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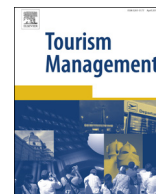
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## Using a randomised experiment to test the causal effect of service quality on visitor satisfaction and loyalty in a remote national park

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### HIGHLIGHTS

- Tested the causal relationship between service quality, visitor satisfaction and loyalty using a randomised experiment.
- Experimentally manipulating two service quality attributes significantly changed attribute performance.
- The manipulation of service quality did not have a statistically significant effect on visitor satisfaction and loyalty.

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### ABSTRACT

For parks and protected areas knowledge of visitor expectations and loyalty is limited. Understanding the relationships between service quality, satisfaction and loyalty continues to both intrigue and frustrate researchers and the managers of protected areas. Significantly, past research has focused on observational data where conclusions of causality rather than association are assumed. This study tested the causal relationships between service quality, visitor satisfaction and loyalty using a randomised experimental design. Two service quality attributes (ranger presence and provision of information) were manipulated to test whether they have an effect on visitor satisfaction and loyalty in a remote national park. Although experimentally manipulating these two service quality attributes did significantly change their perceived performance, they did not have a statistically significant effect on visitor satisfaction and loyalty. The disparity between the results from this randomised factorial experiment and the majority of previous research, with its reliance on observational studies and correlations determined through regression analyses, suggests the need for further collection of experimental data and further consideration of causal effects in protected area research.

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### 1. Introduction

Parks and protected areas have the dual mandate of nature conservation whilst still being social spaces. Recent research suggests an awareness of the increased possibilities for park-people symbiosis where visitors are seen as an asset rather than a burden (Weaver & Lawton, 2011). With changing political and economic values park agencies across the world and in Australia are in many cases required to become more financially self-sufficient as a result of reduced budgets or greater budgetary constraints (Campbell, 2012; Eagles, 2001; Kaczynski & Crompton, 2004;

Moore, Rodger, & Taplin, 2013). This has seen a shift in the consideration of visitor management towards a business context, from simply limiting numbers and activities to the consideration of public involvement in park goal-setting, and greater emphasis on maintaining visitor satisfaction and competent financial management (Eagles, 2001). Park managers are now viewing visitors as clients with their needs and wants given greater priority. Financial contributions from visitors are acknowledged as potentially increasing the capacity of park managers to not only provide a service to the public, but also protect the environment (Buckley, 2009; Eagles, 2001).

While visitors were previously monitored in terms of satisfaction, other concepts are now being used to measure and evaluate the experience of the client (visitor). Visitor loyalty is one such concept. In the last decade more studies of loyalty and its antecedents have appeared in the tourism literature (Lee, Graefe, &

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Burns, 2004; Weaver & Lawton, 2011; Moore et al., 2013). Marketing research has progressed from achieving a high level of satisfaction as the ultimate goal to understanding and influencing behavioural intentions (i.e. loyalty behaviours) as a better predictor and measure of performance (Chi & Qu, 2008). Through producing loyal visitors, tourism managers can establish and better defend a market position in the competition for limited resources and money (Eagles, 2001).

Visitor loyalty to protected areas focuses on the commitment of the individual to a park or destination and is often measured by intention to revisit or recommend to others (del Bosque & Martin, 2008). Loyal visitors are important as they can provide on-site support through willingness to pay higher user fees as well as off-site through positive word of mouth, recommending to others, donations and in some cases political advocacy (Hawkins, Lamoureux, & Clemmons, 2005; Lee et al., 2004; Moore et al., 2013; Weaver & Lawton, 2011).

Measuring visitor loyalty remains a challenge and is primarily measured through the behavioural intentions of those who have visited (Moore et al., 2013; Weaver & Lawton, 2011). Previous research refers to both loyalty and behavioural intentions. Here we preferentially use the term loyalty, taking it to encompass intention to revisit and recommend to others, as well as an allegiance more broadly to natural attractions including national parks and protected areas. Pro-environmental behavioural intentions unrelated to protected areas, such as an interest in recycling or water conservation for example, are not included.

To understand loyalty as a construct, structural equation modelling (SEM) has been used in past tourism studies, including studies of parks and protected areas, to statistically test relationships between service quality, satisfaction and loyalty (e.g. del Bosque & Martin, 2008; Wang, Zhang, Gu, & Shen, 2009; Zabkar, Brencic, & Dmitrovic, 2009). Improvements in service quality have been correlated with increased satisfaction and loyalty behaviours, including retention or expansion of tourist numbers, more vociferous and active tourism support, and ultimately enhanced profitability and political support (Zabkar et al., 2009).

In all these studies causality between the constructs has been inferred through correlation and theoretical assumptions. This is standard practice in statistical analyses of observational data and where the design is embedded in theory testing or building (Vaske, 2008). This means that service quality is assumed to be a determinant of satisfaction and behavioural intentions when they are correlated. Experimentally manipulating one or more of the service/facility items and measuring the influence on these dependent variables would be a useful way to test this assumption. Using experimental approaches based on randomized experiments can be used to complement observational studies, which currently dominate leisure, recreation and tourism research. Although randomised experiments are not frequently undertaken in tourism and recreational research undertaking them would contribute to more definitive conclusions about causal relationships between service quality, satisfaction and loyalty (Chi, 2012).

Therefore, the aim of this study was to test the causal relationships and directions between service quality, visitor satisfaction and loyalty using a randomised experimental design. To achieve this the study manipulated the presence and absence of rangers and provision of information in a large national park in north-western Australia. These two attributes were chosen for this study as they are recognised as adding value to the visitor experience in protected areas as well as being a predictor of visitor satisfaction (Fletcher & Fletcher, 2003; Manning, 2011; Rivera & Croes, 2010). Visitor surveys conducted across the experimental period provided data on the importance and performance of several service attributes as well as overall satisfaction and loyalty,

allowing causality to be explicitly investigated. This is one of only a handful of studies to experimentally manipulate service quality in an operational setting. As such, reflections on the methodology and lessons learnt are an important part of this paper's discussion.

## 2. Literature review

This section reviews literature on loyalty and loyalty behaviours including the acknowledged antecedents of service quality and satisfaction and the methodologies used to determine causality. This review incorporates recent research on visitor loyalty at nature based tourism destinations, with an emphasis, where possible, on protected areas such as national parks.

### 2.1. Loyalty

In its simplest form visitor loyalty is a commitment to a particular destination, place or brand (Baker & Crompton, 2000; Rivera & Croes, 2010). In the last decade there has been an increased number of loyalty studies in protected area tourism research. This is because visitor loyalty is seen as a more accurate predictor of actual behaviour than satisfaction (Chi & Qu, 2008). Research into visitor loyalty to protected areas has focused on how to measure loyalty, the different influences on loyalty, and more recently pro-environmental behaviours (Moore et al., 2013).

For protected area research (and nature based tourism more broadly) loyalty has been largely recognized and measured on the basis of intention to re-visit and recommend to others (Moore et al., 2013; Tian-Cole, Crompton, & Wilson, 2002; Weaver & Lawton, 2011). Behavioural intentions, as derived from the theory of reasoned action (Ajzen & Fishbein, 1980), measure a person's intention to undertake a certain type of behaviour. This theory deems that the intention to perform a behaviour reflects a high level of motivation to actually perform it (Baker & Crompton, 2000; Moore et al., 2013).

