Architects of change:
How does zoo exhibit design impact the efficacy of zoo-based behaviour change campaigns?

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Dedication

To Amira & Ava, my nieces
Declaration

This thesis is an original work. None of the work has been previously submitted for the purpose of obtaining a degree or diploma in any university or other tertiary education institution. To the best of my knowledge, this thesis does not contain material previously published by another person, except where due reference is made in the text.

Rhedyn Myfanwy Ollerenshaw

14 October 2020
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Abstract

Zoos and aquariums are uniquely placed to promote pro-environmental messages to a broad sector of the population. Their ability to connect people with wildlife may facilitate meaningful behaviour change in support of conservation efforts. Many modern zoos have evolved their educational strategies to incorporate social science and psychology to enhance the effectiveness of their visitor conservation education programs.

However, very little has been published on the role of zoo design in contributing to the effective delivery of conservation or pro-environmental messages aimed at affecting behaviour change in zoo visitors. This novel study seeks to understand whether zoo exhibit design can impact the efficacy of these zoo-based campaigns.

Visitor surveys and observations at two Sumatran tiger exhibits in New South Wales, Australia (Taronga Zoo and Taronga Western Plains Zoo), were used to understand the impact of visiting these exhibits on visitors’ perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation. The results of this study show that these factors were positively impacted by visiting a tiger exhibit. Perceived behavioural control is the most significant contributor to intention to undertake behaviours that help protect in the wild.

There is some relationship between engagement with zoo exhibits (particularly interactive elements) and visitor perceived behavioural control, attitudes related to tiger conservation, and sense of connection to the natural world. Tiger visibility was found to be the most significant exhibit engagement factor in contributing to increasing a sense of connection to tigers. This thesis demonstrates that modern, immersive zoo exhibit design can be an effective part of the ‘behaviour-change toolkit’ available to modern zoos in the pursuit of meaningful pro-environmental behaviour outcomes in the zoo-going public, and makes explicit suggestions for zoos on how to maximise the success of their behaviour change campaigns.
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1. Introduction

1.1 Background

*Learning and inspiration are only the first steps by which we fight extinction and ultimately save animals in their wild habitats. Our mission is not fulfilled until we change people’s attitudes and behaviours, and they become exemplary advocates for conservation.*

– Rick Barongi, Chair, World Association of Zoos and Aquariums (WAZA) Conservation and Sustainability Committee, on behalf of the 2015 WAZA Council (Barongi, Fisken, Parker & Gusset, 2015 p. 12).

The conservation of wildlife and wild places is of ever increasing importance. The World Wildlife Fund’s (WWF) 2020 Living Planet Report describes an overall average decline in global vertebrate populations of 68% over the preceding 46 years (Almond, Grooten & Petersen, 2020). Earth’s biodiversity is primarily threatened by unsustainable use of natural resources and habitat degradation for agriculture (WWF, 2018), and other pressures such as climate change and illegal trade in wildlife continue to threaten the survival of wild vertebrate populations.

In 2018 more than 55 percent of people lived in urban areas; this figure is projected to rise to close to 70 percent by 2050 (United Nations Department of Economic and Social Affairs, 2018). While connecting humanity with the natural world in this context may seem like a challenging task, much of the infrastructure needed is already in place (Anonymous Nature Editorial, 2010). For many people living in urban settings, zoos are often the primary, and often only, opportunities to encounter nature more broadly (and live wild animals specifically). Axelsson and May (2008) describe zoos as “among the most complex (sub)urban institutions… where the relationships between humans and animals are being articulated” (p. 43).

In a world in which people are increasingly geographically and emotionally disconnected from the natural environment, zoos and aquariums find themselves at “a privileged intersection between humans and wildlife” (Gray, 2016, para 13). There are over 700 million visits to zoos and aquariums globally per year (Barongi et al., 2015). In Australia alone, there were almost 20 million visits to zoos and aquariums in 2016-17 (Essential Research, 2017). Fraser and Wharton (2007, p. 50) describe zoos as “perhaps the most qualified of all potential conservation organisations to develop and succeed in the promotion of conservation as a top
human priority”. Balmford and Cowling (2006 p. 692) observe that “[c]onservation is primarily not about biology but about people and the choices they make”

1.2 Connection to nature

Conservation starts with a connection

- Studio Hanson Roberts, n.d, website home page

The WAZA Conservation Strategy *Committing to Conservation* asserts that “the key strategy for achieving the required revolution in attitudes and behaviours will be reconnecting the public with nature” (Barongi et al., 2015 p. 17). Yet, even given the commitment of the zoo industry to being “catalysts for conservation” (West & Dickie, 2007 p. 4), it has been challenging to engage and maintain the social will necessary to change behaviour to conserve wildlife and natural environments (Barongi et al., 2015). If zoos can provide context for connecting with animals (Clayton, Prévot, Germain & Saint-Jalme, 2017), this connection may be the facilitator for increased concern about threats to the natural world, and the catalyst for meaningful behaviour change.

Connection or connectedness with nature can be defined as an individual’s belief about the extent to which they are part of the natural environment (Shultz, 2002; Bruni, Fraser & Schulz, 2008). Research has identified that people who feel a higher degree of connection between themselves and the natural world are more inclined to engage in pro-conservation or pro-environmental behaviours (Schultz, 2001; 2011). Individuals’ understanding of the intrinsic value of natural resources is greater when they experience them firsthand; understanding leads to appreciation which increases the likelihood of protection (Charters, 1996). Further, enjoyable experiences of the natural environment where learning is presented can be a catalyst for developing an affinity with, and desire to protect, nature (Van Matre, 1990; Beaumont, 2001). Grajal et al. (2017) hypothesized that individuals reported strong connection to wildlife would also translate to a higher rate of pro-environmental behaviours to address other biodiversity threats. If we take this to be true, zoos are more likely to increase the efficacy of their conservation messages around pro-conservation attitudes and behaviours if they manifest or increase the connection their zoo visitors feel with the natural world.

Zoos cannot however escape their ‘other’ identity as places of entertainment, leisure and recreation – and perhaps nor should they. Most zoo visitors attend the zoo for various entertainment or recreation purposes (Reade & Waran, 1996; Shackley, 1996; Falk, Heimlich & Bronnenkant, 2008; Moss, Jensen & Gusset, 2014), but many note that education or
learning is an enjoyable or important part of their visit (Clayton, Fraser & Saunders 2009; Ross & Gillespie, 2009; Sickler & Fraser, 2009). Indeed, WAZA note that entertainment and conservation-related learning “are not mutually exclusive” (WAZA, 2005 p. 45). Falk et al. (2008) identified that the zoo-going public often stated a combination of motivations for zoo attendance. Free-choice learning environments, like zoos, can offer an attractive ‘learning for fun’ opportunity (Packer & Ballantyne, 2004; Packer, 2006; Ballantyne, Packer, Hughes & Dierking, 2007). The challenge for zoos then, in an increasingly entertainment-driven urbanised world, is to meet the entertainment needs of visitors while still providing opportunities for, and measurable outcomes from, conservation education (Sterling, Lee & Wood, 2007).

1.3 Zoo-based learning

A large portion of historical research on the efficacy of zoos as educators and communicators has looked at cognitive learning outcomes – what facts zoo visitors learn and recall from their zoo visit. While learning this information is in itself not a bad thing, cognitive learning does not always lead to changes in zoo visitor motivations, attitudes or behaviours (Clayton et al., 2017). Many modern, major zoos have evolved their educational strategies to address this, by incorporating social science and psychology to enhance the effectiveness of their visitor conservation education programs.

Despite the acknowledgement of the potential effect of physically visiting a zoo on behavioural outcomes (e.g. Clayton & Myers, 2015), very little has been published about the role of zoo design (e.g. animal exhibits, visitor spaces, entrance and exit precincts, retail and hospitality zones) in contributing to the effective delivery of conservation or pro-environmental messages aimed at affecting behaviour change in zoo visitors. To date, much of the research on zoo design, aside from that on the impact on the animals themselves, has focused on visitor satisfaction with an exhibit (e.g. Broad & Weiler, 1998). An Association of Zoos and Aquariums (AZA) multi-institutional research project, which aimed to determine what specific strategies zoos and aquariums can utilise to influence the impact of zoos on visitor attitudes and behaviour towards animals and the natural world, failed to draw out any specific strategies related to zoo design (Falk, Reinhard, Vernon, Bronnenkant, Heimlich & Deans, 2007a).

Ample evidence from other fields exists that exhibition design features influence learning, in particular the sequencing, positioning, and content of exhibitions and labels (Bitgood & Patterson, 1987; Falk, 1993; Serrell, 1996), as well as how many exhibit elements a visitor
attends to, and for how long (Bitgood, Serrell, & Thompson, 1994; Serrell, 1998). However, these types of studies have not been broadly extended to zoo or aquarium sites, beyond comparisons of the attractiveness of certain species in exhibits (e.g. Myers, Saunders & Birjulin, 2004; Powell & Bullock, 2014).

Scholars in zoo education, conservation psychology, and other disciplines have also identified this gap. Clayton and Myers (2015) observe that “[a]s managed settings, zoos have the opportunity to construct their exhibits and the overall zoo experience in a way that, informed by the research, is designed to achieve the best effect on environmental learning and attitudes” (Clayton & Myers, 2015 p. 48). Fraser et al. (2010), in the Association of Zoos and Aquariums Framework for Zoo and Aquarium Social Science Research, (the AZA Framework) note the insufficient empirical study of exhibit design variables on learning. The authors pose a question for future research: “Does the context of the zoo or aquarium alter the ways in which people learn concepts and develop skills?”, noting that research should “move beyond study of the animal or interpretive text to explore which specific domains of learning are best facilitated through the overall context, and how the context itself serves to teach” (Fraser et al., 2010 p. 22). The AZA Framework also highlights the need for inquiry into how exhibit settings affect learning in zoos and aquariums, noting that while such “context variables” may have been thought about, they have not been adequately investigated (p. 22). It specifies that such research should move beyond research on interpretive material content (e.g. signage) towards an examination of the role of context in learning. This context could reasonably include zoo exhibits. Reading and Miller (2007) suggest that future studies should compare attitude change in visitors between different types of exhibits, and that these studies should comprise multiple approaches, both quantitative and qualitative. Finally, the WAZA Conservation Education Strategy, released as this thesis was being finalised, recommends that “conservation education should be an integral part of exhibit design” (Thomas, 2020 p. 8).

Given the potential key role of zoos as community-based conservation educators in a world facing mass wildlife extinctions due to human activity, I propose that this is an important gap to address. Even more practically, further understanding of this issue will ensure that the considerable resources invested by zoos in their exhibits are used effectively to best support their educational mission in support of wildlife conservation. This study attempted to address, at least in part, the calls to action highlighted above. Uniquely, it sits at the nexus of three diverse fields introduced here: zoo-based informal science learning, the social science of behaviour change, and the impact of visiting zoos. Of this third point, this thesis focussed
specifically on the role of zoo design.

1.4 Research questions

This study sought to understand whether zoo exhibit design can impact the efficacy of zoo-based behaviour change campaigns, using Sumatran tiger exhibits at two Australian zoos as study sites. The two exhibits, at Taronga Zoo in Sydney and Taronga Western Plains Zoo in Dubbo, have very different design styles, which facilitated a comparison of the exhibits’ effectiveness. Further, large carnivores have been shown to be particularly useful species for public engagement on conservation issues (Consorte-McCrea et al., 2019). More information on the conservation challenges facing tigers, and the two zoo exhibits, is provided in Chapter 3.

This is a complex question, and required addressing through four sub-questions:

1. Does visiting tiger exhibits impact visitors’ perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation?
2. What personal factors of the zoo visit have the greatest impact on zoo visitors’ behavioural intentions regarding tiger conservation?
3. What exhibit engagement factors relate to the personal factors that contribute to visitors’ behavioural intentions regarding tiger conservation?
4. What exhibit engagement factors relate to increased sense of connection to tigers?

In designing this study, the researcher intended to both address the gap in understanding as noted in section 1.3, and provide practical, applied recommendations to the zoo community to support their conservation work. The primary audiences for the results of this study are practitioners working in zoos and aquariums. As such, this study is deliberately angled toward applied (rather than purely theoretical) recommendations, and functions in part to build capacity for multi-disciplinary research in the fields of social science and design in zoos.

