for several hours as it struggled to force the body through the hole. Then it seemed to stop making any progress. It seemed stuck. The man, in his kindness, decided to help the moth, so he snipped off the remaining bit of the cocoon. The moth then emerged easily. But it had a swollen body and small, shriveled wings. He expected that the wings would enlarge to the size of his wrist to support the body, but the moth was never able to fly. What the man in his kindness and haste did not understand was that the restricting cocoon and the struggle required for the moth to get through the tiny opening was the way of forcing fluid from the body of the moth into its wings so that it would be ready for flight upon its introduction to the world. Flight would only come after the struggle. By depriving the moth of a struggle through his interference, he also deprived the moth of health.

Story 22

A man was ready to chop some wood for a fire. He would be cooking his family a wonderful meal. He had just been hunting and caught a deer. He went to the basement to grab his axe, but to his dismay could not find it in its usual place. He searched throughout the shed, but in the end he had to cancel his dinner. He suspected his neighbour's grandson of stealing it. To him, as he observed the boy, the way the lad walked, the expression on his face, the manner of his speech - in fact everything about his appearance and behaviour portrayed that he had stolen the axe. He could not believe that this young boy could be so disrespectful that he would steal and ruin his family dinner that he spent so long hunting for. Not long afterwards the man found his axe while digging in his cellar, which brought a halt to his assuming and distrust of the boy. When he saw his neighbour's son

again, nothing about the boy's behaviour, nor appearance seemed to suggest that he had stolen the axe.

Story 23

A certain man went down from Jerusalem to Jericho, and fell among thieves, who stripped him of his clothing, wounded him, and departed, leaving him half dead. By chance a certain priest came down that road. When he saw him being attacked by a hawk, he passed by on the other side. Likewise a Levite, when he arrived at the place, came and looked, and passed by on the other side. It was as if he had some sort of repellent on. But a certain unselfish Samaritan, as he journeyed, came where he was. Feeling pity for this man he went to him and bandaged his wounds, pouring on oil and wine. He set him on his own animal, brought him to an inn, and took care of him. The next day, when he departed, he took out two denarii, gave them to the innkeeper, and said, 'Take care of him and whatever more you spend, when I come again, I will repay you.' "Which of these three do you think was neighbour to him who fell among the thieves?" And another said, "He who gave him sympathy." Then Jesus said, "Go and do likewise."

Story 24

A man said to God, 'I would like to know what Heaven and Hell are like.' God led the man to a room and let him in with his keys. In the room was a round table. On the table was a pot of stew that smelled delicious. The people sitting around the table were thin and sickly. The equipment they had available to them were spoons with very long handles, that were strapped to their arms. Each found it possible to reach into the pot of stew and take a spoonful, however because the handles were longer than their arms, they could not get the spoons back into their mouths. They went to the next room. It was the same as the first one. There was the large round table with the large pot of stew, which made the man's mouth water. The people had the same long-handled spoons, but here the people were well nourished, laughing, talking and seemed to love one another. The man said, 'I still do not have the knowledge.' 'It is simple,' said God. 'It requires but one skill. You see they have learnt to work as a team and feed each other.'

Booklet 2

Story 1

Ten women took their lamps and went out to meet the celebrity bridegroom. Five of the women were foolish, and five were wise. When the foolish ones took their lamps, they did not take extra olive oil with them. But the wise ones took flasks of olive oil with their lamps. When the bridegroom was delayed a long time, they all passed the time by talking of the marvels of the world, then became drowsy and fell asleep. At midnight there was a shout, 'Look, the bridegroom is here! Come out to meet him.' Then all the women woke up and trimmed their lamps. The foolish ones said to the wise, 'Don't be nasty, give us some of your oil, because our lamps are going out.' 'No,' they replied. 'There won't be enough for you and for us. Take the road instead to those who sell oil and buy some for yourselves.' But while they had gone to buy it they got thirsty and had to deviate from the plan to stop for water, taking more time than thought. Then the bridegroom arrived, and those who were set went inside with him to the wedding banquet. Then the door was shut and the foolish women could not get in, due to not being organised.