The term 'loyalty' is frequently used in protected area research rather than behavioural intentions (e.g. Rivera & Croes, 2010; Weaver & Lawton, 2011). Loyalty is an easy to understand term, and loyal visitors are those who demonstrate commitment to a place or protected area through repeat visitation, recommend others visit or relay positive word of mouth communications (Baker & Crompton, 2000; Zabkar et al., 2009). All of these actions are desirable for park managers due to their positive outcomes. Repeat visitation requires less expenditure than capturing first time visitors. Other positive outcomes of loyal behaviours that are of interest to managers can include enhanced reputation, political support and greater profitability (Baker & Crompton, 2000; Wang et al., 2009; Zabkar et al., 2009). Perhaps the simplest way to understand the relationship between the two is to regard behavioural intentions as a means of measuring visitor loyalty.

Tian-Cole et al. (2002) examined the behavioural intentions of visitors to a wildlife refuge in Texas. Lee et al. (2004) investigated the behavioural intentions of tourists at the Umpqua National Forest in Oregon, while Weaver and Lawton (2011) explored the loyalty of visitors to South Carolina's Francis Beidler Forest. In all cases, the core items measured included intention to revisit and recommending the destination to others. Research has generally found a lower mean for revisiting than recommending, suggesting that intention to revisit may not be a good predictor of loyalty, especially for iconic destinations which may be seen as a 'once in a lifetime' experience (Rivera & Croes, 2010).

Other measurement items for loyalty include willingness to, pay a higher entrance fee, advocate to politicians, volunteer time to protected areas, and donate money to managing the area. These last four intentions require greater commitment and overlap with actions

identified as pro-environmental behaviours. These are behaviours undertaken by individuals or groups either promoting or resulting in the sustainable use of natural resources (Halpenny, 2010).

Widely accepted influences of loyalty include quality of service and overall visitor satisfaction. They have been identified as the two important predictors of loyalty (Chi & Qu, 2008; Li & Petrick, 2008; Ostrowski, O'Brien & Gordon, 1993; Weaver & Lawton, 2011). Therefore, it is not possible to discuss the concept of loyalty without exploring the intertwined concepts of satisfaction and service quality (Moore et al., 2013).

Throughout the literature conceptual confusion between service quality and visitor satisfaction exists even though they are two distinctive concepts. Both constructs come from the expectancy disconfirmation theory, meaning expectation levels are the criteria upon which confirmation or disconfirmation is made (Crompton & McKay, 1989; Parasuraman, 1985; Tomas, Scott, & Crompton, 2002). This means both service quality and satisfaction are considered adequate if expectations are met. However, if service performance or satisfaction is lower than expected then they are negative and if they are higher than expected, then they are positive (Oliver, 1980; Tomas et al., 2002). An important distinction between these two concepts is that managers of protected areas (the service providers) can control service quality attributes but they cannot directly control overall visitor satisfaction (Crompton & Love, 1995; Crompton & McKay, 1989).

Although sharing the same theoretical background, the two concepts are very distinctive (Lee et al., 2004; Rivera & Croes, 2010). The concept of service quality reflects visitors' judgements regarding the services and facilities available (Crompton, MacKay, & Fesenmaier, 1991; Lee et al., 2004; Oliver, 1993). Associated attributes include service delivery (including for example interpretation and staff interactions with visitors) and facilities (such as toilets, roads, signs) (Parasuraman, 1985; Zabkar et al., 2009). This attribute-based approach is regarded as a useful step in analysing visitor satisfaction (Coghlan, 2012).

Asking visitors to protected areas questions about a suite of service quality attributes is standard practice in visitor surveys (Moore & Taplin, 2014; Tonge & Moore, 2007). Questions address visitors' perceptions of the importance and performance of facilities such as restrooms, signposts, walk trails and car parks as well as services such as friendliness of staff and guided tours (Arabatzis & Grigoroudis, 2010; Ryan & Cessford, 2003; Tonge & Moore, 2007). Research in Tanzanian national parks by Wade & Eagles (2003) asked visitors for their perceptions of the friendliness of guides, availability of information and the cleanliness of restrooms. All these attributes are of interest to managers because they are potentially amenable to management and possible improvement (Baker & Crompton, 2000; Crompton & Love, 1995). Of this suite of service quality attributes, two are widely regarded as predictors of satisfaction – ranger presence and information provision (Fletcher & Fletcher, 2003; Manning, 2011; Rivera & Croes, 2010).

Satisfaction is an evaluation of the psychological outcomes from an experience by an individual, in contrast to service quality, which is a cognitive evaluation of outputs (Crompton et al., 1991; Oliver, 1993; Tian-Cole et al., 2002). Therefore, visitor satisfaction is highly subjective and can be influenced by external factors such as the weather or group dynamics. As such, managers of protected areas are likely to have greater control over service quality than satisfaction (Moore et al., 2013). With satisfaction being a psychological outcome or emotional response (Manning, 2011) it is less amenable to management. The generic measure of visitor satisfaction at an overall level is a key interest to protected area managers (Crilly, Weber & Taplin, 2012). The most common approach to measuring visitor satisfaction has been asking visitors "how satisfied are you with your visit?" (Tonge & Moore, 2007).

Visitors' perceptions of service quality and satisfaction are measured as they enable managers to monitor their performance and identify where changes might be needed to improve the quality of service (Tomas et al., 2002). For many researchers and park managers visitor satisfaction is still commonly used as a measure, both in assessment of satisfaction with the overall visitor experience and with individual features or attributes. This is because satisfaction is seen as a key to successful management in a competitive landscape (del Bosque & San Martin, 2008).

Recent modelling has examined the relationships between loyalty behaviours and service quality, visitor satisfaction and other antecedents of loyalty. In particular structural equation modelling (SEM) has been extensively used (Lee et al., 2004; del Bosque & Martin, 2008; Nowacki, 2009; Wang et al., 2009; Zabkar et al., 2009; Pinkus, 2010). SEM statistically describes and tests the relationships between variables. Multiple relationships can be assessed simultaneously and modelled constructs are measured with several items, as in factor analysis (Bollen, 1989). The strength of correlation-based relationships can be tested quantitatively, but the direction of causality (i.e., deciding that 'a causes b') still remains a qualitative judgement.

Past research using modelling techniques has shown strong relationships between service quality and both satisfaction and loyalty behaviours (Tian-Cole & Crompton, 2003; Tian-Cole et al., 2002; Nowacki, 2009; Wang et al., 2009; Zabkar et al., 2009). The research is interpreted to mean improved service quality and satisfaction results in repeat visitation and positive word of mouth (Tian-Cole et al., 2002) and that service quality is an antecedent of satisfaction as well as having a direct effect on behavioural loyalty (Lee et al., 2004). All these conclusions regarding relationships between service quality and satisfaction/loyalty derive from statistical correlations rather than from observational studies. Randomised experiments provide an alternative approach that more directly addresses the issue of causality. Randomised experiments are rare in tourism research, possibly due to the difficulties of performing them compared to observational studies.