1.5 Thesis overview

Chapter 2 of this thesis describes the existing literature in three relevant fields: learning science in informal settings, social science and behaviour change, and zoo design. This chapter also further illuminates the gap in existing research and understanding about the role of exhibit design in contributing to effective behaviour change campaigns in zoo settings. Chapter 3 introduces the conservation context and provides an overview of the two research sites examined in this study, which are both Sumatran tiger exhibits in Australian zoos: ‘Tiger
Trek’ at Taronga Zoo, and ‘Tiger Forest’ at Western Plains Zoo. Chapter 4 outlines the research methods, including justifying the chosen approach and discussing methodological limitations. The results of the study are described in Chapter 5. Chapter 6 discusses the results, including providing detailed exhibit design recommendations for zoos. The conclusions and limitations of the study are outlined at the end of Chapter 6.
2. Literature Review

2.1 Introduction

This chapter will summarise and provide a critical analysis of existing research in the three main fields that converge at the point of the key research question of this thesis: does zoo exhibit design impact the efficacy of zoo-based behaviour change campaigns?

Firstly, zoos, including their history and modern missions, are discussed (section 2.2). Following this, literature on science learning in informal environments is analysed (section 2.3), including informal learning in zoos, and the role of emotion and connection in learning. Next, a review of existing research in the field of social science and behaviour change is considered (section 2.4), focusing on the Theory of Planned Behaviour and social science research in zoos. Finally, this chapter will consider the history and science of zoo design (section 2.5), including a brief analysis of the existing literature on the role of design on engagement and learning.

The conclusion of this chapter (section 2.6) will highlight the gap in the literature identified by this thesis, supported by open calls from researchers and prominent zoo scientists, to better understand the impact of zoo design on the capacity of zoos to affect meaningful behaviour change in support of their conservation mission.

2.2 What is a zoo?

The term ‘zoo’ is both very easily understood and enigmatic – while for most people it will conjure an image of a public-facing collection of wild animals, the diversity within the ‘zoo industry’ of what constitutes a ‘zoo’ in the 21st century is enormous. From basic menageries and animals in small, barred cages, to the world’s largest and most active conservation institutions, a zoo in the 21st century is and can be many things. As noted by West and Dickie (2007 p. 4), “Zoos have traditionally been placed in the entertainment sphere, by both the viewing public and zoos themselves. However, there has been a sea change in how some zoos, but by no means all, view their role, repositioning themselves as conservation organisations”. This thesis will focus on these zoos that have a clear conservation focus. However, it is important to consider the evolution of zoos over time to understand how modern, zoo-based conservation organisations have developed.

There is no doubt that the origin of the practice of displaying wild animals is deeply embedded in human history. Some accounts cite Ur, Mesopotamia (now Iraq) in around 2300-2500 BCE (Hancocks, 2010) as the first example of a wild animal collection. Others recall the
menageries of Egyptian pharaohs or the exotic animals housed in the ‘gardens of intelligence’ of Chinese emperor Wen Wang around 1100 BCE (Hanson, 2002; Arnott, 2004; Hancocks, 2010). This seemingly intrinsic human fascination for live animal collections has persisted throughout time; zoos of some kind have been a part of many societies (Hancocks, 2010).

The private exotic animal collections of the 18th and early 19th centuries in Europe and North America were used for entertainment or social status purposes, with the wealthy elite creating a competitive industry in wild animal collection (Hanson, 2002; Hancocks, 2010). London Zoo opened to the members of the London Zoological Society in 1828 in Regent’s Park, and to the public in 1847 (Hancocks, 2010). The popularity of the London Zoo instigated a wave of new public zoos, first throughout Europe. Seventeen major zoos were developed in the next 55 years (Hancocks, 2010).

Melbourne Zoo was the first zoo to open in Australia, in 1862 (Culture Victoria, 2016). Adelaide Zoo opened in 1883 (Royal Zoological Society of South Australia, n.d.). The Royal Zoological Society of New South Wales opened a public zoo in 1884 in Moore Park, Sydney. In 1916, the zoo moved to its current location on Bradley’s Head, Sydney Harbour, and became Taronga Zoo (Taronga Conservation Society Australia, n.d.).

Zoos have evolved rapidly over the last 40 years to meet the expectations of communities and shifting cultural values. Despite being over 20 years old, this evolution is illustrated articulately by George Rabb (Rabb, 1994) in Figure 1:
Most modern, major zoos acknowledge their role in the community as being four-fold (Conway, 2003; Barongi et al., 2015):

1. recreation and leisure,
2. research,
3. refuges for the maintenance of insurance (or ‘assurance’) populations of endangered wildlife,
4. education centres.

The role of zoos as recreation and leisure providers is well documented and rarely disputed (Turley, 2001; Hanson, 2002; Ballantyne et al., 2007; Ross & Gillespie, 2009). The quantity, diversity and reach of science and research undertaken both within the zoo and by zoo scientists in the wild supports their role as research organisations (Kleiman, 1992; Conway, 1995; Macdonald & Hofer, 2011; Spindler, Wiszniewski & Slip, 2012). Zoos hold collections of endangered species that are sometimes extinct or almost extinct in the wild, whether as an insurance population or with the intention of reintroduction to the wild (Jones et al., 2007; Lees & Wilcken, 2009; Zimmerman, 2010; Lacy, 2013). This study is limited to an examination of the role of zoos as centres for conservation education.
In 1980, the Association of Zoos and Aquariums (AZA), the peak representative body for the zoological industry of North America, announced that conservation was amongst its top priorities, heralding the concept of zoos as conservation educators (Stirling et al., 2007). The last three decades have seen an emerging focus on animal welfare, behavioural enrichment, technology, *in situ* conservation and insurance population management (Whitehead, 1995; Tribe & Booth, 2003; Conway, 2003; Mallinson, 2003; Packer & Ballantyne, 2010; Conde, Flesness, Colchero, Jones & Scheuerlein, 2011). Many of the world’s major zoos now consider themselves “zoo-based conservation organisations” (Gusset & Dick, 2010 p.190) acknowledging the role of public animal collections while emphasising their broader role in the conservation field.

**2.2.1 Mission statements in zoos**

A popular way to share the strategic and philosophical stance of a zoo (with the public, government authorities, benefactors, and with industry colleagues) is via a ‘mission statement’ (Patrick, Tunnicliffe, Matthews & Ayers, 2007). Zoo mission statements are typically statements of purpose, expressing the objectives, culture and approach of the organisation, and are employed to guide strategic planning and for use in communications (Stone, 1996; Patrick et al., 2007a; Patrick, Matthews, Ayers & Tunnicliffe, 2007). They can be a unifying instrument within an organisation to focus staff and stakeholders on a shared mission (Stone, 1996). Patrick et al. (2007b) examined the mission statements of 136 accredited AZA zoos. Two prominent themes (conservation and education) emerged, although the authors noted that most of the statements did not clearly identify the relationship between these two themes.

A brief review by the present researcher of current mission statements across zoological organisations demonstrates a similar pattern to that identified by Patrick et al. (2007b). The Education Policy Mission Statement of the Zoo and Aquarium Association Australasia (the peak zoological industry group in Australia, New Zealand and Papua New Guinea) is to “provide inspiring learning opportunities that connect people with nature, enabling individuals and communities to understand and take action to live in balance with the natural world” (Zoo and Aquarium Association Australasia, n.d., p.1). The Conservation Education Mission Statement of the European Association of Zoos and Aquaria (EAZA) is “to mitigate the extinction of biodiversity through quality conservation education that raises awareness, connects people to nature and encourages sustainable behaviours in the millions of people that
engage with EAZA zoos and aquariums annually” (European Association of Zoos and Aquaria, 2016 p.2). The EAZA Strategic Plan 2013-2016 identified that “recognising that… emotional connections to animals will underpin engagement and thereafter attitude and behaviour change of benefit to the conservation of nature” is a key strategy for developing conservation learning and engagement for the future (European Association of Zoos and Aquaria, 2013 p. 10).

The mission statement (‘vision’) of Taronga Conservation Society Australia (the organisation that runs Taronga Zoo in Sydney and Taronga Western Plains Zoo in Dubbo, the research sites for this study) is “securing a shared future for wildlife and people” (Taronga Conservation Society Australia, 2016 p.3). The organisation has also published an emotive ‘mantra’ highlighting their main slogan “For the Wild” (Taronga Conservation Society Australia, 2016 p.33):

The WAZA Conservation Strategy Committing to Conservation weaves ‘visions’ throughout its chapters. These include:

- By helping to create a culture of conservation in our communities, zoos and aquariums are a vital part of the process of generating the attitude and will needed to save species and maintain healthy ecosystems (Barongi et al., 2015 p.22).
- Zoos and aquariums are redefined by society as organisations that save populations of species in the wild, while delivering the highest standards of care and welfare for their resident animals, and providing exceptional, behaviour-changing guest experiences (Barongi et al., 2015 p.30).
- Zoos and aquariums are trusted voices for conservation, and are able to engage and empower visitors, communities and staff measurably to save wildlife (Barongi et al., 2015 p.44).

The common message between these statements is the role of zoos in connecting people with nature and changing behaviour and culture to achieve conservation outcomes. The contribution of ‘connection’ to informal science and conservation learning and the efficacy of zoo-based behaviour change campaigns will be further explored in this chapter. It is also amongst the personal factors examined in this study, the justification and methods for which are outlined in Chapter 4.
2.3 Learning Science in informal settings

2.3.1 Science and environmental education

The term ‘environmental education’ was first used in the 1960s as a facet of the environmental movement, the focus of which was on broadening understanding of the impact of pollution, poor natural resource and land management, and human population impacts (Gough & Gough, 2010). The 1972 UN Conference on the Human Environment (known as the Stockholm Conference) was the first global meeting to clearly call upon environmental education as a means to address global environmental issues. Recommendation 96 of this meeting is frequently cited as the global call to arms of the environmental education movement (Najam & Cleveland, 2003; Handl, 2012), and was the catalyst for the development of the 1976 UNESCO-UNEP Belgrade Charter (UNESCO-UNEP, 1976 p.2):

“The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones.”

The subsequent 1977 UNESCO-UNEP Intergovernmental Conference on Environmental Education (North American Association for Environmental Education, 2015, highlight box 2) Tbilisi Definition of Environmental Education defined environmental education as:

“a learning process that increases people’s knowledge and awareness about the environment and its associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action”.

Environmental education has more recently been defined as “the study of nature, earth systems, sustainability, and individual roles in making decisions and critical thinking related to environmental literacy and actions” (Heimlich & Horr, 2010, p.58).

These early definitions and discussion of environmental education provide the basis for the evolution of formal and informal science learning about the environment, biodiversity and conservation. Gough and Gough (2010) note that environmental education is often seen as part of a movement of social change, citing the 1987 World Commission on Environment and Development *Our Common Future* report’s claim that teachers play an essential role in
facilitating the extensive social changes needed to achieve sustainable development (World Commission on Environment and Development, 1987).

As foreshadowed in the *Our Common Future* report, the learning of science, including environmental science, has been traditionally associated with formal learning environments (Bell, Lewenstein, Shouse & Feder, 2009). However, the perception that most learning happens at school and university is increasingly being questioned and it is apparent that much of what people learn about science through their lifetime is learned informally outside of formal learning centres, in parks, museums, zoos and aquariums (Heimlich, 2010; Nature, 2010). People’s understanding of science over their lifetime is based on information gathered from many sources in many contexts, and with diverse motivations (Dierking, Falk, Rennie, Anderson & Ellenbogen, 2003; Ballantyne & Packer, 2005; Falk, Storksdieck & Dierking, 2007).

### 2.3.2 Informal science learning

Learning and educational objectives usually fall into three domains: cognitive, affective, and psychomotor (Krathwohl, Bloom & Masia, 1964). While informal learning can logically span all three domains, potentially the most powerful advantage of informal learning is within the affective domain. Ellis and Fouts (1996 p.9) define ‘affective’ as “the area of education that focuses on the attitudinal/emotional development of students.”

The National Research Council consensus report *Learning Science in Informal Environments* describes informal science settings as including “learner choice… and structures that build on learners’ motivations, culture, and competence” creating an “open-ended environment for engaging with science” (Bell et al., 2009 p.47). Bell and colleagues also describe ‘designed settings’: institutions such as science centres, museums, zoos and aquaria, and their individual exhibit and program components. Learning in these settings is directed by the visitor and designed by the intended communication goals of the institution (Bell et al., 2009).