Story 2

There were once two brothers, one called Eyes and one called No-eyes. Despite being brothers they were completely opposite. Eyes, a lean young man, was always taking notice of things around him, whereas No-eyes a lazy young man kept to himself, staring only at the ground as they walked to school every morning together. One fresh morning Eyes noticed there was no smoke coming out of Mrs May's chimney. 'Look!' exclaimed Eyes in a frightful tone, 'Mrs May's chimney is on every morning' hoping that no eyes would suddenly be more observant, as Mrs May had to open the gate for the train to pass through at 8.00am every day. No-eyes thought it was of no concern and mumbled something about her sleeping in as he carried on to school. Eyes, suddenly aware, ran over to her house and looked in the window. She was passed out on the ground. He quickly broke in and tended to her – just then he heard the train and quickly opened the gate for it to pass, before calling the hospital, saving her just in time.

Story 3

There was a boy that tended the sheep that would often cluster near a forest. This boy was good at his job, however he would continually go up to the embankment and shout, "Help, there's a wolf!" causing alarm among the farmers. They would come running ready to ward off this hungry wolf, only to find out that what the boy said was not true. Then one day while the boy was pretending he was flying in the sky, he was startled by a noise in the forest. The boy kept his distance, keeping an eye on the movement of the forest. Suddenly appeared a wolf, approaching the sheep, keeping low to the ground for cover and ready to pounce. The boy ran to the embankment so fast that he almost tripped on a rock and shouted "Help, there's a wolf!" to alert the farmers to save the sheep. The farmers heard the boy, however they believed he was telling a lie so no one came to his aid. The whole flock was eaten by the wolf, giving him a valuable warning not to abuse trust. The boy was then docked his pay for each sheep that was eaten.

Story 4

A long time ago Jesus was having a feast with many sporting men, one man asked him to tell them a parable, Jesus thought for a while then said, "Suppose you have a reliable practitioner, and you go to his home in the middle of the night and ask him, 'Friend, lend me three loaves of bread; a friend of mine on a journey has made my house his stopover for a couple nights, and I have no food to offer him during his stay.' Suppose the one inside answers in a disgruntled voice, 'Don't bother me. The door is already locked, and my children and I are in bed. I can't get up and give you anything at this time.' I tell you, that even though he will not get up and give you bread because of your friendship. If you have perseverance, he will surely get up and give you as much as you need.

Story 5

A man had a fig tree growing in his vineyard, and he went to look for fruit on it but did not find any. So he went on his carriage around the vineyard to find the gardener and he said, 'For three years now I've been coming to look for fruit on this fig tree and haven't found any. Get your axe and cut it down! Why should it use up the soil?' "Sir", the man replied, "Have patience and leave it alone for one more year, and I'll dig around it and fertilize it. If it bears fruit, fine! If not, then I will cut it down if you like." The man agreed to these terms and left the fig tree, but kept a very good eye on it as he was determined to get rid of the fruitless tree. The first few months he was tempted to just chop it down and plant a new tree.

Just as the year was approaching an end, time took its course and the fig tree had more fruit than any other he had seen before.

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Story 7

Once there was a hungry dog walking near a river looking for food. All he could find was algae, so he gave up searching. Just as he was leaving the river he came across a large bone. He was so happy with his find that he could not hide his joy. His tail wagged harder than ever before. He then decided to go down by the river and enjoy his great find. While he was chewing his bone, he looked down over the bridge, seeing that there was a dog with an even bigger bone than his! This made him feel as if his bone was now average. His automatic reaction was one of greed. As he lent closer to the other dog he realised that if he was quick enough he could drop his bone and grab the other dog's bone. He quickly dropped his bone, and to his surprise the other dog dropped his at the same time! And then with a splash, both the bones were gone and he was left with nothing but to think about how not being satisfied with what he had, caused him to have no food at all.

Story 8

This is the story of a man who had two sons. The younger son sat his father down and asked for his portion of the estate as an early inheritance. Once received, the son set off on an exploration of the west and began to waste his fortune on wild living. When the money ran out, a famine hit the country and the son found himself in dire circumstances. One day he found himself in trouble with the police for breaking into a barn and sleeping in it for days. The young man finally came to his senses, recognizing his foolishness and decided to return to his father and ask for mercy. The father, who had been watching and waiting, receives his son back with open arms. He is overjoyed by the return of his lost son! Immediately the father turns to his servants and asks them to prepare a giant feast in celebration. The other son who always lived rightly was not impressed at the level of forgiveness and love the father had for the other son, but the father told him that he should be glad instead that his reckless brother had returned.