## 2.2. Randomised experimental research in protected areas

Few studies in protected area research have taken a randomised experimental approach, with several notable exceptions. One of these is research reported by Park, Manning, Marion, Lawson, and Jacobi (2008) on an intervention study examining the effectiveness of alternative management practices in Acadia National Park. Using a randomised experimental context of treatments and controls they examined five different management techniques that had been designed to keep visitors on the maintained trails. Methods used included observation and visitor surveys with results showing all management practices reduce the number of visitors who walk off trail. This study, however, did not examine effects of changes on visitor satisfaction or loyalty.

Another exception is research by Steckenreuter and Wolf (2013) who undertook an intervention study with visitors paying park user fees in Kamay Botany Bay National Park in New South Wales (Australia). They used interventions to determine if two different persuasive messages encouraged park visitors to pay user fees. When randomly implementing one of three interventions (control with no treatment; message 1 or message 2) they found visitors reacted with their immediate behaviour being influenced. This study, however, only examined the influence of the intervention on one specific loyalty behaviour. Apart from this study no other studies in protected area tourism research have been undertaken using randomised experiments to determine causality between service quality attributes and loyalty behaviours.

### 3. Methods

The study site for this research was Karijini National Park, a remote park in north-western Australia (Fig. 1). At 627,455 ha in size, Karijini National Park is the second largest national park in the state of Western Australia. The Park is managed by the Western Australian Department of Parks and Wildlife (DPaW) which has responsibility for managing over 100 national parks in Western Australia (WA). The Park features spectacular geological formations and deep gorges including Dales, Knox and Hamersley Gorges. Activities include hiking, sightseeing, nature study and camping, with the Park receiving around 180,000 visitors p.a. (Smith & Pinkus, 2012). Karijini National Park is a popular place to visit during winter months when this study was conducted with fine weather, cool nights (above freezing) and average maximum temperatures of 24 °C during the day.

The Park was chosen for this research in consultation with Department of Parks and Wildlife staff. Most visitors stay overnight in this Park and spend an extended time in the Park enabling them to provide well-informed responses to questions about service quality and satisfaction. Dales Gorge was selected as a suitable site for the proposed interventions. Dales Gorge Campground, which permits camping in a natural setting, is a 5 min walk from the Gorge and thus provides a steady flow of visitors across the day who can be surveyed. Dales Gorge itself provides a relatively confined space where visitors could interact with a ranger (one of the two interventions). The Gorge also only has two access points and it was at these points that the information sheets were provided (the second intervention). The more heavily used of these two access points, adjacent to a large parking area and a short walking distance from Dales Gorge campground, provided an ideal intercept point where research staff could intercept visitors coming out of the Gorge and distribute the surveys.

Staff from the Department of Parks and Wildlife were involved in the design and execution of the interventions. However, staff shortages resulted in an informed Department of Parks and Wildlife volunteer (wearing a ranger uniform) taking the role of the ranger in Dales Gorge, rather than a Departmental staff member.

#### 3.1. Questionnaire content and rationale for interventions chosen

The survey was distributed to all exiting adult visitors at the main entry/egress point to Dales Gorge (Fig. 1). The survey began with questions on visitor demographics and trip specific characteristics. These questions were sourced from DPaW's statewide survey, as requested by that agency as part of a collaborative approach to this study. Following the visitor demographic questions visitors were asked to assign levels of importance and performance to nine service quality attributes. These attributes are widely used in park visitor surveys (Griffin, Moore, Crilley, Darcy & Schweinsberg, 2010) and included several related to the selected interventions. The exact wording of the included attributes can be seen in the tables in the Results section. A 7-point Likert scale was used with 1 being the lowest (not at all important/not at all satisfied) and 7 the highest (extremely important/extremely satisfied).

Three questions on overall visitor satisfaction derived from del Bosque and San Martín (2008) and measured on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree) were also included. Following the visitor satisfaction questions were 8 questions about the likelihood of loyalty behaviours, measured on a scale from 1 (very unlikely) to 7 (very likely). The loyalty questions were derived from Tian-Cole et al. (2002), Lee et al. (2007), Nowacki (2009) and Wang et al. (2009). All visitors were also asked to record their level of interaction with rangers during their current visit to Dales Gorge with possible responses including none, seen rangers, listened to rangers, and talked to rangers. There was no question on the visitor survey asking if people had collected the information sheet as suggesting an information sheet existed may prejudice the responses of visitors who felt they may have missed out.

To undertake an effective randomised experiment attributes that could be changed (i.e. manipulated) as well as being important to visitors were identified. The first attribute, ranger presence, was chosen for this research as previously it had been identified as a strong predictor of satisfaction (Fletcher & Fletcher, 2003; Manning, 2011; Rivera & Croes, 2010). The second attribute chosen for manipulation for this experiment was the provision of an information sheet. Manning (2011) noted that information can add value



Fig. 1. Map showing location of Karijini National Park.

Source: <http://www.romartraveler.com/ROMAR07/Romar07Pages/Australia-PacificIslands/OUTBACK-KARIJINI.html>.

in improving visitors' experiences. The fact that both these attributes had previously been identified as areas of concern in Karijini National Park gave additional support for their inclusion in this research. Visitor surveys undertaken by park staff between 2008 and 2011 found visitors were least satisfied with "... talks by rangers or others" and "useful information on plants and animals" (Smith & Pinkus, 2012).

Note that the proposed relationship between service quality and satisfaction/loyalty has been augmented in this study with management interventions of service quality. In the literature service quality typically refers to *visitor perceptions* of service quality rather than the *actual level of service* provided. This paper concentrates on links between the actual level of service quality provided, in the sense of resource allocation by management, and the perceived performance of attributes, satisfaction and loyalty.

### 3.2. Survey design

In large part the novelty of this study rests on its randomised experimental design. Randomisation was achieved by randomly allocating treatments to days. Rather than the intervention treatments being randomly allocated to individual visitors, they were randomly allocated to days. This enabled randomised allocation of treatments that was practically achievable and statistically robust (see Section 3.4 Statistical Analysis).

Four treatments were allocated to four days each. The four treatments were: rangers absent and information sheet absent (the control); rangers present and information sheet absent; rangers absent and information sheet provided; and rangers present and information sheet provided. Statistically, these treatments collectively constitute a balanced  $2 \times 2$  experimental design with four replicates. Surveying was conducted for 16 days in the month of July 2012 during school holidays, the peak visitor period for this Park.

On the ranger intervention days a Park ranger was placed at the bottom of the walk trail into Dales Gorge where they were visible and interacted with visitors. They remained in the Gorge for the period 9.30 am to 4.00 pm talking with visitors who entered the Gorge. The ranger conversed with as many visitors as possible. For some groups the interaction was only a few minutes while for others it lasted for up to 15 min, with the ranger answering questions from the visitors and providing information on the Gorge and Park. On the days when the ranger was absent no rangers entered the Gorge during the day, although park staff performed their normal duties near the Gorge. Park staff also continued to operate the Park's Visitor Centre and undertake management activities in

Dales Campground and other parts of the Park where they provided information as requested by visitors.