The term ‘free-choice science learning’ was developed to address the misconception that informal science learning is simply a product of the physical space, rather than a differentiated, unique learning process (Falk, 2001). Early research into learning in informal environments focussed on cognitive gains made by participants as a result of attending an informal learning centre (Miles & Tout, 1992). Results from this research suggested that learning outcomes in informal environments were poor (Miles & Tout, 1992; Falk, Brooks & Amin, 2001).
Further research, beginning in the 1990s, called for a broader theoretical understanding of the distinction between formal and informal learning processes (Falk, 2007). This research demonstrated that the context of informal learning is very different to that of traditional learning environments (Falk & Dierking, 2000; Anderson, Storksdieck & Spock, 2007; Bell et al., 2009). In particular, the socio-cultural, personal and physical contexts of learning, and the cumulative and multi-dimensional nature of learning outside of formal environments has been noted (Rennie, 2007; Bell et al., 2009). Learning in informal settings is generally episodic and highly personalised (Falk and Dierking 2000; Bell et al., 2009). People in informal learning settings are active participants who make meaning of their learning experiences based on previous knowledge and experiences (Dierking et al., 2003).

Informal science learning can appear disorganized and unplanned, but it is the individual, personally motivated nature of this learning that appears to lead to long-term impacts (Stocklmayer , Rennie & Gilbert, 2010). Learning as a process is cumulative (Dierking et al., 2003), and informal science learning is often much more effective at engendering excitement, inspiration and a sense of empowerment (Anonymous Nature Editorial, 2010). While formal learning centres have the advantage of a captive audience, informal learning environments benefit from the increased “emotionally evocative component” that formal settings often lack (Clayton et al., 2017 p.87). Informal educational experiences have the potential to have an enormous effect on a person’s interest in science (Stocklmayer et al., 2010).

Because it is not directly linked to formal educational facilities or programs, informal or free-choice education is a valuable opportunity for adult science learning (Falk et al., 2007b; Anonymous Nature Editorial, 2010). Those designing the school science syllabus of today’s adult population could not have anticipated the need for people to make so many decisions about life that rely on science understanding. Medical care, internet privacy, food purchasing, choices about energy sourcing and climate change are a small number of a multitude of daily choices that rely on science knowledge (Nature, 2010). In the absence of opportunities for contemporary science learning, people are ill-equipped to make informed decisions in these areas (Bell et al., 2009). Therefore, free-choice learning in informal contexts, driven by opportunities to choose when and what to learn, is an important contributor to the public understanding of science (Bell et al., 2009).

Falk and Dierking’s Contextual Model of Learning (CML) is a framework for understanding learning in free-choice settings and describes learning as a dialogue between an individual’s personal, sociocultural and physical contexts (Falk & Dierking, 2004; Falk & Storksdieck,
The CML acknowledges the inevitable changeability of these variables in an individual’s experience in an effort to conceptualise the relationship between an individual and their environment at a given time (Falk & Storksdiek, 2005).

Drawing from constructionist, socio-cultural and cognitive theories of learning, the CML’s strength is in its emphasis on three contexts: personal, sociocultural and physical (Falk & Storksdiek, 2005). The personal context encompasses the individual’s experience, including prior knowledge and experience, both specific to the educational topic and more broadly. It also considers the visitor’s motivation for attending the learning setting. The sociocultural context acknowledges that people are products of relationships and broader culture. Cultural values and context (of both the learning setting in society, and the individual) can significantly influence the process and product of learning.

To some degree, both the personal and sociocultural contexts are acknowledged and addressed in modern informal education programs. For example, Falk, Heimlich and Bronnenkant (2008) found that identity-related motivational factors could be used to understand how visitors to informal learning centres make meaning from their experience. Clayton, Fraser and Saunders (2009) suggest that animals displayed in a zoo (and the associated feeling of connection to animals) can facilitate topical social interactions in groups. And, as discussed in section 2.2.1, many zoo mission statements acknowledge these contexts, by highlighting the importance of connection to animals or the natural environment.

Of the three contexts identified in the CML, least explored is the physical context; that is, that learning always takes place in a physical space, and that physical space will influence learning (Falk & Dierking, 2002; Dierking et al., 2003; Heimlich, 2010). Falk and Dierking (2000) in their book *Learning from Museums* note the emotional impact of places and spaces on people, acknowledging that learning is “inextricably bound to the environment in which it occurs” (p. 59), and that people can form long lasting emotional memories of spaces, including those in which learning occurs. It follows then that the physical context of the zoo as a learning environment may impact on environmental learning, based on the ability of space to impact people emotionally. This concept will be explored in this study.

### 2.3.3 Learning in zoo settings

The main, and obvious, difference between zoos and most other informal learning settings is that zoos maintain live animal collections. Consequently, zoo exhibits generally focus on the display of animals, rather than interactive or teaching exhibits more commonly found at
science centres or museums. Zoos are amongst the unique educational leisure settings that can be a site of “learning for fun” (Packer, 2006 p. 329).

Education in zoo settings has historically focussed on formalised programs for visiting school groups or interpretation-based information delivery (de White & Jacobson 1994; Swanagan, 2000; Andersen, 2003; Roe & McConney, 2015). The traditional educational approach of zoos has been to deliver factual information on a sign or via a keeper talk, and hope that the visitor reads or listens, respectively (Churchman, 1987; Dierking, Burtynk, Bühner & Falk, 2001; Andersen, 2003; Balmford et al., 2007; Clayton, 2016). Thus, a large portion of research on the efficacy of zoo as educators and communicators has looked at cognitive learning outcomes – essentially, what facts zoo visitors learn and recall from their zoo visit.

This ‘acquired knowledge’ approach, however, is ineffective in anything other than facilitating a short term acquisition of ‘wildlife trivia’ (Hyson, 2004; Balmford et al., 2007; Bruni et al., 2008) and is inconsistent with modern science communication, the intent of which is to create awareness of and engagement in science content (Burns, O’Connor & Stocklmayer 2003; Bubela et al., 2009; Polman & Gebre, 2015). Modern science communication emerged from a dissatisfaction with the ‘deficit model’ of science communication (Lewenstein, 2015). The deficit model of science communication maintains that public skepticism towards science and failure to engage in behaviours that are consistent with scientific evidence is caused by a lack of scientific information or knowledge, and that overcoming this knowledge deficit will address this (Dickson, 2005; National Academies of Sciences, Engineering and Medicine, 2017). In fact, research suggests that people are often aware of the science around a topic, but still fail to agree or act consistently with that science (National Academies of Sciences Engineering and Medicine, 2017). The variability in reactions, opinions, and behaviour in relation to science is more likely to be explained by several other more complex factors, including values, attitudes, personal psychologies, and personal decision making (Baram-Tsabari & Osborne 2015; Maynard & Scheufele, 2016).

Beyond education strategies simply conveying factual information comes ‘awareness raising’. In zoos, this usually involves alerting people to particular challenges to species, ecosystems or biodiversity conservation. This communication approach can often focus on crises or the inevitability of poor outcomes in an attempt to stimulate conservation action by visitors (Dierking, Adelman, Ogden, Lehnhardt, Miller & Mellen, 2004; Clayton et al., 2018). Often, the type of behaviour that would address the identified problem (e.g. not purchasing a certain product such as elephant ivory, or proactively purchasing sustainable seafood) is poorly
articulated, or the messages are indirect and short term (Vining, 2003). Visitors are left anxious, powerless and unmotivated, thinking that it remains the role of those more capable (governments, industry, philanthropy) to address the problem (Dierking et al., 2004; Sterling et al., 2007). In the absence of a clear understanding of the threat to the species or environment, or a sense of personal connection, individuals appear to lack the motivation to understand the environmental issue more fully, let alone reflect on their own behaviour and consider amending it to address the threat (Clayton et al., 2017).

Despite these points, research does point encouragingly towards the value of environmental education in informal learning environments. There has been limited research to date into the impact of the conservation messages conveyed during a zoo or aquarium visit, including messages that promote the adoption of pro-environmental behaviours (Tribe & Booth, 2003; Clayton et al., 2009; Weiler & Smith, 2009; Ballantyne, Packer, & Falk, 2011). Limited research also exists into the reception and perception of these messages by zoo visitors (Moss & Esson, 2010; Ballantyne & Packer, 2016).

Most people who undertake a science-related culture or leisure activity (such as visiting a museum, zoo, national park or botanic garden) are motivated by a need to manifest and maintain, even briefly, their sense of personal value in the world, and by a need to satisfy their intellectual curiosity. Visits to zoos and museums resulted in 54% of visitors reconsidering their role in conservation action and seeing themselves as potential contributors to addressing environmental problems (Falk et al., 2007a). Packer and Ballantyne (2004, p.68) suggest that the potentially competing factors of education and entertainment in a zoo setting are in fact “synergistic”. They note that “…education is entertainment, discovery is exciting, and learning is an adventure. Visitors perceive these as elements of the same construct, distinct from both effortful learning and passive enjoyment” (Packer and Ballantyne, 2004 p.68)

In line with broader research on the deficit model approach to science communication, environmental knowledge alone is not enough to change environmentally relevant behaviour (Clayton et al., 2017; Schultz, 2011; Moss et al., 2014). While understanding more about the natural world is a worthwhile outcome of a zoo visit (Moss et al., 2014), there are many other opportunities (television documentaries, books, formal education courses, internet sources amongst many examples) for people to access this ‘knowledge’ that do not require physical zoo visits or the existence of captive collections of wild animals. Zoos must therefore strive to provide environmental education that goes beyond cognitive learning, towards education that translates into changes in attitudes and behaviour required to address contemporary
conservation challenges (Ogden & Heimlich, 2009). Fraser and Sickler (2009) propose that zoos can evolve into more effective tools for promoting conservation and sustainability learning if they move beyond a model of increasing natural history knowledge as the only method to accomplish this.

More recently, Barriault and Rennie (2019) have proposed a Visitor Based Assessment Framework for Animal Exhibits (AFAE). This framework was developed based on an existing framework for assessment of museum exhibits, and adapted for assessments of live animal exhibits. While the AFAE is too lengthy to reproduce completely in this review (see Barriault & Rennie, 2019 p. 36 for more detail), it broadly consists of three levels of engagement, and associated learning-related behaviours:

1. Initiation
   a. Finding and identifying
   b. Observing habitat/animal

2. Transition
   a. Exploring to prolong engagement
   b. Demonstrating affective engagement

3. Breakthrough
   a. Making links to prior knowledge/experience
   b. Explaining
   c. Extending the experience

Testing of the AFAE demonstrated that it is a useful tool for capturing the visitor learning experience and evaluating the potential learning impact of an animal exhibit. This is done by identifying both the most common learning-related behaviours exhibited and the level of engagement most visitors attain. The authors highlight that as the ‘breakthrough’ level represents more significant meaning-making and deeper thought, zoos should explore how to drive more visitors towards this level of engagement for deeper learning. There is potential for the AFAE to be tailored to assess specific conservation-learning outcomes for programs or exhibits.

Environmental education in zoos must assist people to acquire knowledge and to understand how to adopt behaviours that are consistent with pro-environmental outcomes (Clayton et al., 2017; 2018). Messages that emphasise single, achievable and explicit actions or behavioural alternatives are more likely to be successful in inducing behavioural change than broad pleas
to safeguard the environment or conserve biodiversity (Costanzo, Archer, Aronson & Pettigrew, 1986; Schultz, 2011).

2.3.4 Making a connection

As demonstrated in the discussion about zoo mission statements (section 2.2.1) there is a consistent focus by the zoo community on ‘connecting’ with and ‘connection’ between zoo visitors and the natural world. In discussing a connection, most zoos and researchers are contemplating the concept of emotional connection. Unlike emotional connections between humans, generally described as a shared, reciprocated feeling or perception between people (Di Cerbo, n.d.), a connection with animals and nature is described by Hinds and Sparks (2008, p.112) as “the subjective experience of an emotional attachment with the natural environment”. However, there is still a “lack of coherence about what reconnecting to nature means, why it should happen and how it can be achieved” (Ives, Abson, von Wehrden, Dorniger, Klaniecki & Fischer, 2018).

It is frequently suggested that humans have become less connected to the natural world due to a shift from wilderness or rural settings into cities (Beck & Katcher, 1996; Melson, 2001, Stilgoe, 2001). At its most extreme, it is suggested that the human/nature relationship is broken, eventuating in a failure to value and consequently protect the natural systems that give and sustain life (Monbiot, 2013). A 2014 interdisciplinary study found that “the Western disconnect from nature is central to the convergent social-ecological crises and is primarily a problem in consciousness. Connectedness with nature is therefore defined as a stable state of consciousness comprising symbiotic cognitive, affective, and experiential traits that reflect, through consistent attitudes and behaviors, a sustained awareness of the interrelatedness between one’s self and the rest of nature” (Zylstra, Knight, Esler & Grange, 2014, p. 119).