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farmhouse. In the night it became very cold and he was uncomfortable, turning often and having a bad sleep. The next night he swallowed his pride and asked the farmer for the blanket, however the farmer replied "I am terribly sorry, but since you did not need it, I have given it to another guest that is not as used to the cold."

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There was once a very poor young man called Stan. He worked in a factory with barely enough to pay for the interest on his house. After paying all the bills he struggled to afford food to survive. At lunchtime he noticed a man in torn clothes and without food staring despondently at a pamphlet. This poor man looked frail, muttering in a toneless voice. He could not believe that this man looked in a worse condition than himself. Upon seeing this he felt a great sense of sympathy and decided that he could afford to give the man a portion of his own food. As time went by the man started to become a normal weight. After a year the man suddenly stopped working with Stan. Stan was saddened to lose a friend. A week later the man appeared at Stan's door dressed in a fine suit. He told Stan that he inherited a large sum of money from a wealthy uncle. He explained how thankful he was for Stan's kindness due to his selfless nature and that he would like to buy him a house and give him enough money to live comfortably for a year.

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This story is about a man called Ben, who lost a great deal of money. This caused much hardship on his family. While Ben was going about his routine he came across an old man singing in the street. He asked Ben why he was so grim. Ben replied "Old man I have lost more money than you could ever dream of." The old man asked "Can you afford to eat?" "Yes", replied Ben. "Can you afford a home?" "Yes" replied Ben. The old man then stated "I may never have had as much money as you lost, but I am rich in happiness, therefore I am never poor. The difference between you and me is that I have chosen today to be happy and to look not at what I do not have, but at what I do have." Ben thought the old man was just senile, but had a burning curiosity to see if the old man was right. So he decided to change his attitude, to not see life simply as one crusade after another. He relished what he had, not what he lost and became more content and noticed his family became much happier.

Story 12

During the wintertime, an ant was living off the grain that he had stored up for himself during the summer. The grain took some time to gather, but it was crucial for him to survive in his environment, to not do so would be the equivalent of jumping in acid. In the end it was a good investment, in fact a crucial investment. The cricket came to the ant and asked him to share some of his nice grain, as he had not gone through the hard labour like the ant had before winter came. The ant said to the cricket, 'And what were you doing all summer, since you weren't gathering grain to eat?' The cricket was stunned, hoping that not even an ant could be selfish enough to not share his food. So he replied, 'because I was busy singing I didn't have time for preparation.' The ant laughed at the cricket's reply, and hid his heaps of grain deeper in the ground. 'Since you sang like a lazy fool in the summer,' said the ant, 'you better be ready to dance the winter away!'

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Once there was a Greek ship transporting sour grapes with men bound for Athens. Eventually it was wrecked off the coast. Had it not been for the dolphins that swam past this spot all would have perished. But the dolphins took the shipwrecked people and swam them to shore. Now it was the custom among the Greeks to take their pet monkeys and dogs with them whenever they went on a voyage. So when one of the dolphins saw a monkey struggling in the water, he thought it was a man, and made the monkey climb up on his back. Lucky for the monkey, as he did not know how to swim. The dolphin asked if he lived nearby. With a whisper the monkey said that he did, even though he did not live nearby. "Do you know Seriphos?" asked the dolphin. The monkey, thinking Seriphos was a person's name, boasted that it was his best friend. As Seriphos was a town, the dolphin knew the monkey was a liar. This infuriated the dolphin after he had helped the monkey, so he took off, leaving the monkey to struggle in the water because he lacked honesty.