For the second intervention an A4 colour information sheet was placed at the two entrances to walk trails into Dales Gorge: the major entry where the researchers were located and a more minor entrance with a small parking area and a longer walk from Dales Gorge Campground to a trail into the Gorge. These are the only entry points to the Gorge ensuring all visitors saw and could collect to take with them a sheet before entering the Gorge. The information sheets were placed in self-administering pamphlet boxes attached to large information signs at the two entrances to the Gorge. The information sheet was A4 colour double sided and contained information on the geological features of the Gorge as well as some of the possible wildlife that might be seen by visitors including reptiles, birds and mammals [copy provided for reviewers and can be provided online]. It was designed in collaboration with interpretation staff from the Department.

### 3.3. Hypotheses

Possible effects of the interventions were tested for four sets of responses: importance of each attribute; performance of each attribute; overall satisfaction; and loyalty (Table 1). These hypothesised relationships are detailed in Table 1. In addition to these hypotheses, indirect effects are also possible. For example, the presence of rangers has the potential to increase performance on the attribute "Other visitors well-behaved" due to the policing effect of rangers present and on the attribute "Useful visitor guides and maps" due to the information provided by rangers. Therefore, relationships for each attribute were formally tested in addition to the specific hypotheses listed in Table 1. Due to the statistical design of this study, and in particular the randomisation of treatments, conclusions concerning the hypotheses involve causal relationships rather than associations between variables described in past literature using observational data.

### 3.4. Statistical analysis

The unit of analysis was days rather than visitors. That is, each day corresponds to an observation for statistical analysis rather than each visitor. This is because the intervention treatments were randomly allocated to days rather than individual visitors. Therefore, mean responses for each of the sixteen days were first calculated from the responses of individual visitors. This reduces the statistical sample size to sixteen while still retaining statistical power as each of these means are estimated with high precision

**Table 1**

Hypothesised causal effects of interventions on service quality, visitor satisfaction and loyalty tested experimentally in this study.

Hypothesis	Explanation
H1: The presence of rangers and provision of information sheet will have no impact on the importance of the attributes to visitors.	No relationship is expected between the interventions and importance of attributes given the interventions are designed to improve performance not importance (H1).
H2: The provision of information sheet intervention will increase performance on the attribute "Useful information on the features of Dales Gorge".	Each intervention, as detailed in H2–H4, may increase attribute performance depending on the relationship between the intervention and the attribute.
H3: The presence of rangers intervention will increase performance on the attribute "Access to friendly, helpful rangers".	
H4: The presence of rangers intervention will increase performance on the attribute "Presence of rangers".	
H5: The presence of rangers intervention will increase the overall satisfaction of visitors.	Since the interventions are intended to increase overall satisfaction and loyalty, the effect of the interventions on these responses are tested for each satisfaction and loyalty question (H5–H8).
H6: The provision of information sheet intervention will increase the overall satisfaction of visitors.	
H7: The presence of rangers intervention will increase the loyalty of visitors.	
H8: The provision of information sheet intervention will increase the loyalty of visitors.	



since they are based on a large number of visitor responses. This is a between subject design (Cozby & Bates, 2011) since each surveyed visitor is measured after exposure to only one treatment. While obtaining responses from the same visitor for all treatments (within-subject design) may be statistically superior it was both impractical since visitors are unlikely to visit the same gorge multiple times and responses on latter days are likely to be biased by earlier experiences.

Two-way analysis of variance was then performed to test whether mean responses varied significantly depending on the presence of the information sheet, the presence of rangers, or the interaction effect presence of information sheet\*presence of rangers. This interaction effect can be interpreted as the information sheet having a different effect depending on whether rangers were present or absent.

Formally, the factorial design is analysed using the multiple regression equation given by

$$Y = \beta_0 + \beta_1(\text{Info}) + \beta_2(\text{Ranger}) + \beta_3(\text{Interact})$$

where *Info* takes the value of 0.5 for days where the information sheet was provided and  $-0.5$  when it was not provided; *Ranger* takes the value of 0.5 for days where the ranger was present and  $-0.5$  when the ranger was absent; and *Interact* takes the value of 0.5 when either both or neither of the information sheet and rangers are provided and  $-0.5$  when exactly one enhancement is provided. The dependent variable *Y* takes 16 values equal to the mean response on each of the 16 days, and the analysis is repeated for each attribute importance, attribute performance, satisfaction and loyalty question.

This parameterisation of the independent variables (using sum-to-zero constraints) (Dobson & Barnett, 2008) simplifies interpretation of regression coefficients as follows:  $\beta_0$  is the “overall” average response (that is, the average of the 16 values for the 16 days);  $\beta_1$  is the difference in mean response when the information sheet is provided compared to when it is not provided;  $\beta_2$  is the difference in mean response when the ranger is present compared to not present; and  $\beta_3$  measures the interaction effect, meaning the effect of the ranger being present depends on whether the information sheet is provided or not. When the interaction effects is significant ( $\beta_3 \neq 0$ ), the average ranger effect of  $\beta_2$  is lower by  $\beta_3/2$  when the information sheet is not provided and higher by  $\beta_3/2$  when the information sheet is provided. That is,  $\beta_3$  is the difference in the effect of the ranger depending on whether the information sheet is provided or not. The interaction effect is not hypothesised to exist, and in this case the effect of each treatment (information sheet and ranger) does not depend on the level of the other treatment, simplifying interpretation. For example, in the absence of any interaction effect,  $\beta_2$  is not only the average effect of the ranger being present, but also the effect of the ranger when the information sheet is provided and the effect of the ranger when the information sheet is not provided. Coefficients are easier to interpret in the presence of interaction effect in the regression, than when values of 0 and 1 are used (corner point constraints) (Dobson & Barnett, 2008).

Finally, utilizing the survey question that asked for the level of interaction visitors had with rangers, each visitor was allocated to a group that had interaction (talked or listened to rangers) and those that did not (possibly saw rangers, but did not talk or listen to them). Means for each satisfaction and loyalty question were then tested for differences between these two groups using *t* tests. This analysis has the advantage of capturing the observational (non-randomised) information of whether visitors actually had interaction with rangers rather than whether they visited on a day when rangers were present. This analysis mimics the analysis typically

found in the literature and enabling a comparison of results between analysis based on a randomised design and analysis based on observational data.

## 4. Results

### 4.1. Responses, visitor and visit characteristics

In total, 1482 visitors were approached with 1399 agreeing to participate in the survey. This provided a response rate of 94%. The majority were first time visitors (78%) and were Australian (83%) with 59% of these being from Western Australia. Even these visitors, however, tended to be from Perth, the capital city of Western Australia and approximately 1400 kms from Karijini. All age groups were evident in the Park: 18–24 years old (14%), 25–34 (18%), 35–44 (18%), 45–54 (16%), 55–64 (19%) and 65+ (15%).

Respondents were most likely to be staying at Karijini National Park overnight (77%). The average number of nights these respondents stayed was three. Less than 5% of visitors were at the Park for a short stop (under 2 h). The majority (68%) of respondents indicated that they found out about Karijini National Park through “Word of mouth/friends”. There was a substantial difference in percentages between this form of knowledge and the next two, “Park agency internet/website” and “Visitor Centre (local tourism office)” which both recorded 11% of responses.

Over half of respondents (57%) indicated there were two adults in their group, with the next highest percentage pertaining to four adults in their group (14%). Large groups were less common with only 11% of respondents indicating their group size was larger than 5 adults. Groups containing two children were most common with 37%, followed by no children (19%). Groups containing more than five children were uncommon and constituted only 6% of responses.