Conceptually similar, biophilia (a term popularised by E.O. Wilson) is “the innately emotional affiliation of human beings to other living organisms” (Kellert & Wilson, 1993 p.31). The concept speaks to the biological, adaptive nature of an emotional relationship with the natural environment as a strategy for survival (Myers et al., 2004). The ‘biophilia hypothesis’ (Kellert & Wilson, 1993) asserts that emotional response to the natural environment is genetically encoded (Clayton & Myers, 2015).

Informal pro-environmental education must seek to address this disconnect, and should consider promoting and using concepts like biophilia, emotion or nature-connectedness as
mechanisms for this. The next section will review existing research and understanding of this, both within and outside the zoo environment.

2.3.5 The role of emotion and connection in learning and behaviour

The motivational and affective elements that contribute to pro-environmental behaviour are complex (Kals, Schumacher & Montada, 1999; Clayton et al., 2009), and research suggests that applying a purely cognitive and rational approach to studying it is unhelpful (Kals et al., 1999). Emotion and learning are accepted to be interrelated, as emotion influences how people prioritise engagement in issues (Damasio, 1994; Boler, 1999). Hence, the role of emotion in catalysing pro-environmental behaviour is worthy of examination.

Psychologists generally agree that emotion includes three core elements: “a subjective component of feelings, a physiological component of arousal, and a motor component of expressive gesture” (Barbalet, 1998 p.86). Ingleton (1999 p.2) states that “emotion states include decision-making and a disposition to act, and so emotion has elements of reason and action as well as of feeling”. Emotions are also integral to decision making (Bechara, Damasio & Damasio, 2000).

The role of emotional factors as conduits for science learning is well summed up by Bell et al. (2009 p.128):

> From the perspective of science learning, a key educational challenge for designed spaces is to link emotional and sensory responses with science-specific phenomena. Associating scientific thinking with engaging and enjoyable events and real-world outcomes can create important connections on a personal level. Promoting or supporting a variety of emotional responses (surprise, puzzlement, awe) and a variety of processing modes (observation, discovery, contemplation) increases the likelihood of connecting with a greater variety of people and encouraging them as learners.

Emotional arousal can lead to increased attention and willingness to learn (Krapp, Rennihger & Hidi, 1991; Pekrun, 1992). A study examining the vocal tone and degree of arousal in visitor conversations during zoo visits found that conversations demonstrated an ideal arousal state: alertness, engagement and relaxation (Myers et al., 2004). Arousal has also been demonstrated to assist with retention and retrieval of information in memory processes, due to increased cortisol levels during arousal (Buchanan & Lovallo, 2001; Abercrombie, Kalin, Thurow, Rosenkranz, & Davidson, 2003; Abercrombie, Speck & Monticelli, 2006). Moderate
levels of emotional arousal stimulated by novel or surprising stimuli can produce behaviours related to increased engagement, such as curiosity or exploration (Csikszentmihalyi & Hermanson, 1995; Ballantyne & Packer, 2005).

Existing research on the role of nature connectedness in behaviour outside of the zoo field has established that a stronger sense of connection to nature can be a potential driver of pro-environmental behaviour (Kals et al., 1999; Vaske & Kobrin, 2001). Schultz (2000) proposes that increased sense of value for nature will result in a higher concern for it, and a stronger commitment towards conservation and protection of the natural environment. Building on the notion of interconnectedness with nature, Davis, Green and Reed (2009) proposed the notion of commitment to the environment. Positing the environment as a person’s ‘partner’ in an interdependent relationship analogous to a romantic partnership, the authors considered how commitment to the environment from within this relationship could relate to environmental behaviours. A stronger level of commitment predicted higher levels of pro-environmental behaviour. Further, stronger commitment was associated with higher rates of pro-environmental behavioural intention.

Zoos acknowledge that they can use the potential for emotional connection between animals and visitors to provide unique opportunities for learning and encouraging pro-environmental behaviours (Barongi et al., 2015). Some research suggests that zoo experiences can induce emotional responses (Myers et al., 2004; Smith, 2009). One obvious way of facilitating an emotional connection between zoo visitors and animals is by creating direct experiential linkages between them. Direct interaction with, or close observation of, live animals can personalise the animal, increase empathy and provide a foundation for learning and positive attitudes towards the species (Clayton et al., 2009; Lukas & Ross, 2014). Zoos can enable an empathetic emotional connection between visitors and the animals displayed, which serves to increase the care visitors have for that species in the wild (Myers & Saunders, 2002). In one study, tigers stimulated stronger positive emotional responses compared to African wild dogs and spotted hyena, perhaps due to the aesthetic attractiveness of tigers and the presence of juvenile animals (Powell & Bullock, 2014). Large carnivores have also been demonstrated to be “powerful catalysts for public engagement with biodiversity conservation” (Consorte-McCrea et al., 2019 p. 134).

Clayton et al. (2017) found that a feeling of connection to animals and nature, which can be facilitated by a visit to a zoo, is a powerful predictor of concern about the impact of wildlife trade on wildlife conservation. Howell, McLeod and Coleman (2019) found that the degree of
connection reported by visitors correlated with a number of pro-conservation statements delivered on a visitor survey, reinforcing the idea that facilitating a connection between zoo visitors and zoo animals may contribute to inspiring “conservation-mindedness” in visitors (p. 5).

Zoo visits may act as proxies for nature experiences. Contact with nature can increase sense of connection and love for the natural world (Wilson, 1984; Kaplan & Kaplan, 1989). Zoo visits can increase implicit self-nature associations and ‘connectedness with nature’, a person’s belief about the extent to which they are part of the natural world (Schultz, 2002; Bruni et al., 2008). Schultz (2002) found that the extent to which a person identifies as being ‘part of nature’ correlates with general environmental attitude, with sense of connection to nature being a primary component of inclusion with nature. Schultz, Schriver, Tabanico and Khazian (2004) found that implicit connections with nature were strongly positively correlated with explicit environmental concern. Strong, positive emotional experiences combined with prior environmental knowledge and existing affinity for nature may facilitate learning and encourage engagement with conservation (Powell & Bullock, 2014).

As a counterpoint, Beery and Wolf-Watz (2014) found only a modest relationship between environmental connectedness and reported pro-environmental behaviour. Mayer and Frantz (2004) note that “future research needs to elaborate on whether simply feeling a sense of connectedness to nature in itself leads to eco-friendly acts, or whether feeling connected to nature establishes the necessary condition that makes a request for eco-friendly acts more effective” (p. 514). Further, Skibins and Powell (2013) found that reported pre-visit levels of connection to wildlife was not a direct predictor of positive behaviours towards species or biodiversity.

While creating a connection between people and animals is undoubtedly a positive outcome, on its own this phenomenon would not necessarily meaningfully contribute to conservation. It is therefore imperative that zoos capitalise on their ability to connect people and wildlife by examining how this can be translated from a feeling or experience into pro-conservation attitudes or behaviours. This is the realm of social science. Broad applications of social science in behaviour change will be discussed in the next section, followed by an examination of current social science practices in zoos.
2.4 Social science

Ultimately, the purpose of most conservation messaging in modern zoos is to affect behaviour change that will result in improved outcomes for conservation. However, establishing behavioural outcomes is complex, due at least in part to the multitude of influencing factors (Heimlich, 2010). Clayton and Myers (2015) identify two core aspects of human behaviour: behaviour is a factor of multiple causes, and behaviour is changeable.

Clayton and Myers (2015) demonstrate this complexity in Figure 2:

![Figure 2: Factors affecting behaviour (Clayton & Myers, 2015 p. 193)](image)

Well known behaviour and learning models, including the Theory of Planned Behaviour (Ajzen, 1991) and the Contextual Model of Learning (Falk & Dierking, 2000), acknowledge that behavioural outcomes are a function of many inputs, including attitudes and perceived behavioural control or self-efficacy. Contemporary educational models describe behaviour as a “function of behavioural intentions which are affected by factors such as knowledge, attitudes, skills and self-efficacy” (Heimlich, 2010 p.181). This is the domain of psychology and social science; thus, these sciences have a key role to play in establishing true, sustainable change in attitudes, values and behaviours (McKenzie-Mohr, 2000a; 2000b). Influences on behaviour are not always clear or easily identified, and so behaviour change programs that do
not base themselves in psychological science may be less successful (Clayton, Litchfield & Geller, 2013; Moon & Blackman, 2014).

Beginning in the mid 2000s, researchers began to examine the role of social sciences in addressing conservation and other environmental challenges. Mascia et al. (2003 p. 649) note that

“Although it may seem counterintuitive that the foremost influences on the success of environmental policy could be social, conservation interventions are the product of human decision-making processes and require changes in human behaviour to succeed. Thus, conservation policies and practices are inherently social phenomena as are the intended and unintended changes in human behaviour they induce’.

The field of conservation psychology emerged as a result of this sentiment (Saunders, 2003; Clayton & Myers, 2015). Recalling that Clayton and Myers (2015 p.2) define conservation psychology as “the use of psychological techniques and research to understand and promote a healthy relationship between humans and the natural environment”, conservation psychology built on the discipline of environmental psychology, which examined the ways that the environment and humans impact each other (Clayton & Myers, 2015). Conservation psychology is inherently mission driven, and necessarily encompasses the entire spectrum of research, from theoretical to applied (Saunders, 2003).

In defining this new field, Saunders (2003) and Mascia (2003) argue that it should address how humans care for and behave towards nature, and the pathway towards developing knowledge and beliefs about nature. Mascia (2003) articulated two additional social foci (relationships between humans and between humans and institutions) to acknowledge the social context of human life (Clayton & Myers, 2015). These additional foci are particularly relevant to zoo-based conservation education and behaviour change campaigns. First, zoos are institutions, and the relationship between their visitors and that institution is likely to be a significant component of the effectiveness of the zoo as an educational facility. People generally trust zoos as sources of environmental information (e.g. on ocean protection per Mott & Boyle (2000)) and trust is frequently identified as a key factor in learning in fields such as organizational management, leadership and health (Edmonson, 1999; Weinstein, 2004; Rubin, Amlôt, Page & Wessely, 2009). Secondly, as established earlier in this chapter, zoo visits are social occasions (Morgan & Hodgkinson, 1999) and social interactions in a zoo context can increase levels of concern, connection and knowledge about environmental challenges (Clayton et al., 2018).
2.4.1 Behaviour change theories and models

There are numerous and diverse models and theories of change, which Van der Linden (2013 p. 210) argues are distinct from each other: models of behaviour “aid in understanding behaviours by identifying the underlying factors that determine and influence them” while theories “show how behaviours can be changed”. Models of behaviour are diagnostic, and theories are applied to support interventions (Van der Linden, 2013). Albarracin, Zanna, Johnson and Kumkale (2005) note that most effective behaviour change programs include attitude arguments, educational material for cognitive understanding, and behavioural skill functions.

A comprehensive review of behaviour change theories and models is not practical in this thesis. Instead, I have reviewed selected concepts that are relevant to behaviour change studies in zoos and other informal learning environments.

Theory of Planned Behaviour


Both models conceptualise the predictors of behaviour. The earlier TRA theorized that attitudes towards a behaviour and subjective norms were predictors of behavioural intention (Ajzen & Fishbein, 1980). The TPB (Figure 3) extends the TRA by including a third predictive variable called perceived behavioural control. These three variables in concert lead to the formation of a behavioural intention (Ajzen, 2002), an individual’s intention or willingness to perform the subject behaviour. Finally, intention is an immediate precursor of behavioural outcomes (Armitage & Conner, 2001). As noted by Ajzen himself, the TPB is flexible in that a variable ‘weight’ can be afforded to each of the variables in the model, relative to its significance in the scenario (Ajzen, 1991;2002).
The TPB (Ajzen 1991; 2002) is generally considered to be a reliable theoretical model for predicting behavioural outcomes based on its variables (Armitage & Conner, 2001; Gass & Seiter, 2013). Conner and Armitage’s (1998 p. 1453) observation that “[O]ne good indicator of the usefulness of models like TRA/TPB is their power to help design effective interventions which produce behaviour change” was particularly noted in selecting the TPB as a core element of this study.

An attitude is a learned predisposition to respond towards an attitude object (Fishbein & Ajzen, 1975; Ajzen, 2002) and "a relatively enduring organization of beliefs, feelings, and behavioral tendencies towards socially significant objects, groups, events or symbols" (Hogg & Vaughan, 2005 p. 150). Attitudes are evaluative and can be favourable or unfavourable towards the attitude object, and importantly they are developed through personal experience (Ajzen, 2002).