Story 15

A lion that had grown too old to hunt pretended to be sick. All the other animals felt so sorry for the lion. They thought it was strange that such a mighty beast could be so stricken by sickness that he could not leave his cave. They decided they would not frolic for the day and come in the cave to pay their respects to the poor lion. An owl was watching the cave curiously, as a large mouse wondered through the entrance happy to pay his respects. He waited some time for the mouse to come out, however it did not seem like he would emerge from the cave. Then in went a monkey. He also did not come out. He noticed that this went on for some time, animals would go in, but they would not come back out. The wise Owl also came to greet him from outside the cave with care to not simply become bare bones. When the lion asked the Owl why he did not come in the cave to visit, the Owl replied, "Because I can see the tracks going in, but none coming out, you beast of deceit."

Story 16

A republican professor stood before his class of 20 senior biology students from Valley College, about to hand out the final exam. "I want to say that it's been a pleasure teaching you this semester. It is in my belief that you've all worked extremely hard and many of you are off to medical school after summer. So that no one gets their GPA messed up because they might have been celebrating a bit too much this week, anyone that would like to opt out of the final exam today will receive a "B" for the course." There was much rejoicing amongst the class as students got up and passed by the professor to thank him and sign out on his offer. As the last taker left the room, the professor looked out over the handful of remaining students and asked, "Anyone else? This is your last chance." One final student rose up and took the offer. The professor closed the door and took

attendance of the students remaining. "I'm glad to see you have confidence in yourself." he said. "You all have A's."

Story 17

Snow was falling from the sky. Seeking shelter from the storm, a tribal goat herder drove his goats all covered with white from the thickly falling snow into a cave. He had thought the cave was empty, but he soon discovered that there were some elegant wild horned goats that had already taken shelter there. The wild goats were far more numerous than his own and they were also bigger and stronger. The goat herder therefore tossed the fodder he had brought from the woods to the wild goats, while he let his own goats go hungry. When the weather cleared, he found that his own goats had died, while the wild goats had already gone away and were tramping their way through the untrodden thickets upon the mountains where animals had not yet grazed. The goat herder went back home without any goats at all and feeling very greedy. Hoping for a larger flock he did not even profit from the goats that were his to begin with. All he could think about was why he was so selfish to his own goats.

Story 18

There once was a wolf called Sam. He had grown so much stouter than the other wolves, that they started calling him a lion. This made him feel very mighty indeed. This satisfied him for a while, however he soon felt he deserved more than this. He thought he could actually be a lion if he wished. So one day he felt he would take what he deserved, that he would show just how mighty he really was. So he left the pack and began to consort with the lions at their lair near the tar pit, as he could feel no better place for himself than among the large powerful lions. A fox made fun of him for his arrogance and said, 'I hope that I never get such an inflated idea of myself as you now have of yourself, next thing you will think you're a gymnastic champion. You may seem like a lion in contrast to the wolves, but when the lions take your measure, you'll go back to being nothing but a wolf with a big ego!'

Story 19

There once was a little boy who had a temper. His father gave him nails and made an agreement that every time he lost his temper, he must hammer a nail into a section of the backyard fence. The first day the boy drove 37 nails into the fence. Over the weeks, as he learned to regulate these feelings, the number of nails gradually dwindled down. He found it easier to handle his temper than to drive nails into the fence. The father suggested the boy pull out one nail for each day he could handle his temper to continue the lesson. Eventually the young boy told his father all the nails were gone. The father led his son to the fence and said, "Now look at the holes in the fence. The fence will never be the same, even after a decade. When you say things or do things from losing your temper, they leave a scar just like those holes. Wisdom will tell you that you can put a knife in a man and draw it out. It won't matter how much control you have or how many times you say, 'I'm sorry,' the wound is still there."

Story 20

One night a monkey was sitting around a fire with a gathering of animals. He decided the party would become much livelier and remain operational if he would dance around the fire. As he fancied himself a bit of a dancer, or at least the life of the party, he got up in front of the gathering of animals and began to dance. His audience clapped loudly. As he became exhausted he sat down to talk to the animals. They were all so delighted over the show and were paying him so

many compliments. A competitive camel that was at the party could not believe this, usually he was the life of the party, he never danced but he was an excellent story teller due to his many adventures. Thinking that he could pull another trick out and get just as much attention, the camel went out in front of the crowd and tried to dance like the monkey. But the jealous camel without the same gift and feeling a bit jittery, looked silly as he shuffled around and the crowd booed him and sent him away.