On the days when the ranger was present, 44% of surveyed visitors indicated they talked to the ranger and an additional 5% indicated that they only listened to the ranger. While 28% indicated that they saw rangers the remaining 22% indicated that they did not see a ranger. The fact that only approximately half the visitors interacted with the ranger on these days is consistent with the effect of management providing a ranger since in practice a ranger cannot physically interact with all visitors, and in any case some may not desire such interaction. This has important implications that we return to in the Discussion.

### 4.2. Effects of interventions

The effect of the interventions on the importance of attributes using the factorial design analysis are summarised in Table 2 and show mixed support for H1. The information sheet had statistically insignificant ( $p > 0.05$ ) effects on the importance of all attributes supporting H1. In contrast, the presence of rangers had significant and positive effects for five attributes: “Access to friendly, helpful rangers”; “Presence of rangers”; “Well designed and maintained walking tracks/trails”; “Clean, well presented toilet facilities”; and “Other visitors well-behaved”. For example, the largest and most significant effect of rangers was to increase the importance of “Presence of rangers” by 0.62 ( $P = 0.001$ ), although the interaction effect suggests this effect is lower by 0.31 (or 0.30) when the information sheet was provided and higher by 0.31 (or 0.93) when the information sheet was not provided. That is, providing the information sheet eliminated most of the increased importance of this attribute that occurred when the ranger was present. As hypothesised, however, interaction effects are generally insignificant ( $P > 0.05$ ) and when they are significant the coefficients are relatively small with *p*-values close to 0.05 ( $P = 0.045$  and 0.034).

**Table 2**  
Effects of interventions on the importance of attributes.

Attribute	Coefficients			P-values			
	Overall	Info	Ranger Interact	Info	Ranger	Interact	
Able to enjoy nature in this park	6.41	0.00	−0.02	−0.04	0.972	0.818	0.560
Access to friendly, helpful rangers	4.72	0.18	<b>0.38</b>	−0.02	0.152	<b>0.006</b>	0.810
Well designed and maintained walking tracks/trails	5.60	0.04	<b>0.22</b>	−0.03	0.526	<b>0.009</b>	0.751
Presence of rangers	4.36	0.21	<b>0.62</b>	<b>−0.31</b>	0.158	<b>0.001</b>	<b>0.045</b>
Useful visitor guides and maps	5.92	0.10	0.09	0.00	0.240	0.268	0.985
Clean, well presented toilet facilities	5.69	0.11	<b>0.21</b>	0.12	0.128	<b>0.012</b>	0.113
Useful information on the features of Dales Gorge	5.76	0.10	0.08	0.06	0.249	0.322	0.453
Value for money for fees paid to DEC	5.67	−0.18	0.25	<b>0.10</b>	0.547	0.208	<b>0.034</b>
Other visitors well-behaved	6.09	0.06	<b>0.14</b>	−0.10	0.292	<b>0.029</b>	0.103

Mean visitor importance for the four treatments (left) and statistical significance for the effects of information sheet, rangers, and the info\*ranger interaction (right). P-values less than 0.05 are in bold.

The effects of the interventions on the performance of attributes are summarised in Table 3, with the presence of rangers significantly increasing the performance of the two attributes relating directly to rangers. For the attribute “Presence of rangers”, mean performance is increased by 0.99 ( $P = 0.000$ ) on the seven point Likert scale and for “Access to friendly, helpful rangers the increase was 0.81 ( $P = 0.000$ ). Thus there is strong evidence in favour of hypotheses H3 and H4 (Table 1). Finally, the lack of significant interaction effects suggests these effects of the ranger are similar regardless of whether the information sheet was provided.

The mean performance on the attribute “Useful information on the features of Dales Gorge” was insignificantly increased by 0.15 when the information sheet was provided ( $p = 0.100$ ). Therefore, hypothesis H2 is not supported. However, performance of a third attribute “Well designed and maintained walking tracks/trails” was

**Table 3**  
Effects of interventions on the performance of attributes.

Attribute	Coefficients			P-values			
	Overall	Info	Ranger Interact	Info	Ranger	Interact	
Able to enjoy nature in this park	6.50	0.04	0.06	0.01	0.525	0.330	0.806
Access to friendly, helpful rangers	5.24	0.16	<b>0.81</b>	0.02	0.190	<b>0.000</b>	0.848
Well designed and maintained walking trails	5.97	<b>0.13</b>	0.00	−0.02	<b>0.031</b>	0.932	0.746
Presence of rangers	4.87	0.11	<b>0.99</b>	−0.04	0.438	<b>0.000</b>	0.770
Useful visitor guides and maps	5.78	0.06	0.08	−0.08	0.466	0.332	0.362
Clean, well presented toilet facilities	5.78	0.10	0.11	0.05	0.265	0.202	0.586
Useful information on the features of Dales Gorge	5.64	0.15	0.06	0.01	0.100	0.521	0.967
Value for money for fees paid to DEC	6.10	0.14	0.06	0.06	0.115	0.436	0.552
Other visitors well-behaved	6.03	−0.09	0.06	0.11	0.299	0.494	0.183

Mean visitor performance for the four treatments (left) and statistical significance for the effects of information sheet, rangers, and the info\*ranger interaction (right). P-values less than 0.05 are in bold.

significantly increased by 0.13 ( $p = 0.031$ ) when the information sheet was provided.

Despite the presence of rangers contributing to a strong improvement in the performance of the two related attributes, this translated into small and statistically insignificantly higher satisfaction (Table 4). When the information sheet was present, however, there was a statistically significant but small decrease in the mean level of agreement with the satisfaction items “My choice to visit was a wise one” by 0.10 ( $p = 0.003$ ) and “My visit was exactly what I needed” by 0.08 ( $p = 0.034$ ). Thus the evidence does not support H5 and H6 as the presence of rangers increases satisfaction but insignificantly and the presence of the information sheet significantly decreases satisfaction slightly.

The provision of an information sheet and presence of rangers had statistically insignificant effects on loyalty (Table 4). The only exception was a statistically significant ( $p = 0.008$ ) interaction effect for “Pay increased park fees to improve park facilities and park management” where visitors were more willing to pay more park fees if either the ranger or the information sheet was present (mean of 4.48 and 4.48) rather than neither (4.12) or both (4.19). Thus the improved importance and performance of attributes (Tables 3 and 4), especially due to the presence of rangers, caused no statistically significant improvement in satisfaction and negligible improvement in loyalty. Thus hypotheses H7 and H8 are not supported.

Finally, the observational data of whether visitors interacted with (talked to or listened to) rangers was tested for relationships with satisfaction and loyalty (Table 5). For all three satisfaction questions, mean satisfaction is significantly higher for visitors who interacted with a ranger than those that did not, however the difference in satisfaction means is small ( $<0.1$  Likert points). Six out of the eight loyalty behaviours have means significantly higher for visitors who interacted with a ranger. The only two behaviours to not be statistically significant were to “Volunteer my time to help conserve this park or similar protected areas” and “Visit this park again”. Thus hypothesis H7 is supported when the data are analysed using the observational data of whether visitors choose to interact with rangers, consistent with past literature suggesting improved service quality increases satisfaction and loyalty but inconsistent with the results of the analyses reported here following the randomised experimental design. This difference in conclusions from the experimental (Table 4) and observational (Table 5) approaches is a major contribution of this paper; the consequences are discussed in detail in the next section.