Attitudes are affected by cognitive and emotional (affective) components and can thus be changed by stimulating either or both component (McGuire, Lindzey & Aronson, 1985). Manstead (1990) suggests that the many theories on attitude change agree, at least generally, on three pathways to attitude change: direct experience of the attitude object, persuasive communications, and induced behaviour change (such as through training, incentive or education). In the zoo context, direct experience of an attitude object could constitute directly seeing or interacting with a live animal or experiencing or observing the effect of humans on animals (e.g. the impact of marine entanglement or pollution in a marine animal show). Persuasive communications could be traditional signage, keeper talks, or information
conveyed by interactive exhibit elements like touch screens, games and shows. Induced behaviour change is not a pathway frequently observed in a zoo context.

A subjective norm is a person’s perception of what others think about the behaviour (Gass & Seiter, 2013). Fishbein and Ajzen (1975) describe subjective norm as having two components: the normative beliefs of a person (pressure to behave in a certain way based on social perceptions) and motivation to comply (willingness to conform with that social pressure). Subjective norms might reflect social trends (e.g. a shift towards purchasing organic food). Of the three antecedents to behavioural intention in the TPB, subjective norms have typically proven to be the weakest contributor to intention (Krueger, Reilly, & Carsrud, 2000; Armitage & Conner, 2001; Ham, Jeger & Ivković, 2015) which may be attributable to the predictive power of the two other, more personal variables (attitudes and perceived behavioural control) (Ajzen, 1991).

Perceived behavioural control acknowledges that not all behaviour is entirely volitional, or entirely under control (Ajzen, 1985), and that both internal (e.g. knowledge or skills) and external factors (e.g. resources or time) can influence the expression of the action or behaviour (Gass & Seiter, 2013). Ajzen (2002) clarifies that perceived behavioural control “should be read as ‘perceived control over performance of a behaviour’” (p.668) rather than as a measure of control over the accomplishment of an outcome. Ajzen also acknowledges that perceived behavioural control measures could be interpreted to incorporate self-efficacy (“the ease or difficulty of performing a behaviour”; p. 680) as well as ‘controllability’ (“the extent to which performability is up to the actor”) (Ajzen, 2002 p.680).

A meta-analysis by Armitage and Conner (2001) demonstrated that perceived behavioural control independently predicted intention and behaviour across several fields. In practice, researchers appear to use the concepts of perceived behavioural control and self-efficacy in behavioural studies interchangeably (Zimmerman, 2000). Self-efficacy has been found to be a robust predictor of pro-environmental behaviour (Hines, Hungerford & Tomera, 1987; Zimmerman, 2000; Bamberg & Möser, 2007; Clayton et al., 2017). The TPB has been validated by numerous studies, particularly in health behaviour (Armitage & Conner 2001; Gass & Seiter, 2013).

Despite its popularity, the TPB has been criticised. For example, Sniehotta, Presseau and Araújo-Soares (2014) note that reviews of the TPB have found that variability of behaviour is not accounted for by the theory. The authors particularly note that the TPB has failed to address why some individuals who intend to act subsequently fail to do so. They also cite that
other factors, not accounted for in the model, such as beliefs, have been found to be stronger predictors of behaviour than intention (Araújo-Soares, Rodrigues, Presseau, & Sniehotta, 2013; Conner, Gaston, Sheeran & Germain, 2013). Other criticisms focus on the simplicity of the TPB, questioning whether “… a theory of all volitional behaviour based on only four explanatory concepts [is] sufficiently elaborated” (Sniehotta, Presseau & Araújo-Soares, 2014 p. 2). The TPB also omits a central role for emotion (Conner et al., 2013) and unconscious influences, exclusively focusing on rational influences (Sheeran, Gollwitzer & Bargh, 2013; Sniehotta, Presseau & Araújo-Soares, 2013). One study found that authors whose studies that did not support the assumptions of the TPB often explained this inconsistency via weaknesses in their study rather than questioning the TPB itself (Ogden, 2003). Finally, some authors note that ‘In practice, the field has already moved on” (Sniehotta, Presseau and Araújo-Soares 2014, p. 4), as it is not uncommon to find researchers using expended or modified versions of the TPB, undermining its inherent value as a stand-alone theory.

The TPB is becoming more widely used in studies of environmental and conservation-focused behaviour. Tonglet, Phillips and Read (2004) and Chan (1998) found that positive attitudes to recycling were the major contributor to recycling behaviour. Also concerning recycling, Nigbur, Lyons and Uzzell (2010) found that intention to recycle predicted recycling behaviour, and attitudes and perceived behavioural control (combined with a personal norm, influenced by social norms) predicted intention. Fielding, McDonald and Louis (2008), in investigating intention to engage in environmental activism, found that positive attitudes and a sense of normative support for the behaviour contributes to stronger intention to participate in activism. As noted above, several studies in zoos have also validated perceived behavioural control (or self-efficacy) as a predictor of pro-environmental behaviours.

Community-based social marketing

Community-based social marketing (CBSM) hybridises psychology and social marketing theories to produce a strategy for affecting behaviour change (McKenzie-Mohr & Smith, 1999; McKenzie-Mohr, 2000a; 2000b). The strategy has four discrete steps (McKenzie-Mohr 2000a; 2000b) (noting that steps one and two are variously reported as being considered together, or conducted in reverse order, dependent on source and context):

1. Identifying desired behaviour to promote
2. Uncovering barriers to desired behaviours
3. Piloting the program
4. Evaluating the implementation of the program more broadly.

This focus on understanding barriers is fundamental to social marketing, while the actual understanding of the desired behaviour and how to apply the strategy in practice requires the application of psychology and broader contextual knowledge (Andreasen, 1995; McKenzie-Mohr, 2000b;).

Applied behavioural analysis represents another, earlier hybrid model of social marketing and psychology (Geller, 1989; Geller, Bechtel & Churchman, 2002). This approach promotes sustainable behaviour through affecting external factors that influence behaviour (Clayton and Myers, 2015).

The process is as follows:

1. Define the target behaviour
2. Observe the incidence of the behaviour in an unmodified situation
3. Intervene to adjust the behaviour, using prompts, feedback and reward
4. Test the effectiveness of the intervention

Both models employ evaluation as a core step, which is likely to have contributed to their general effectiveness as models for behaviour change campaigns. The major divergence between the two models is that CBSM, possibly learning from earlier studies of applied behavioural analysis, identifies barriers to a desired group of behaviours before a target behaviour or behaviours is chosen (McKenzie-Mohr, 2000a; 2000b). In practice, this can ensure that program developers invest their resources in programs that are more likely to be effective (McKenzie-Mohr, 2000b). In the context of a multitude of conservation challenges that require addressing, this is a particularly pertinent consideration. This study will attempt to further contribute to helping zoos better focus their behaviour change campaigns on aspects of behaviour or experience that are most likely to contribute to its success.

2.4.2 Social science research in zoos

The TPB has emerged as the principal behaviour change theory used in modern zoo-based behaviour change campaign development. This section will review the application of the TPB in several Australian zoo-based campaigns.
The Connect-Understand-Act (CUA) model, developed by Zoos Victoria around 2006 (Lowry, 2009) is inspired by the TPB and community-based social marketing, and aims to motivate zoo visitors to take concrete behavioural actions to address conservation threats (Lowry & Hradsky, 2011; Squires, Lowry & Banks, 2016). Other zoo organisations, including Taronga Conservation Society Australia, have adopted the CUA, which was used as part of the design and development of Tiger Trek (see Chapter 3).

Central to the development of the CUA model is acknowledgement that it is ineffective to instruct a person to change their behaviour, and simply expect that instruction to be followed (Lowry, 2009). Instead, the application of tools within the CUA model allow educators to literally connect with visitors, teach an understanding, and affect behaviour (Lowry, 2009).

The model is divided into three phases, outlined in Table 1 (Squires et al., 2016 p. 98). Lowry (2009 p. 13) proposes an extensive list of tools, reproduced in Table 2.

Table 1: Connect-Understand-Act phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Connect</td>
<td>To shape attitudes and values that will assist with the uptake and maintenance of conservation-sensitive behaviours</td>
</tr>
<tr>
<td>2. Understand</td>
<td>To teach priority ecological understandings</td>
</tr>
<tr>
<td>3. Act</td>
<td>To remove barriers to target behaviours and teach the skills needed for people to live in better balance with wildlife.</td>
</tr>
</tbody>
</table>
Table 2: List of tools that can be embedded within the CUA model

<table>
<thead>
<tr>
<th>Connect</th>
<th>Understand</th>
<th>Act</th>
<th>Essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tactile experiences</td>
<td>Themed</td>
<td>Targeted behaviour</td>
<td>Multi-sensory</td>
</tr>
<tr>
<td>Close encounters</td>
<td>Games</td>
<td>Remove barriers</td>
<td>Comfort</td>
</tr>
<tr>
<td>Eye contact</td>
<td>Interactive</td>
<td>Convenience</td>
<td>Appropriate</td>
</tr>
<tr>
<td>Encourage observations</td>
<td>Encourage observations</td>
<td>Incentive</td>
<td>Fun</td>
</tr>
<tr>
<td>Storytelling</td>
<td>Thought provoking</td>
<td>Eco-badging (appeal to)</td>
<td>Themed</td>
</tr>
<tr>
<td>Characterising</td>
<td>Analogies</td>
<td>Social norms</td>
<td>Targeted</td>
</tr>
<tr>
<td>Role play/drama</td>
<td>Role play/drama</td>
<td>Likeness</td>
<td>Layered/targets</td>
</tr>
<tr>
<td>Discovery</td>
<td>Visual aids/props</td>
<td>Walk the talk</td>
<td></td>
</tr>
<tr>
<td>Unexpected/surprise</td>
<td>Relevant</td>
<td>Join others</td>
<td></td>
</tr>
<tr>
<td>Mimicry</td>
<td>Appropriate</td>
<td>Relevant</td>
<td></td>
</tr>
<tr>
<td>Privileged insights</td>
<td>Storytelling</td>
<td>Feedback</td>
<td></td>
</tr>
<tr>
<td>Reflective pauses</td>
<td>Reflective pauses</td>
<td>Tangible action</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anecdotes</td>
<td>Access experts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reinforcement (of)</td>
<td>Commitments/plots</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layered/targeted</td>
<td>Prompts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Comparisons</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The CUA model has been applied to conservation education programs inside and outside the zoo. Two of the most well-known zoo-based behaviour-change programs in Australian zoos have been the ‘They’re Calling on You’ program and the ‘Don’t Palm Us Off’ program. Developed in 2008, ‘They’re Calling on You’ was designed using the CUA model to encourage zoo visitors to donate old mobile phones to the zoo’s recycling program, to address habitat destruction from the mining of coltan to build phones (Lowry, 2009). Visitors were taught about the impact of coltan mining on gorilla habitat via keeper talks and provided plastic satchels in which to post their old phones to the recycling program. Along with diverting mobile phones from landfill, the program raised money for primate conservation programs. Approximately a year after the program began, 28% of people who received a phone recycling satchel at a keeper talk had returned it. A further four percent were returned by visitors who had taken one from a dispenser at the zoo (not during a keeper talk) (Lowry, 2009). The industry standard return rate is reportedly four percent (Lowry, 2009). This result demonstrates that the CUA model can assist in developing effective zoo-based behaviour-change campaigns.

The ‘Don’t Palm Us Off’ campaign, developed by Zoos Victoria in 2009, aimed to raise awareness about the impact of palm oil farming on orangutans, and to change food labelling laws to require palm oil to be explicitly labelled (Pearson, Lowry, Dorrian & Litchfield, 2014; Dunstan, Fairbrother & Sluys, 2016). Also designed using the CUA model, the campaign was
adopted by several other zoos in Australia including Taronga Conservation Society, Zoos South Australia, Perth Zoo and the National Zoo and Aquarium (Zoos Victoria, n.d.). In an evaluation of the effectiveness of the program, Pearson et al. (2014) found a marked and maintained increase in knowledge about palm oil issues, increased positive attitude towards orangutans, and an increase in support for palm oil labelling. Increases were observed in charitable donations towards the program, and visitors reporting that they had changed their food purchasing behaviours to avoid purchasing palm oil-containing products increased by almost 40% (Pearson et al., 2014). After the campaign was modified to also facilitate visitors directly contacting companies that use palm oil in their products (via emails and postcards), six companies voluntarily agreed to label palm oil in their products, and eight companies made commitments to source 100% certified sustainable palm oil for their products (Dunstan et al., 2016). Personal communication to campaign managers cited the ‘Don’t Palm Us Off’ campaign as a major influence on these decisions (Dunstan et al., 2016).