Story 21

A man found a cocoon of an emperor moth. He took it home so that he could watch the moth come out of the cocoon. A small opening appeared. He watched the moth for several hours as it struggled to force the body through the hole at various stages. Then it seemed to stop making any progress. It seemed stuck. The man decided to help the moth, so he snipped off the remaining bit of the cocoon. The moth then emerged easily. But it had a swollen body and small, shriveled wings. He expected the wings to enlarge to the size of his fist to support the body, but moth was never able to fly. What the man with his impatient mood and kindness did not understand was that the restricting cocoon and the strenuous struggle required for the moth to get through the tiny opening was the way of forcing fluid from the body of the moth into its wings so that it would be ready for flight upon its first moment in the world. Flight would only come after the natural struggle. By depriving the moth of a struggle he also deprived the moth of health.

Story 22

A man was ready to chop some wood for a fire. He would be cooking his family a wonderful meal. He had just been hunting and caught a deer. He went to the shed to grab his burgundy axe, but to his dismay could not find it in its usual place. He searched throughout the shed, but in the end he had to cancel his dinner. He suspected his neighbour's son of stealing it. To him, as he observed the boy, the way the lad walked, the expression on his face, the manner of his speech - in fact everything about his appearance and behaviour portrayed that he had stolen the axe. He could not believe that this young boy could be so disrespectful that he would steal and ruin his family dinner that he spent so long hunting for, hoping the boy would lose his index finger with it. Not long afterwards he decided to judge the boy, the man found his axe while digging in his cellar, which brought a halt to his accusing and doubting. When he saw his neighbour's son again, nothing about the boy's behaviour, nor appearance seemed to suggest that he had stolen the axe.

Story 23

A certain man went down from Jerusalem to Jericho, and fell among thieves, who stripped him of his clothing, wounded him, and departed, leaving him half dead. By chance an elder priest came down that road. When he saw him being attacked by an eagle, he passed by on the other side. Likewise a Levite, when he arrived at the place, came and looked, and passed by on the other side. It was as if he had some repulsive smell. But a certain flamboyant Samaritan, as he journeyed, came where he was. Feeling compassion for this man, he went to him and bandaged his wounds, pouring on oil and wine; and he set him on his own animal, brought him to an inn, and took care of him. The next day, when he departed, he took out two denarii, gave them to the innkeeper, and said, 'Take care of him and whatever more you spend, when I come again, I will repay you.' 'Which of these three do you think was neighbour to him who fell among the

thieves?" And another said, "He who showed mercy on him." Then Jesus said, "Go and do likewise."

Story 24

A sergeant worried about his high cholesterol and weak heart said to God, 'I would like to know what Heaven and Hell are like.' God led the man to a room and let him in. In the room was a round table. On the table was a pot of stew that smelled delicious. The people sitting around the table were thin and sickly. The utensils they had available to them were spoons with very long handles, that were strapped to their arms and each found it possible to reach into the pot of stew and take a spoonful, however because the handles were longer than their arms, they couldn't get the spoons back into their mouths. They went to the next room. It was the same as the first one. There was the large round table with the large pot of stew, which made the man's mouth water. The people had the same long-handled spoons, but here the people were ready for survival, laughing, talking and seemed to care for one another. The man said, 'I don't understand. 'It is simple,' said God. 'It requires but one skill. You see they have learnt to use cooperation and feed each other.'

Appendix C

Task instructions presented to panel.

Read each story, think about the overall message that it is portraying, then write down as many single words that encompass this message on the blank page directly after that story. Ensure that you do not read over the story more than once (once you have read the story do not scroll back up). Repeat for each story.

An example would be jealous or hope.

Appendix D

Target words used in lexical decision task.