## 5. Discussion

The importance of this study rests on its development and application of an experimental methodology enabling consideration of causal relationships between service quality, satisfaction and loyalty. This methodology was applied in a real world field setting to test the effect of manipulated changes in service quality on visitor satisfaction and loyalty. The two manipulated service attributes – the presence of rangers and provision of information – have been widely identified as important to visitors in previous nature based tourism research.

Surprisingly, few causal relationships were found, with a non-significant increase in satisfaction associated with the presence of rangers and a significant decrease in satisfaction associated with the information sheet. Neither treatment contributed to significant increases in loyalty. Analysis of the data as if it arose from an observational study (ignoring the randomisation), however, showed significant associations between interacting with rangers and both visitors' satisfaction and loyalty. These contradictory results are discussed below, firstly through their juxtaposition against

**Table 4**  
Effects of interventions on satisfaction and loyalty.

Attribute	Coefficients				P-values		
	Overall	Info	Ranger	Interact	Info	Ranger	Interact
<b>Satisfaction</b>							
I am satisfied with my visit to this park	6.57	−0.06	0.06	0.02	0.095	0.125	0.638
My choice to visit this park was a wise one	6.61	<b>−0.10</b>	0.03	0.02	<b>0.003</b>	0.232	0.587
My visit to this park was exactly what I needed	6.35	<b>−0.08</b>	0.03	−0.06	<b>0.034</b>	0.454	0.108
<b>Loyalty</b>							
Recommend to friends and relatives that they visit this park	6.59	0.01	−0.02	0.00	0.759	0.632	0.995
Donate money to help protect this park or similar protected areas	4.54	0.07	0.04	−0.08	0.395	0.643	0.341
Say positive things about this park to other people	6.62	−0.05	0.01	−0.01	0.278	0.936	0.899
Volunteer my time to help conserve this park or similar protected areas	3.07	0.12	−0.08	0.06	0.326	0.472	0.578
Pay increased park fees to improve park facilities and park management	4.32	0.04	0.04	<b>−0.33</b>	0.703	0.724	<b>0.008</b>
Talk to other people about the importance of this park and other protected areas	5.66	0.11	0.07	−0.07	0.239	0.505	0.389
Visit this park again	5.05	−0.02	0.05	−0.06	0.928	0.763	0.701
Visit another national park in Australia	6.70	−0.04	0.04	−0.04	0.308	0.421	0.327

Mean visitor satisfaction and loyalty for the four treatments (left) and statistical significance for the effects of information sheet, rangers, and the info\*ranger interaction (right). P-values less than 0.05 are in bold.

previous research findings and secondly through methodological reflections.

### 5.1. Service quality as an influence on satisfaction and loyalty

Improving service quality attributes did not significantly increase overall satisfaction and loyalty. This is despite previous papers reliant on observational data (e.g. Lee et al., 2004, 2007; Rivera & Croes, 2010; Tian-Cole et al., 2002) concluding the opposite, with service quality widely noted as a significant antecedent of satisfaction and behavioural intentions/loyalty. For example, Lee et al. (2004) in their study of visitors to Umpqua National Forest in Oregon suggest service quality has a “direct effect” on behavioural loyalty. Structural equation modelling reported in the tourism literature “positively relates” destination attributes (i.e. service quality), satisfaction and visitors’ behavioural intentions (Zabkar et al., 2010) and identifies quality as an “antecedent” of satisfaction with satisfaction having a “positive effect” on loyalty (Wang et al., 2009). It is important to note that in these previously reported studies, the investigated relationship is between service quality as perceived by visitors and satisfaction/loyalty. In this study, in contrast, the main relationship explored is between changes in service quality (i.e. information, rangers) and satisfaction/loyalty.

Given the overwhelming body of evidence from previous observational studies linking perceived service quality and satisfaction (and more recently loyalty) some possible reasons for the

absence of this relationship in this study are explored in this section before investigating methodological explanations for this difference. One reason for the lack of significant relationships in this study relative to other studies could be the very high visitor satisfaction and loyalty at this Park, making it difficult to significantly increase. This research raises the question of how to measure a change in satisfaction if everyone is satisfied. A solution may be found in Taplin's (2012, 2013) work where importance and satisfaction are measured relative to alternatives by asking visitors to report on their satisfaction and loyalty when comparing their current visit to previous visits to competing venues. Building on this approach another alternative way to more accurately measure and interpret satisfaction and loyalty might be found in the benchmarking literature. Benchmarking is a system for comparing performance to achieve improvement. It allows for the relative performance of service quality attributes, plus satisfaction and loyalty, to be evaluated spatially (i.e., within a selected park and/or across the park system) and temporally (i.e., repeat measures over time) (Moore & Taplin, 2014).

A second possible reason for the minimal effect of improved service quality could be due to the type of visitors attracted to remote parks. Smith, Tuffin, Taplin, Moore and Tonge (2014) used psychographic and behavioural variables to segment nature-based tourists to a suite of protected areas within Western Australia including Karijini National Park. Their research found that the main segment of visitors to Karijini National Park were ‘Nature

**Table 5**  
Relationship between interaction with rangers by individual visitors and satisfaction and loyalty (non-randomised visitor level analysis).

Attribute	Means		Difference in means	P value
	No interaction	Ranger interaction		
<b>Satisfaction</b>				
I am satisfied with my visit to this park	6.58	6.62	<b>0.04</b>	<b>0.001</b>
My choice to visit this park was a wise one	6.65	6.67	<b>0.02</b>	<b>0.003</b>
My visit to this park was exactly what I needed	6.34	6.43	<b>0.09</b>	<b>0.019</b>
<b>Loyalty</b>				
Recommend to friends and relatives that they visit this park	6.59	6.57	<b>−0.02</b>	<b>0.031</b>
Donate money to help protect this park or similar protected areas	4.44	4.56	<b>0.12</b>	<b>0.000</b>
Say positive things about this park to other people	6.64	6.65	<b>0.01</b>	<b>0.000</b>
Volunteer my time to help conserve this park or similar protected areas	3.09	2.94	−0.15	0.220
Pay increased park fees to improve park facilities and park management	4.12	4.48	<b>0.36</b>	<b>0.037</b>
Talk to other people about the importance of this park and other protected areas	5.54	5.68	<b>0.14</b>	<b>0.001</b>
Visit this park again	5.00	5.11	0.11	0.260
Visit another national park in Australia	6.68	6.76	<b>0.08</b>	<b>0.021</b>

Mean visitor satisfaction and loyalty for visitors interacting or not interacting with rangers (left) and statistical significance for the effect of interaction with rangers (right). Ranger interaction is defined as visitors reporting to have listened or talked to rangers (irrespective of the treatment applied on the day of their visit). P-values less than 0.05 are in bold.