Clayton et al. (2013) describe Zoos Victoria’s ‘Seal the Loop’ program, aimed at encouraging visitors to reduce rubbish ending up in coastal areas. The program encouraged visitors to recycle plastic waste at the zoo, which was then used in the construction of ‘Seal the Loop’ bins in coastal areas for disposal of fishing tackle. Information on the environmental threat from solid waste and discarded fishing tackle, as well as how visitors can address the issue, was provided in exhibit signage as well as verbally during seal shows at the Melbourne Zoo. Evaluation of the ‘Seal the Loop’ program found that visitors that received information via the seal show reported a much higher rate of learning information than exhibit-only visitors, and a higher willingness to change future behaviour (Mellish, Pearson, Sanders & Litchfield, 2016).

As part of a global conservation partnership, Zoos Victoria conducted a field-based program at the Melako Community Conservancy in northern Kenya. The program used soccer games and educational messages fostering positive attitudes towards wildlife to redirect boredom-stimulated wildlife-harming behaviours in young men (Squires et al., 2016). This intervention resulted in a reduction in “warrior idle time” (p. 106), with this time now taken up by training for a playing in soccer competitions. Consequently, human-wildlife conflict reduced, less animals were killed, and there was higher tolerance of wild animals at local waterholes.

Most recently, Zoos Victoria has promoted a balloon litter program using the slogan “when balloons fly, seabirds die” (Zoos Victoria, n.d). The campaign has promoted the use of bubbles at outdoor events and raised awareness of the impact of balloons (often released into
the air, accidentally or intentionally) on marine wildlife. Balloons and strings pose an entanglement risk to seabirds and other marine wildlife (Wilcox, Mallos, Leonard, Rodriguez & Hardesty, 2016). An evaluation of the ‘When Balloons Fly’ program (Mellish, Pearson, McLeod, Tuckey & Ryan (2019) found that visitors who experienced the program had more favourable social norms towards avoiding the use of balloons after their visit, and an increased likelihood to use bubbles. Two-thirds of study participants reported that they had changed their behaviour at an outdoor event after their visit because of their experience at the zoo.

In addition to designing visitor interventions that are specifically based on the TPB, there is an increasing field of research into the impact of a zoo-based experience on separate elements of the TPB, including on attitudes, intention and behaviours. In 2010, the AZA recognized the need for a framework on zoo and aquarium social science research. The framework reviews the limited existing work in social science research in zoos and identifies research priorities and directions (Fraser et al., 2010). This section will review the evolution of social science and behaviour change programs in zoos.

Prior to 2000, limited comprehensive studies on visitor experience had been conducted (Fraser et al., 2010). These studies mostly found that zoo visits did not significantly affect visitor attitudes or post-visit behaviour. Kellert and Dunlap (1989) examined the impact of a zoo visit on basic attitudes, knowledge, and awareness of zoo visitors. The study found that learning was largely confined to basic animal facts, with little or no impact on attitudes (Kellert & Dunlap, 1989). A study by Broad (1996) found that visitors to Jersey Zoo departed the zoo with more knowledge about the threatened status of animals, but a delayed follow up survey demonstrated that this had had no impact on their behaviours.

A 1997 study of ‘The Swamp’ exhibit at Brookfield Zoo, Chicago, was amongst the early evaluations of a conservation-focused exhibit (Saunders, Perry & Elizabeth, 1997). The exhibit was designed to convey the message that “healthy cypress swamps and Illinois wetlands – examples of threatened ecosystems – provide many surprising benefits to humans” (Saunders et al., 1997 p. 4). Researchers proposed to evaluate whether an exhibit that promotes the benefit of local natural ecosystems can impact visitors’ desire to protect such ecosystems. The results indicated that visitors appreciated their local cypress swamps, and that they felt connected to the conservation themes conveyed. However, the study did not detect a significant shift in awareness of the conservation issues, possibly due to a pre-existing high level of awareness in visitors (Saunders et al., 1997).
Despite these discouraging studies, zoos and social scientists persisted in evaluating the impact of zoos on visitor behavior. A number of studies have evaluated the impact of zoos on visitors’ knowledge of and concern about threats to wildlife. Clayton et al. (2017) found that a visit to a small urban zoo in Paris (Menagerie of the Jardin des Plantes) significantly affected conservation knowledge. Visitors to the National Aquarium in Baltimore demonstrated more focused conservation thinking after their visit and reported changes in knowledge and engagement appeared to persist over up to eight weeks following the visit (Adelman, Falk & James, 2000). However, Balmford et al. (2007) undertook a pre-/post-visit visitor survey at six UK zoos and one wetland centre, asking visitors about conservation knowledge, concern, and their awareness of activities they could undertake to address environmental issues. The study found very little evidence of statistically significant change in any of these measured factors.

Recalling the TPB, there are a number of studies focused on analyzing zoo influences on attitudes, norms and perceived behavioural control (or self-efficacy), which in the TPB are precursors to behavioural intention and behaviour. Many found results consistent with the rationale behind the TPB, highlighting its relevance to designing and examining the efficacy of zoo-based behaviour change campaigns.

A study by Clayton et al. (2018) examined the impact of an informational exhibit at two zoos in China on attitudes regarding wildlife trade. The study looked specifically at the effect of installing informational signs about the impact of wildlife trade on six locally relevant target species (tigers, rhinoceros, bears, elephants, sharks and turtles) highly threatened by wildlife trade. Signs were made to highlight each animal group, which contained photographs and cartoon images of the animal, a first-person narrative story (from the animal’s perspective) about the impact of wildlife trade on him or her, a description of relevant Chinese laws, endangered status, and a list of ‘things you can do to help’. Surveys of visitors demonstrated that (compared to a baseline taken prior to the intervention) the signs while alone (i.e. not in a social group) had no impact on concern for wildlife or desire to help. However, those visitors who viewed the signs and then talked to others about the signs showed statistically higher levels of concern, connection and knowledge, and were more likely to indicate they wanted to help (Calyton et al., 2018). Visitors who saw signs about the impact of wildlife trade on locally relevant target species also estimated that a higher percentage of the general Chinese population would be concerned about the impact of wildlife trade. This suggests that informational exhibits at zoos may be able to influence perceptions of social norms. On this
point, the authors of the study conclude “Because the perception of what is normative can be more influential than the reality, this has the potential to be a powerful tool for changing attitudes” (Clayton et al., 2018 p. 7).

In a multi-institutional research project entitled ‘Why Zoos and Aquariums Matter’, zoos across the United States examined zoo visitor motivations, the meaning derived from their visit, and attitudes and values towards zoos and aquariums (Falk et al., 2007a). Zoo visitors reported that their zoo experience fortified or strengthened their attitude towards conservation, and more than half were inspired to reevaluate their role in addressing environmental issues (Falk et al., 2007a).

A visit to a Paris zoo significantly increased visitors’ self-efficacy regarding their personal ability to help protect biodiversity. This higher level of self-efficacy was the strongest predictor of behavioural intent following the visit (Clayton et al., 2017). The authors propose that future research examining what aspects of a zoo visit foster self-efficacy would improve efforts to encourage specific behaviour changes. This study intends to contribute to increased understanding of this mechanism.

Much of the social science research in zoos has attempted to understand the impact of zoos on visitor behaviours. Some research has examined whether the zoo experience can impact immediate at-zoo behaviours. For example, Swanagan (2000) found that zoo visitors who had an interactive experience with an exhibit (in this case, seeing an elephant show or touching an elephant-related artifact) were more likely to return solicitation postcards provided by the zoo that allowed them to share their views on elephant protection legislation with their political representatives. Visitors that played an interactive game at a Brookfield Zoo exhibit reported stronger interest in performing pro-environmental behaviours than those that did not (Dotzour, Schultz, Manubay, Smith & Saunders, 2002).

However, most visitor behaviour research is focused on behaviors outside the zoo. Wellington Zoo researchers examined the impact of a persuasive information campaign about nighttime cat containment to stop cat predation on native animals (MacDonald, 2015). Some visitors attended an animal presentation about the issue, some of whom were asked to make a public commitment (via a pledge card) to contain their cats at night. All of the participants who completed the pledge card had implemented the behaviour six weeks after their zoo visit, compared to half of the presentation-only visitors, indicating that the pledge aspect of the intervention was a significant contributor to post-visit behaviour (MacDonald, 2015).
Some studies have found no link between zoo-based interventions and post-visit behaviour. While a visit to the National Aquarium in Baltimore appeared to focus the longer-term conservation thinking of visitors, participants in the study reported no new conservation-related behaviours at six to eight weeks post-visit, and enthusiasm and commitment to conservation appeared to return to baseline pre-visit levels (Adelman et al., 2000).

A study at the Leatherdale International Polar Bear Conservation Centre at the Assiniboine Park Zoo in Winnipeg, Canada, attempted to examine the role of post-visit action resources on behaviour following a zoo visit. The post-visit action resources were designed using the CBSM approach, and comprised a brochure on climate change, and fact sheets on targeted pro-environmental behaviours including how to achieve them in the local area (Bueddefeld & Van Winkle, 2017). Weekly emails were sent to participants in the study, highlighting one target behaviour per week and providing supplementary information on polar bears (including updates on the polar bear housed at Assiniboine Park Zoo), sustainability, and conservation in general (Bueddefeld & Van Winkle, 2017). While participants qualitatively reported that their behaviour had changed in line with the six targeted behaviours, the quantitative data did not support a difference in targeted behaviours between the group given the post-visit action resources and the study group that did not receive them. Some pre-environmental behaviour change was observed, but these behaviours lay outside the targeted behaviours. The researchers did conclude that the visit to the zoo increased awareness in zoo visitors of behaviours they could alter to address climate change and support polar bear conservation.

This research supported findings by other studies, including Clayton, Luebke, Saunders, Matiasek and Grajal (2014), which found that visits to a zoo had a positive effect on attitudes towards climate change.

While not the topic of this thesis and as such not covered in detail in this review, interactive programs or animal performances can have an impact on visitors’ attitudes and behaviours towards conservation. A study of San Diego Safari Park visitors (Hacker & Miller, 2016) demonstrated that visitors who reported stronger intentions to engage with conservation related activities after their visit had stronger positive attitudes towards elephants and negative attitudes to the modification of nature. Up-close encounters with elephants and witnessing active behaviours were related to the greatest changes in conservation intent. The authors concluded that opportunities to see animals up close or performing active behaviours may be a pathway to improving delivery of the zoo’s conservation messages. Similar to Mellish et al. (2016)’s findings related to seal shows and marine conservation discussed earlier, visitors
who witnessed a dolphin show or interactive program reported doing more conservation-related actions after their visit (Miller, Zeigler-Hill, Mellen, Koeppel, Greer & Kuczaj, 2013). More broadly, Mann-Lang, Ballantyne and Packer (2016) found evidence of the value of animal presentations as educational tools, and also found that increasing the educational content of such shows does not reduce the entertainment value.

More recent research has also looked at opportunities to best engage the entire zoo-going community. Ballantyne, Hughes, Lee, Packer and Sneddon (2018) contend that the personal values of zoo visitors influence the way they engage with and respond to on-site conservation messaging, and that this variable engagement may influence the way visitors adopt the pro-environmental behaviours promoted at the zoo. Their study found that visitors who place high value on universalism values ("personal values that privilege the preservation of the natural environment; concerns for animal welfare; equality, justice protection; and acceptance of others" (p. 198)) more frequently attend zoos. The authors conclude that, if this is true, zoo experiences may be successful in engaging visitors with that value set, but not successful in attracting or engaging visitors with different values. On this basis, Ballantyne and colleagues (2018) propose that zoos and aquariums (and other wildlife tourism attractions) should adopt a "values-based approach to the design of visitor experiences and interpretive materials rather than a values-change approach" (p.199). This approach could engage a wider range of zoo visitors and consequently potentially enhance the impact of the experience on visitor understanding and behaviour.

This section has summarised the past and current state of social science research in zoos and established that much of the existing research focusses on elements of the visitor experience that equate to variables in the TPB. It also established that the TPB forms the basis for some well-established and successful zoo-based behaviour change campaigns and is therefore familiar to the zoo community. Combined with research outside of zoos that establishes that it is a reliable model for predicting behavioural outcomes (Armitage & Conner, 2001; Gass & Seiter, 2013), the TPB will form the social science basis for this research project, allowing the results and recommendations of this study to be more easily translated and applied by zoos in the future. This thesis will examine whether a campaign to encourage preferential purchasing of products containing certified sustainable palm oil communicated through Sumatran tiger exhibits influences zoo visitors’ attitudes, perceived behavioural control, and behavioural intention related to tiger conservation. Further, it will seek to understand how the differential
designs of the two exhibits may impact the effectiveness of the campaign at each site. More
detail on the campaign is provided in Chapter 3.