Related and Unrelated Words

Story	Related		Unrelated	
1	Organised Plan	Selfish Prepared	Thirsty Universe	Polarised Road
2	Aware Observant	Alert Thoughtful	Drunk Irrelevant	Fresh Frightful
3	Lie Trust	Truth Lesson	Plant Planes	Sky Cover
4	Reliable Perseverance	Persistent Hospitality	Scholastic Destination	Sporting Practitioner
5	Patience Time	Faith Nature	Staff Inside	Carriage Like
6	Clever Deception	Foolish Cunning	Sizable Gateway	Linear Whirlpool
7	Greed Satisfied	Envy Jealousy	Numb Mediocre	Algae Automatic
8	Love Forgiveness	Family Tolerance	Office Inspector	West Exploration
9	Pride Arrogant	Boastful Proud	Speckled Rough	Shear Nautical
10	Kindness Selfless	Grateful Empathy	Peculiar Brewery	Pamphlet Toneless
11	Content Attitude	Outlook Positive	Routine Campaign	Burning Activity
12	Prepared Lazy	Work Deserve	Long Peppery	Original Acid
13	Karma Kind	Favour Reward	Mishap Hunter	Ankle Open
14	Honesty Liar	Truthful Helpful	Affluent Monthly	Whisper Sour
15	Wise Deceit	Cunning Caution	Bizarre Doorway	Bare Frolic
16	Belief Confidence	Honest Achieve	Marine Silence	Valley Republican
17	Greedy Selfish	Caring Cruel	Greasy Unwed	Tribal Virtual
18	Ego Arrogance	Ignorant Comparison	Majestic Generation	Tar Gymnastic
19	Control Wisdom	Regret Teaching	Bundle Contract	Section Decade
20	Jealous	Talent	Pocket	Jittery

	Competitive	Humility	Collapse	Operational
21	Nature Impatient	Haste Interference	Wrist Introduction	Moment Strenuous
22	Accusing Judge	Assuming Distrust	Basement Grandson	Burgundy Index
23	Cruel Compassion	Pity Unselfish	Hawk Repellent	Elder Flamboyant
24	Cooperation Survival	Knowledge Love	Equipment Keys	Cholesterol Sergeant

Non-Words

Inlatient	Estipmelt	Condrol	Saction
Torm	Keps	Surbital	Serbeant
Merdy	Elber	Karna	Antle
Knowlurge	Stranulus	Campession	Flatbosant
Evo	Tur	Prond	Rough
Farth	Stoff	Clemer	Capual
Selkless	Taneless	Considance	Rebuglican
Interpetence	Ingropuction	Conperitive	Ovenational
Kinchens	Pompalet	Trast	Covar
Lozy	Acud	Fanity	Offire
Lasson	Prines	Costant	Burting
Arrodense	Gempastic	Outlark	Rolsine
Crell	Unped	Luve	Wert
Toperance	Instecdor	Croll	Unted
Enly	Nomb	Natere	Intade
Conderation	Cloesderol	Setisfred	Artomasic
Grond	Albae	Ignodart	Magastic
Prevalation	Environrant	Trith	Plint
Petiance	Carsiade	Alpitade	Aptility
Relarble	Sporning	Conding	Bilarie
Foalish	Sasible	Suy	Kan
Graseful	Pecultor	Trushful	Amoluent
Argodent	Neuticol	Lear	Scer
Tive	Lipe	Coption	Doonway
Alort	Drosk	Tarent	Poklet
Pary	Halk	Regrit	Bondle
Jealors	Jatlery	Porative	Compadon
Wark	Lang	Abrieve	Selance
Harde	Wrost	Embathy	Bredety
Honart	Mirone	Disarve	Propery
Natual	Vatious	Deflit	Frelic
Pertistant	Schorastic	Haldful	Manthey
Jadge	Inbex	Wilgom	Derade

Disprust	Grendsin	Jerlorsy	Meciodie
Lue	Sey	Borstful	Slackled
Decuption	Farnhurse	Unrelfich	Ropellant
Reavy	Firal	Rotard	Hanter
Cating	Gleasy	Altusing	Bargurdy
Hanesty	Warster	Farsor	Mashop
Hoslitamy	Delisation	Astuling	Bostment
Balief	Veltey	Wase	Bage
Obsardent	Fristful	Percavelance	Pronditioner
Teashing	Consrant	Homality	Corlipse
Gleety	Trical	Selrich	Elevart
Adere	Frish	Kand	Opun
Troutitful	Irrelocent	Compardson	Genetation
Fargoveness	Exprodatian	Ornagised	Cereblity
Propaved	Unitarse	Plen	Rond

Appendix E

Information sheet.