Explorers'. These are chiefly visitors who want to participate in a large range of nature activities and have less of a focus on social connection and rejuvenation. The most important attribute to this segment of visitors is the 'ability to enjoy nature' whilst service quality attributes such as "Interesting guided walks and talks", "Useful information on plants and animals" and "Friendly and responsive staff" have low importance assigned to them in comparison. As such, the effect of visitor satisfaction and loyalty already being high combined with visitors to whom service quality is not vitally important could have contributed to the lack of significant effect on visitor satisfaction and loyalty in this study.

A third possible reason the relationship between ranger presence and satisfaction/loyalty was not significant when analysed according to the randomised experimental design (Table 4) is that only about half the visitors interacted with rangers on days when the ranger was present. Since it is not possible to force all visitors to interact with rangers, these results represent the practical effect of management providing rangers but do not necessarily answer the theoretical question of the effect should all visitors choose to interact with rangers. This theoretical question is difficult to answer since forcing visitors to interact with rangers may be detrimental to loyalty, however p-values for loyalty were all above 0.4 (Table 4) and even if the coefficients for loyalty were doubled (representing the estimated effect on the half of the visitors who did interact) the coefficients would remain statistically insignificant.

It is also plausible that the relationship between interaction with rangers and satisfaction/loyalty (Table 5) may be interpreted as the result of satisfied/loyal visitors interacting with rangers rather than the ranger interaction increasing satisfaction/loyalty. It is most likely that both effects are present, ranger intervention increases satisfaction and increased satisfaction causes interaction with rangers, however this is never acknowledged in the literature using observational studies and suggests observational studies may be interpreted as over-estimating the causal effects of rangers on satisfaction and loyalty. Importantly, since managers can only provide a ranger who will interact with some of the visitors, the 'reality' of this intervention (Table 4) is more relevant for park management than the effect (if any) on the visitors who interact with the ranger.

Surprisingly, the presence of the information sheet had a significantly negative influence on visitor satisfaction. Given that previous research undertaken by DPaW (Smith & Pinkus, 2012) showed that visitor satisfaction at Karijini National Park could be improved through the provisioning of "useful information on plants and animals", this result was unexpected. A possible reason might be that the actual information sheet provided, instead of becoming the expected 'satisfier' and generating satisfaction, actually became a 'dissatisfier'. It has been hypothesised that dissatisfiers can cause dissatisfaction when not adequately maintained or do not work properly (Alegre & Garau, 2010). For example, the presence of a little information might heighten desires for more information, which was not then provided.

The information sheet provided was an A4 double-sided colour sheet containing information and pictures on the geology of Dales Gorge as well as local flora, fauna and was designed in partnership with local staff from DPaW. The type of information, its medium and the way it was made available could all have contributed to the information sheet's negative influence resulting in it becoming a dissatisfier. With the development of technology, including apps for smart phones, interpretation in some parks has become very sophisticated (Eagles et al., 2002) which perhaps visitors expected or preferred. Additionally, interpretative signs on the flora and fauna in situ might have resulted in a different outcome as anecdotal comments to our ranger implied this would have been a favoured option for the provisioning of such information.

The non-significant relationship found in this study between the manipulated service items and loyalty could also potentially have been influenced by the negative effect of treatment on satisfaction. Structural equation modelling reported in the tourism literature "positively relates" destination attributes (i.e. service quality), satisfaction and visitors' behavioural intentions (Zabkar et al., 2010) and identifies quality as an "antecedent" of satisfaction with satisfaction having a "positive effect" on loyalty (Wang et al., 2009). Yet, for this experiment the manipulation of service quality attributes did not have a significant effect on loyalty. It is therefore possible that the correlation between service quality and satisfaction or loyalty reported previously in the literature is spurious: rather than a causal effect the correlations are created by other factors.

## 5.2. The methodological consideration of randomised experiments

Methodological concerns are at the heart of this study. This section discusses why research using field-based randomised experiments complements observational studies and it is crucial to investigate causal influences on visitor satisfaction and loyalty. It also helps understand the very different results from this experimental study and previous observational work.

The scientifically designed and analysed experiment using the random allocation of treatments (Table 4) showed a non-significant relationship between a ranger being present and visitor satisfaction and loyalty; however, the analysis using the observational data (Table 5) produced statistically significant relationships for most of the measured items. This latter approach is the one commonly found in the literature where observational studies accompanied by structural equation modelling or multiple regression have been used, generally producing highly significant relationships (Baker & Crompton, 2000; Chi & Qu, 2008; Zabkar et al., 2009).

If viewed alone, the analysis using the observational data can be correctly interpreted as proving the existence of relationships between service quality and both satisfaction and loyalty. The analysis using the randomisation, however, finds the relationship is not significant, suggesting the relationships are not causal. Below, we first discuss why these observational relationships may exist, be strong, and yet not causal. Second, we discuss why the randomised experiment approach is important and should be adopted in future research.

First, a possible reason for these differing results is that more satisfied and loyal visitors take more advantage of services provided, so the causality is in the opposite direction to that commonly suggested in the literature. For example, visitors who are more satisfied with their visit to Karijini may be more inclined to approach a ranger or be open to a ranger approaching them, as this interaction will enhance their positive experience. Unsatisfied visitors, however, may avoid contact with a ranger as this increases engagement with the visit and consequently is expected to magnify the feelings of a negative experience.

Alternatively, some other characteristic of visitors (such as an interest in the natural environment) may cause both satisfaction/loyalty and also a desire to interact with rangers. While other visitors may feel that they do not require any additional information, as they are already well informed about the park. If it is the case that other factors explain the results, then survey questions capturing these factors must be included in the research design. Past research has identified a core group of benefits desired by visitors, which includes those derived from nature and those from relaxation (Archer & Griffin, 2005; Weber & Anderson, 2010). Of importance is Crilley et al.'s (2012) research on predicting visitor satisfaction in Kakadu National Park which showed that benefits attained by visitors were a stronger predictor of an overall positive response to a park than visitor service quality ratings.

The associations identified from observational studies may be a result of common method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). A visitor may respond to prompts within the same questionnaire in similar ways, creating a correlation between answers to these questions across visitors. In this study we were not measuring the relationship between perceptions of service quality and satisfaction/loyalty, which could result in common method bias. Rather, the researchers determined the interventions and then tested the relationship between an intervention and satisfaction/loyalty. This avoids the potential for common method bias for testing the study hypotheses.

Note that it is the observational nature of the way the data are collected that creates this inability to make causal conclusions. Observational data refers to data collected by observing visitor behaviour without any manipulation of factors (such as service quality or presence of rangers). These observational studies are the norm in visitor studies (Vaske, 2008), and while they can establish the existence of relationships they should not be used to prove causal relationships. Language such as service quality “causes” satisfaction or loyalty or synonyms such as “influences”, should be avoided in the context of observational studies.

Second, randomised experiments provide a scientifically valid way to make inferences about causality that are standard and accepted in scientific research but are more innovative in visitor studies on satisfaction and loyalty. Note that the randomisation is crucial for this analysis, both its presence and taking into account the way the randomisation was applied during analysis (in the Karijini study, this implies analysis at the level of day rather than visitor since this is how the randomisation was applied). Pre and post treatment studies (such as measuring visitor responses before and after an intervention), such as Park et al., (2008) and Steckenreuter and Wolf (2013), are not randomised experiments as other factors may change at the same time the treatment changes. While these studies have the benefit of including an intervention controlled by researchers or management (but not visitors), they do not include the crucial randomisation, and hence are best regarded as observational studies rather than randomised experiments.