2.5 Zoo design

This section will review historical and modern zoo design development and techniques.
Exhibition design for learning will be discussed, followed by a brief summary of relevant
research into museum and building design. The term ‘exhibit’ is used interchangeably in zoo
design to refer to a single animal habitat or a group of habitats. In this thesis, ‘exhibit’ will
generally be used to describe a single animal habitat and ‘exhibit complex’ used to describe
larger groups of exhibits (and used in the phrase ‘exhibit design’ for simplicity, regardless of
its reference to a single or group of habitats).

Exhibit design is a complex and interdisciplinary process. It brings together architecture,
landscape design, graphic design and animal husbandry (Melfi, Bowkett, Plowman & Pullen,
a stage that can evoke an emotional response from zoo visitors by using physical tools to
convey a theme and affect mood. However, there is a figurative distance between
understanding a conservation message and designing an exhibit that adequately conveys it
(Polakowski, 1989). The challenge of moving beyond beautiful exhibits and teaching people
about wild animals has been described as the most compelling and exciting challenge of zoo
exhibition in the 21st century (Conway, 2007).

Gwynne, in Coe and Dykstra (2010), notes that there are few communication tools with the
potential to be as effective in connecting humans and animals as good exhibits of living
animals. Animal exhibits are “a zoo’s heart and its organizing principle” (Conway, 2007 p.
15). A good exhibit should inspire, meaning that it should appeal to both the intellectual and
emotional levels of visitors’ understanding (Vining, 2003). Exhibits can act as a connector or
conduit for communication, by providing an opportunity for engagement between the zoo as a
science communicator and zoo visitors (Neilsen, 2017). The WAZA Animal Welfare Strategy
notes that exhibit design has two roles: one in providing a suitable home for animals, and the
other to act as a “stage” to support opportunities for “intuitive environmental learning”
(Mellor, Hunt & Gusset, 2015 p.40).
2.5.1 Early zoos and zoo design

The evolution of zoo exhibit design is commonly described as being generational (Campbell, 1984; see also Figure 1 in section 2.2). First generation exhibits are utilitarian, bare cages often housing solitary animals. Second generation exhibits, usually constructed of concrete or other unnatural materials, make some attempt to acknowledge the needs of the animal by incorporating furniture or evoking landscapes (e.g., using sculpted concrete to represent rocks). Third generations exhibits are often ‘immersive’, and display animals in at least approximately natural social groupings (Coe 1987; 1994; Coe & Dykstra 2010: Moss, Francis & Esson, 2008). The concept of immersion is discussed in more detail later in this section.

Coe (1992) identifies two strands of zoo exhibit design development: one where animals are seen as vessels for entertainment or as emblems of power, and the other where animals are displayed for instruction and inspiration. These two strands converged in the Victorian era (Coe, 1992), a time when interest in the natural world was emerging in all classes of European society (Naylor, 2002). Along with this interest in natural history came a recognition of the value of scientific study and thus the establishment of wild animal collections for that purpose (Coe, 1992; Graetz, 1995: Hancocks, 2001; 2010).

Reflecting this Victorian era trend, London Zoo in Regent’s Park opened to the public in 1847 (after having been open to the members of the London Zoological Society in Regent’s Park since 1828) (Zoological Society of London, 2017). The layout of the zoo was innovative, based on taxonomic relationships, reflecting the research basis of the collection (Hancocks, 2010). Carnivores were housed in the ‘Carnivore House’, and similarly reptiles, mammals and birds were housed together in grand halls and buildings (Coe, 1986).

The popularity of the London Zoo instigated a wave of new public zoos across Europe and around the world in the 19th century. Grand and ornate buildings evoking exotic locations dominated zoo design. Temples, palaces and grand pavilions were reproduced to represent the geographical origins of the animals (Hancocks, 2010). Exhibits were designed to speak to an emerging European public interest in far-off lands, stimulated by expanding colonial empires, and little thought was given to the behavioural or biological needs of the animals (Hancocks, 2010).

The 20th century saw a new wave of innovation in design, although this was not without its critics. Carl Hagenbeck is known as the pioneer of natural-looking and barless zoo enclosures, using dry moats to separate animals from each other and from visitors, and is widely credited
as being the first zoo designer to look to nature for inspiration, creating panoramas of natural environments (Hancock, 2001; Hancocks, 2010). Hagenbeck opened Tierpark Hagenbeck near Hamburg, Germany in 1907, employing innovative panorama techniques and displaying animals in bio-regional groupings (Hancocks, 2001). Although his work was immediately popular with zoo visitors, it was derided by fellow zoo professionals as being expensive and making animals hard to see (Bridges, 1974; Rothfels, 2008; Hancocks, 2010). Of particular concern to some colleagues was the dismissal of the taxonomic approach to arrangement of animals throughout the zoo which was seen to threaten the newly-established role of zoos as places for scientific study (Hancock, 2001; Hancocks, 2010). Hagenbeck employed his design style around the world, notably at the Jardin des Plantes in Paris, where he reportedly developed the artificial rock still commonly in use in zoos. Victor Borcherdt designed Hagenbeck-style exhibits for the Denver Zoo and St Louis Zoo in the early 1900s, and Hagenbeck’s sons worked with designers at the Brookfield Zoo in Chicago in the 1930s (Coe, 1986).

Just as Hagenbeck’s designs became popular, the 1930s also saw a shift to an increasingly modernist approach to zoo design, emphasising functionalism over naturalism (Coe, 1994; Hancocks, 2010). While some zoos continued to apply the Hagenbeck concept (e.g. using moats as barriers), designs were simplified, and the detailed replication of natural elements was replaced with abstract sculptures and smooth concrete. Bethold Lubetkin, a designer responsible for several 1930s modernist exhibits in English zoos including the Penguin Pool at London zoo is quoted as having enjoyed “the contrast between the perfect man-made symmetry… and the wobbling idiocy of the animals” (Walter, 1996 p. 9).

2.5.2 Zoo exhibit naturalism, landscape immersion and modern design

Zoo design in the later 20th century became directed towards displaying animals in a natural-looking habitat. ‘Naturalistic’ design, rather than being focussed on function, provided animals with a stimulating environment that closely resembled their natural habitat (Cousins, 1990). More natural looking vegetation (real, artificial, or painted), substrates and barriers contributed to making animal enclosures appear more like their natural environments. Today, most modern zoo exhibits will use some degree of naturalism.

Exhibit naturalism has continued to evolve. In the 1970s, examples of ‘landscape immersion’ began to emerge, initially via work to develop a master plan for Woodland Park Zoo in Seattle, USA (Hancocks, 2010). In landscape immersion, the natural habitat landscape of
animal exhibits is expanded to public areas, embedding visitors in the same natural landscape before they even see the animals (Hancocks, 2010). People and animals appear to share the same landscape due to invisible or discrete barriers. Immersive experiences are thought to build appreciation, affiliation and respect for the animal (Coe, 1985; Polakowski, 1987; Coe, 1994; Clayton & Myers, 2015). The World Zoo Conservation Strategy, published in 1993 by the then World Zoo Organisation (now WAZA) and the Captive Breeding Specialist Group of the IUCN/Species Survival Commission, noted that “immersion exhibits involve zoo visitors in the environmental circumstances of the animals, and such experiences are conducive to favourable reception by visitors of strong conservation messages” (IUDZG/CBSG (IUCN/SSC), 1993, p.3). Coe describes landscape immersion as the tool for “making the zoo experience real” (Coe, 1985 p. 206). Like Hagenbeck’s design, central to the immersion concept is the lack of sense of barriers between humans and animals. In that sense, immersion design could be considered an extension of Hagenbeck’s design principle.

The Woodland Park design team used natural materials, inspired by real habitats (such as logs, soil mounds, streams or ponds of water) to function as - or hide - barriers and buildings, and replicate the sense of wilderness (Hancocks, 2010). The landscape therefore appears continuous and consistent across both the visitor and animal zones (Coe, 1994). The publication of Woodland Park Zoo’s (1976) The Long Range Plan for Woodland Park Zoological Gardens outlined a theory for designing and constructing immersion exhibits, and is amongst the most influential texts on the concept of immersion design.

The plan notes that successful landscape immersion relies on two factors:

1. the completeness and correctness with which the characteristic landscape is projected, and
2. the care and accuracy with which the viewpoints and views are located and composed, concealing barriers, enhancing perspectives, composing light and shadow, and most importantly, visually unifying animal space and visitor space”

(Woodland Park Zoo, 1976 p. 44).

Animals should be seen only as a part of the landscape via selected views, with more continuous or cross-exhibit views along pathways limited. Exhibits should “unfold dynamically, view by view, from a variety of overlooks” (Woodland Park Zoo, 1976 p. 45). The Woodland Park Zoo team also found that landscape immersion improved the welfare of animals in their care. Chimpanzees provided with more natural flooring and opportunities to
forage for their foods resulted in increased natural behaviours (Hyson, 2000). Increased natural plantings stimulated novel breeding events in owls, and caracals showed a preference to spend time and eat in the naturalistic part of their enclosure over the more familiar but less naturalistic older section (Hancocks, 2001).

Many modern zoos successfully use aspects of landscape immersion, including the Bronx Zoo, Zoo Zurich, Disney’s Animal Kingdom in Florida, and several Australian zoos. Some immersion exhibits have directly connected visitors to in situ conservation. For example, Bronx Zoo’s Congo Gorilla Forest allowed visitors to decide how their US$3 admission fee would be spent, on one of three real-world conservation projects (Gwynne, 2007). Zoo Zurich’s Masoala Hall directly reflects the reality of Masoala National Park in Madagascar, and through faithful horticulture and animal collections acts as a “living outpost of Madagascar at the heart of Europe” (Hatchwell & Rubel, 2007 p. 214). The exhibit also channels financial and in-kind support from visitors, donors and the Swiss government to the national park.

Like Hagenbeck’s pioneering design approach, the landscape immersion concept pioneered at Woodland Park Zoo was not universally welcomed by zoo professionals. The untidy appearance of the simulated wild habitats, challenges with animal visibility, and the cost of expanding design features to visitor areas was unpopular (Hancocks, 2010). However, David Hancocks (Hancocks, 2010) is critical of the limited practice of the fundamental principles of landscape immersion. Hancocks, Director of Woodland Park Zoo in the 1970s, zoo historian and zoo director for more than 30 years, describes the “prolific combination of fence posts, drain covers, stainless steel dishes, concrete edges… common in most zoo exhibits”. Hancock notes that these elements “defeat[s] the justifications for the exhibit’s existence, and reverts the menageries’ base purpose of showing people the shape, size and colour of wild animals” (Hancocks, 2010 p. 126).

Often complimentary to (or used as an extension of) landscape immersion is ‘cultural resonance’. The use of art, architecture and other physical features (often culturally or ethnically relevant to the native country or biogeographical zone of the animal on display) can assist with ‘telling the story’ of the exhibit (Coe, 1994; Coe & Dykstra, 2010). This technique is employed extensively at Disney’s Animal Kingdom and Melbourne Zoo’s Trail of the Elephants (Coe & Dykstra, 2010). The Trail of the Elephants uses architecture (huts, buildings), landscape (agricultural representations, tropical planting, sand and soil floors) and art (carvings, artefacts and paintings) to highlight the complex conservation challenge of
mitigating conflict between humans and wild elephants to ensure the protection of elephants and support for local communities (Zoos Victoria, 2017). Cultural resonance is also used extensively in Taronga Zoo’s Tiger Trek (see section 3.3.1 for detail).

Research in zoos has gone some way to validating naturalistic and immersive design’s contribution to the role of zoos in environmental education and conservation impact. Immersion zoo exhibit design techniques can create a literal connection between visitors and animals (Bruni et al., 2008). Exhibiting animals in naturalistic settings may be effective in increasing visitor concern for animals (Bruni et al., 2008; Lukas & Ross, 2014). Targeted exhibit design and interpretation may contribute to an increase in ‘conservation caring’ as described by Rabb and Saunders (2005) by linking the zoo experience with matters of conservation concern (Skibins & Powell, 2013). The WAZA Animal Welfare Strategy (Mellor et al., 2015) states that landscape immersion design facilitates ‘intuitive environmental learning’ (Mellor et al., 2015 p. 40). Torre (2016) likens the experience of an effective zoo exhibit to a film script, proposing that the visitor exhibit pathway should begin with a “portal concept” (p. 11), involve immersive storylines and hands-on experiences, and close with a delineating experience that illustrates how zoo visitors can help address global environmental issues. Coe (1985) has proposed elements such as viewing distance, angle and relative position of the visitor to the animal and degree of landscape immersion as potential factors influencing visitor experience. Lighting, colour, crowding, space, realism, visibility and sound may also influence the visitor experience, as may the sequencing and positioning of exhibit content (Bitgood & Patterson, 1987; Falk & Storksdieck, 2005). This study will attempt to build upon this existing research, to understand the relationship between exhibit design and pro-environmental behaviour in zoo visitors.