This study is part of my Honours Degree in Psychology, supervised by Jeffrey Coney at Murdoch University. The aim of this study is to investigate how the two hemispheres process language differently. A better understanding of how language is processed may help to understand reading disabilities in more detail.

If you consent to take part in this research study, it is important that you understand the purpose of the study and the tasks you will be asked to complete. Please make sure that you ask any questions you may have, and that all your questions have been answered to your satisfaction before you agree to participate.

What the Study will Involve

If you decide to participate in this study, you will be asked to read passages being presented and respond to stimuli (words) on a computer screen. It is estimated that this will take approximately 1.5 hours.

Voluntary Participation and Withdrawal from the Study

Your participation in this study is entirely voluntary. You may withdraw at any time without discrimination or prejudice. All information is treated as confidential and no names or other details that might identify you will be used in any publication arising from the research. If you withdraw, all information you have provided will be destroyed.

Benefits of the Study

It is possible that there may be no direct benefit to you from participation in this study. While there is no guarantee that you will personally benefit, the knowledge gained from your participation may help others in the future that have a reading disability.

If you have any questions about this project please feel free to contact either myself, Jason Lloyd at: Lloyd.J.M@outlook.com or 0431627457, or my supervisor Dr Jeffrey Coney at: J.Coney@murdoch.edu.au or 9360 2387. My supervisor and I are happy to discuss with you any concerns you may have about this study.

Once we have analysed the information from this study we will put a summary of our findings on the School of Psychology and Exercise Science website at <http://www.murdoch.edu.au/School-of-Psychology-and-Exercise-Science/>. You can expect to receive this feedback by the end of the year.

If you are willing to consent to participation in this study, please complete the Consent Form.

Thank you for your assistance with this research project.

This study has been approved by the Murdoch University Human Research Ethics Committee (Approval 2013/096). If you have any reservation or complaint about the ethical conduct of this research, and wish to talk with an independent person, you may contact Murdoch University's Research Ethics Office (Tel. 08 9360 6677 or e-mail ethics@murdoch.edu.au). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

Appendix F

Instructions for LDT.

You will be presented with a booklet with 24 passages. During each trial, you should carefully read the passage provided (only one at a time), ensuring that you think of the overall meaning of the passage as you read. You will be required to wear ear defenders throughout testing to reduce distractions. Once you have read the passage and are ready to start the trial, you will put your head on the chin rest and press the enter key. During the trial a cross will appear in the centre of the screen. It is very important that you do not divert your gaze away from this cross and remain in the chin rest. The CCTV camera above the monitor will project an enlarged image of your pupils onto a screen, which will help me ensure that you are maintaining central vision. The cross will disappear and a string of letters will appear on either the left or right side of the screen. When you see the string of letters, you must decide whether it is a real word or a non-word.

Do not move your eyes away from the fixation point to read the target word more clearly, but simply stare at the centre of the screen, where the cross appears. Any deviation will negatively affect the results of the study and may result in the findings being excluded. If you have decided that a real word has been presented, press down the 2 switches at the same time with both index fingers. If you think that a non-word has been presented do not press any buttons. An incorrect response will result in the word 'ERROR' in red letters appearing on the screen. It is important that you try to respond as fast as possible, while making as few errors as possible.

After each block of trials your response time and error rate will be displayed on

the screen. At this point read the next passage and press the enter key when you are ready to continue. If you find that you need a quick break between trials, feel free to pause before you press 'Enter' on the keyboard to start the next trial.

Before testing begins, you will complete a practice trial to ensure you are familiar with the procedure. If you have understood these instructions and have no further questions, please sign the consent form and we can begin.

Appendix G

Consent form.

Project title: Hemispheric Differences in the Comprehension of Passages

1. I agree voluntarily to take part in this study.
2. I have read the Information Sheet provided and have received a full explanation of the purpose of this study, the procedures involved and of what is expected of me.
3. I understand that I will be asked to read passages being presented and respond to stimuli (words) on a computer screen.
4. The researcher has answered all my questions and has explained possible problems that may arise as a result of my participation in this study.
5. I understand I am free to withdraw from the study at any time without needing to give any reason.
6. I understand I will not be identified in any publication arising out of this study.
7. I understand that my name and identity will be stored separately from the data, and these are accessible only to the investigators. All data provided by me will be analysed anonymously using code numbers.
8. I understand that all information provided by me is treated as confidential and will not be released by the researcher to a third party unless required to do so by law.