Another advantage of the randomised experiment conducted in this paper is that it answers questions of more interest to management: whether the provision of a service increases satisfaction or loyalty. Studies in the literature tend to answer questions concerning whether visitors who perceive service quality is higher also perceive satisfaction is higher or are more likely to be loyal. These studies avoid the crucial question of what they can do to influence these outcomes and the accompanying assumption that visitor perceptions of service quality can be improved by increasing the level of service quality.

A potential criticism of the randomised experimental approach is that the statistical sample size is reduced to the number of experimental units to which the randomisation of treatments is applied (in this study days). While it is true that a larger study using more days would provide more precise answers there are two reasons this is not a significant limitation. First, the mean responses on these days are calculated using *all* the visitor responses, so the effective sample size remains the number of visitors. Effectively, these day means provide more precise estimates than a single visitor. Secondly, this approach provides strong statistical evidence that the interventions caused changes in service quality (Table 4). For example, despite the insignificant causal effect of ranger presence on satisfaction and loyalty, the same analysis ( $n = 16$  days) produced a highly significant ( $p = 0.000$ ) increase in performance for the attributes “presence of rangers” and “access to friendly, helpful rangers”. This proves the statistical analysis has sufficient power to prove causal relationships when they exist, and hence the insignificant statistical evidence of a causal effect on satisfaction

and loyalty is most likely due to this effect being absent or negligible rather than due to any lack of statistical power.

Finally, we emphasise that the randomised experiment approach answers questions more pertinent to managers: whether a management intervention will change visitor satisfaction and loyalty. This study proved that placing a ranger in Dale’s Gorge significantly increased satisfaction with attributes of service quality, however, this did not cause significant increases in visitor satisfaction or loyalty. If the ultimate objective is to increase satisfaction or loyalty, then this intervention may not be worthwhile. Observational studies may show that satisfied and loyal visitors value interaction with rangers but say less about the effect of management interventions.

### 5.3. Recommendations for implementing randomised experiments

Based on this Karijini study, some advice regarding the implementation of randomised studies in a visitor satisfaction or loyalty setting is pertinent. If managers and researchers are interested in expanding from their current observational studies to examine possible causal effects then they will need to devote resources to conduct randomised experiments. Given the difference in results obtained from this study compared with other related research, managers would be wise to devote further time and resources to further research before acting on this study’s results. In a similar vein this study should be regarded as adding to a body of theory for further testing rather than providing a definitive endpoint.

The ideal design choice is to randomise treatments to visitors but this is logistically difficult if not impossible at most nature based tourism destinations. In the Karijini study, this was avoided by randomly assigning interventions to days. Attempts to randomise to individual visitors is not only more difficult to implement (for example, the ranger must simultaneously ensure they speak with some visitors but avoid others, and know which to approach and which to avoid) but likely to create contagion effects. For example, visitors allocated to a no ranger treatment may overhear the ranger talking to visitors in the ranger present treatment. Alternatively, seeing rangers talk to other visitors but refusing to talk to them may cause dissatisfaction. The difficulty of switching treatments on and off for different visitors to a protected area make such an experimental approach possible only when treatments are randomised to individual days rather individual visitors. Furthermore, close collaboration with site managers is crucial. These difficulties may explain the lack of scientific experimentation in past visitor studies.

Factorial designs, such as the 2<sup>2</sup> design underpinning this study, constitute efficient experiments. In particular, they permit the investigation of several interventions simultaneously, which is important given the logistic difficulties of organising the study. Not only can interaction effects between interventions be investigated, but when these are negligible the study has equal numbers of observations for each level of each treatment (for example, rangers are present for the same number of days as they are absent, which is statistically optimal for estimating the effect of rangers).

A further consideration is the characteristics of the interventions. In this study, the ‘strength’ of the intervention may have been insufficient to have a significant effect at this study site. This study only investigated the presence or absence of rangers and the information sheet and the difference may not have been sufficient. Although the park rangers were not visible at Dales Gorge on ‘ranger absent’ treatment days, Camp Ground hosts and park staff were visible elsewhere in the Park and this may have reduced the difference in visitors’ responses. Also, the information sheet in this study may have had too minor to produce a detectable effect, as there are information signs permanently available at Dales Gorge. In this

study it was not possible to remove the presence of all park staff or to remove information signs on some randomly allocated days due to safety issues even though this would have increased the 'strength' of the experiment. Moreover, this would not answer a question of practical interest to managers since the level of service provided on 'no intervention' days is minimal and reducing below this level was considered unpalatable or below the duty of care by managers.

Another opportunity for further research and a limitation of the Karijini study relates to the overall visitor satisfaction in this park being high. This makes it difficult for any intervention to have a significant effect on satisfaction. Hence future research might investigate whether interventions to improve service quality might have significant causal effects on satisfaction and loyalty in parks where these are lower. In Western Australia this is difficult to achieve as parks in general have an overall high visitor satisfaction level. An alternative approach might be testing the effect of decreasing rather than increasing service quality through randomised experiments. This type of experiment would require the involved protected area management agencies to be fully supportive, as expectations based on past literature suggest this may lower satisfaction or loyalty. Such experiments may, however, reveal areas where management expenditure is unwarranted in the sense that reducing service quality does not reduce overall satisfaction or loyalty.

Finally, in cases where management intend making changes to their management practices to improve satisfaction or loyalty, it is suggested that brief randomised experiments should be considered prior to permanent changes to accurately assess their effect. Pre versus post intervention studies do not provide strong scientific proof of causal effects but short randomised experiments may be possible to provide this evidence first. Managers need to consider the benefits of producing scientific evidence of their enhancements if they are to continue to make decisions objectively rather than their assumptions or intuition. In an environment of diminishing resources and extra accountability managers may not be able to expect their funding sources to remain secure without scientific evidence of the value they provide.

## 6. Conclusion

The overarching research aim of this study was to test causal effects of service quality on visitor satisfaction and loyalty. Past research has assumed causality when statistical associations were evident (del Bosque & Martin, 2008; Wang et al., 2009; Zabkar et al., 2009), however this study suggests these associations may not be causal. Two service quality attributes (ranger presence and provision of an information sheet) were manipulated to test whether they had an effect on visitor satisfaction and loyalty in a remote national park. Only through undertaking such randomised experiments can scientific conclusions be drawn about the impacts of management interventions. Thus this research provides crucial insights for management.

Although the experimental manipulation of these two service quality attributes did significantly change attribute performance (service quality), they did not have a statistically significant effect on overall satisfaction or loyalty. This is despite previous papers reliant on structural equation modelling (e.g. Tian-Cole et al., 2002; Lee et al., 2004, 2007; Rivera & Croes, 2010) concluding the opposite, with service quality widely noted as an antecedent of satisfaction and behavioural intentions/loyalty.

The disparity between the results from the randomised factorial experiment and the majority of previous research, with its reliance on observational studies and correlations, suggests an urgent need for further collection of experimental data and a re-evaluation of causal effects in protected area research.

## Uncited reference

USDA, 2012.

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## Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.tourman.2015.01.024>.

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