Name of participant: _____

Signature of participant: _____

Date:

...../...../.....

I confirm that I have provided the Information Letter concerning this study to the above participant; I have explained the study and have answered all questions asked of me.

Signature of researcher: _____

Date:

...../...../.....

Appendix H

Neuropsychologia guide for authors.

***Neuropsychologia* is an international interdisciplinary journal devoted to experimental and theoretical contributions that advance understanding of human cognition and behavior from a neuroscience perspective. The journal will consider for publication studies that link brain function with cognitive processes, including attention and awareness, action and motor control, executive functions and cognitive control, memory, language, and emotion and social cognition. *Neuropsychologia* has a long history of publishing lesion-deficit studies, and these remain highly appropriate for the journal. Submission of papers describing the use of other methodologies – most notably functional and structural neuroimaging, cognitive electrophysiology, and transcranial magnetic stimulation - is strongly encouraged, however. Animal studies are also welcome, provided they have a direct and explicitly specified impact on understanding human cognition and behavior. Studies of clinical populations that are primarily descriptive or intended to elucidate a clinical disorder, or that evaluate a therapeutic intervention, are not appropriate for the journal. Special issues and Review Papers are published regularly with the aim of providing authoritative surveys of topics of major interest.**

NEW SUBMISSIONS Submission to this journal proceeds totally online and you will be guided stepwise through the creation and uploading of your files. The system automatically converts your files to a single PDF file, which is used in the peer-review process. As part of the Your Paper Your Way service, you may choose to submit your manuscript as a single file to be used in the refereeing process. This can be a PDF file or a Word document, in any format or lay-out that can be used by referees to evaluate your manuscript. It should contain high enough quality figures for refereeing. If you prefer to do so, you may still provide all or some of the source files at the initial submission. Please note that individual figure files larger than 10 MB must be uploaded separately.

References There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

Formatting requirements There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions. If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes. Divide the article into clearly defined sections.

Figures and tables embedded in text If you choose to use our Your Paper Your Way service, please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file.

REVISED SUBMISSIONS

Use of wordprocessing software Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier:

<http://www.elsevier.com/guidepublication>). See also the section on Electronic artwork. To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your wordprocessor.

Article structure

Subdivision - numbered sections Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

Results Results should be clear and concise.

Discussion This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Appendices If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Essential title page information

- **Title.** Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
- **Author names and affiliations.** Where the family name may be ambiguous (e.g., a double name), please indicate this clearly. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
- **Corresponding author.** Clearly indicate who will

handle correspondence at all stages of refereeing and publication, also post-publication. **Ensure that phone numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address. Contact details must be kept up to date by the corresponding author.** • **Present/permanent address.** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Abstract A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

Graphical abstract A Graphical abstract is optional and should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership online. Authors must provide images that clearly represent the work described in the article. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. See <http://www.elsevier.com/graphicalabstracts> for examples. Authors can make use of Elsevier's Illustration and Enhancement service to ensure the best presentation of their images also in accordance with all technical requirements: [Illustration Service](#).

Highlights Highlights are mandatory for this journal. They consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point). See <http://www.elsevier.com/highlights> for examples.

Keywords Immediately after the abstract, provide a maximum of 6 keywords, using British spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Acknowledgements Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Database linking Elsevier encourages authors to connect articles with external databases, giving their readers one-click access to relevant databases that help to

build a better understanding of the described research. Please refer to relevant database identifiers using the following format in your article: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN). See <http://www.elsevier.com/databaselinking> for more information and a full list of supported databases.

Footnotes Footnotes should be used sparingly. Number them consecutively throughout the article. Many wordprocessors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article. Do not include footnotes in the Reference list. *Table footnotes* Indicate each footnote in a table with a superscript lowercase letter.

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<http://www.elsevier.com/artworkinstructions>. **You are urged to visit this site; some excerpts from the detailed information are given here.**

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Figure captions Ensure that each illustration has a caption. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

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