2.5.3 Museum and retail design

Museums, like zoos, are amongst the most highly patronised informal learning centres in Australia (Australian Bureau of Statistics, 2011). Both types of organisation invest substantial resources in exhibit design, but there is a paucity of “shared knowledge, concepts and vocabulary” amongst the main contributors to exhibit production (Forrest, 2015 p. 4). This is underpinned by a lack of a formalised empirically-based ‘theory’ of museum exhibit design; most design choices are based on anecdotal or informal knowledge drawn from experience and practice rather than study (Forrest, 2015). Even given this, there is significantly more published research in the field of museum exhibitry when compared to zoo exhibitry. This
project therefore relied on this existing museum-based research in its literature review and in designing of the project.

In an analysis of the Hyde Park Barracks in Sydney, Australia, Stenglin (2009) chose semiotic devices to analyse the physical space to establish a set of principles that can be used to design and analyse these three-dimensional spaces as communicative devices. The scope of this study does not allow for a deep dive into the complex field of semiotics, which “explores the organisation of meaning according to the communicative functions that semiotic systems have evolved to fill” (Stenglin, 2009 p. 36). However, the tools presented by this semiotic study are a useful starting point for the analysis of zoo exhibits as communication devices. Following is a summary of the concepts considered most relevant to zoo exhibit design.

‘Serial’ structures are those in which information or experiences are organized linearly or chronologically while ‘orbital’ spaces are those which have a core and satellite experiences or zones (Stenglin, 2009). ‘Binding’ is concerned with the correlation between space and emotion; ‘bound’ spaces are enclosed and restricted relative to ‘unbound’ spaces, which are more open and spacious. Highly bound spaces can feel claustrophobic, but bound spaces can incite a feeling of comfort and intimacy and encourage quiet and contemplation (Forrest, 2015). Conversely, highly ‘unbound’ spaces can be intimidating and make visitors feel vulnerable, while more moderately unbound spaces can incite awe and feelings of freedom and opportunity.

‘Bonding’ is concerned with feelings of affiliation and alignment with the space and its message (Stenglin, 2009). Bonding can be achieved using icons and hybridizing concepts (Bernstein, 1975). In spatial design, this could translate to the use of physical icons and motifs and employing multi-functional spaces or spaces that represent another (Stenglin, 2009). An immersive zoo exhibit, or the use of cultural resonance could be considered an example of this.

‘Path-venue’ analysis considers visitor movements as they move through a space. The ‘path’ serves to facilitate movement through the space, and deposit visitors at ‘venues’ along the path. Finally, prominence is concerned with attracting attention, and is also relevant to visitor movement – it can serve to encourage people to move from one space to another, or to maintain their presence in a space for a desired time (Stenglin, 2009). Both of these concepts are routinely employed in zoo design, with linear paths often branching into small caves, buildings or viewing windows. Physical installations of signs, doors, interactive elements or obvious viewing windows can be used to draw visitors to particular areas or cause them to
stop and linger. Interactive experiences are often also social experiences, with people often discussing their experience or commenting on the experiences of others. The impact of a zoo visit may be influenced not only by interactive experiences themselves, but by the social context that makes interactive elements more attractive and engaging, and the experience with them more vivid and memorable (Consorte-McCrea et al., 2019).

Visitor preference for spaces is an important consideration in design. Studies in retail environments have demonstrated that more emotionally pleasing environments lead to more positive evaluations of the products for sale (Mehrabian & Russell, 1974; Bitner, 1992). Kaplan (1987) found that a preference for a particular environment can be predicted by three environmental dimensions: complexity, mystery, and coherence. Increased complexity, a measure of how visually rich a space is, or the rate at which information is conveyed, correlates with increased environmental arousal. Mystery, the use of design features to suggest that there is more to come or more to learn (e.g. a trail disappearing around a corner) is suggested to increase excitement and maintain engagement. Both complexity and mystery can be considered to contribute to ‘exploration’ within a space (Kaplan, 1987). Coherence, on the other hand, contributes to understanding of cognitive information. Increased coherence (clarity, order and unity of features) correlates with a positive evaluation of a space; more coherent spaces are more pleasant (Nasar, 1989).

Discussion of zoo design in academic literature is limited, with more written for publication in trade magazines and business websites. It is therefore difficult to know how much the zoo design industry considers the impact of the concepts outlined above when planning and constructing. What is evident, however, is that it would not be difficult to find examples of many of these concepts (as noted relevantly above) in a large number of modern zoo exhibits, including those two exhibits which form the study sites for this project. Chapter 3 will describe these two sites, and where relevant, the application of the semiotic concepts highlighted in this section will be identified. Further, any notable impact of the application of these concepts will be drawn out in the Discussion (Chapter 6) and recommendations for zoo design.

2.5.4 Impact of design on engagement and learning

A limited amount of research is available that investigates how specific features of exhibition design influence learning and engagement in free-choice learning environments (Bitgood
1992; Serrell & Adams, 1998). Most of what exists has been conducted in a museum setting, although some zoo-based studies focusing on the impact of animals on learning are available.

Further, most existing research into the relationship between exhibit design and visitor outcomes has been focused on learning or engagement on site, rather than on personal factors such as attitudes and perceived behavioural control. For example, Skibins and Powell (2013) noted that a small number of visitors reported a strong connection to jellyfish following their visit to Shedd Aquarium. The authors hypothesised that this may be due to the advanced exhibit design and interpretation techniques employed in the exhibit.

Most recently, Pavitt and Moss (2019) have examined the impact of zoo exhibit design on visitor engagement and conservation attitudes, comparing walk-through exhibits with traditional (non-walk-through) exhibits. Overall, walk-through exhibits were significantly more effective at engaging visitors with animals. Visitors in walk-through exhibits made more comments about the displayed species, including both surface-level and deeper informational level comments. Visitors dwelled longer in walk-through exhibits. While more than half of visitors reported that they had learned something at a walk-through exhibit, only 23.2% could demonstrate this by providing a new fact they had learned (the metric chosen by the researchers to demonstrate learning in this study). Further, comments relating to conservation were made in only 2.3% of total observations, with almost all of those comments made in walk-through exhibits, “reinforcing the conclusion that visitor engagement is greater with walk-through exhibits than traditional exhibits” (p. 192). The study found a significant reduction in support for the statement “Some species are just meant to die out” after the visit to the walk-through exhibit (p. 190), and visitors more strongly agreed that they “would like to do more to help wildlife” (p. 190). However, there was no significant change in reported connection to wildlife or perceived ability to help protect animal species. The authors suggest that the results of this study may indicate that more direct conservation education engagement is necessary (e.g. through staff or volunteers) rather than relying on immersive exhibits to engage visitors.

The layout of exhibit spaces has been found to influence learning, including the sequence in which information is presented and positioning within the broader display space (Falk, 1993). Further, the ease in which visitors can orient themselves and navigate within a space are highly correlated with cognitive learning outcomes (Falk & Balling, 1982; Kubota and Olstad, 1991; Falk & Dierking, 2000). Proximity to animals has been found to be significant in visitor behaviour; the closer people are to the animals on display, the more likely they were
to stop at the exhibit (Bitgood, Patterson & Benefield, 1988). Studies examining the impact of naturalistic exhibit design have demonstrated that naturalistic exhibits can increase the time visitors spend in an exhibit, even if an animal is not visible (Shettel-Neuber, 1988; Davey, 2006; Nakamichi, 2007).

In addition to layout, more physical aspects of the exhibit experience have been found to influence learning. Ogden, Lindburg and Maple (1993) found that playing ecologically relevant sounds (e.g. animal vocalization, birds, thunder and trees and foliage) had a positive effect on the zoo visitor experience. Visitors reported an increased awareness of nature, as well as increased learning, with almost twice as many people reporting that they had learned something during their visit when the sounds were being played.

Exhibit ‘attraction’ or length of viewing/interaction is a widely used measure of the educational potential of exhibits (Moss & Esson, 2010). In museums, small, highly interactive exhibits and open-ended exhibits with a technological element have been demonstrated to engage visitors for longer periods of time (Borun & Dritsas, 1997; Sandifer, 2003; Dancstep, Gutwill and Sindorf, 2015). Zoo visitors have been shown to spend more time at naturalistic exhibits that had higher degrees of environmental enrichment (Coe, 1985; Tofield, Coll, Vyle & Bolstad, 2003, Ridgway, Livingston & Smith, 2005; Moss et al., 2010) and at larger viewing areas at zoo exhibits (Moss et al., 2008).

While not strictly related to design, aspects of the visitor experience of animals on display has been established to affect engagement on site. Perhaps unsurprisingly, visitors have been shown to also spend more time at exhibits where animals are visible and active (Margulis, Hoyos & Anderson, 2003; Luebke, Watters, Packer, Miller & Powell, 2016) or where there are infant animals in display (Bitgood et al.,1988; Ridgway et al., 2005). Visitors have also been observed to dwell for twice as long at exhibits where animals are clearly visible as when they are not (Bitgood, et al., 1988). Visitors generally show a preference for exhibits containing larger animals (Bitgood et al., 1988; Ross & Gillespie, 2009) although one study at an aquarium found that green moray eels attracted visitors for a long period of time and attributed this to the “dread and wonder” they invoke (Zwinkels, Oudegeest & Laterveer, 2009 p.74). Visual obstacles, screens and low lighting were found to impact viewing times by inhibiting animal visibility.

This overview of a diverse field of spatial analysis and design in various contexts is not comprehensive, but it demonstrates that there is some empirically tested basis to the theory that physical context affects the visitor experience, engagement and learning. While we have
established that basic learning or acquisition of information does not automatically translate to transformed environmental attitudes, intentions or behaviour, the existence of an apparent pathway from exhibit engagement to impact on visitors is supportive of further exploration of this concept. Further, the largely practice-based awareness of the potential of immersive exhibits to increase visitor receptiveness to pro-environmental messages warrants more thorough investigation.

Much of the empirical research on the impact of zoo exhibit design, aside from impact on the animals themselves, has focused on visitor satisfaction with an exhibit, how an exhibit makes them feel about an animal, or on learning-based outcomes. Despite the widespread acknowledgement of the potential effect of visiting a zoo on behavioural outcomes, very little has been published about the role of zoo design in contributing to the effective delivery of conservation or pro-environmental messages aimed at affecting behaviour change in zoo visitors. I propose that this is an important gap to address, not least to ensure that the considerable resources invested by zoos in their exhibits are used effectively to best support their educational mission in support of wildlife conservation.

Clayton and Myers (2015) observe “As managed settings, zoos have the opportunity to construct their exhibits and the overall zoo experience in a way that, informed by the research, is designed to achieve the best effect on environmental learning and attitudes” (p. 48). Fraser et al., (2010), in the AZA Framework for Zoo and Aquarium Social Science Research, note the insufficient empirical study of exhibit design variables on learning. The authors pose a question for future research: “Does the context of the zoo or aquarium alter the ways in which people learn concepts and develop skills?”, noting that research should “move beyond study of the animal or interpretive text to explore which specific domains of learning are best facilitated through the overall context, and how the context itself serves to teach” (Fraser et al., 2010 p.22).

The AZA Framework for Zoo and Aquarium Social Science Research (Fraser et al., 2010) highlights the need for inquiry into how exhibit settings affect learning in zoos and aquariums, noting that while such ‘context variables’ may have been thought about, they have not been adequately investigated. Fraser et al. (2010) specify that such research should move beyond research on interpretive material content (e.g. signage) towards an examination of the role of context (e.g. exhibit design) in learning.
2.6 Conclusion and justification for research

Animal exhibits are the zoo or aquarium's natural voice, the best means available to communicate our message to the public. Delivery of the message of empathy and positive change in public attitudes about wildlife and our place in nature is one of the most important contributions our institutions can make to the local and global conservation movement (Coe, 1994 p. 1).

This chapter reviews the available literature on three main concepts: science learning in informal environments, social science and behaviour change, and zoo exhibit design.

At the nexus of these three fields sits this research project, which seeks to answer the central research question of this thesis: does the design of zoo exhibits impact the efficacy of zoo-based visitor behaviour change campaigns? Figure 4 shows the hypothesised pathway from exhibit experience to behaviour, bringing together the concepts from within the literature discussed in this chapter. Specific references are given for Manstead (1990) and Ajzen’s (1991) Theory of Planned Behaviour; see sections 2.3.4 and 2.3.5 for discussion and references on the role of emotion and connection, and sections 2.3.2 and 2.3.3 for discussion of learning and cognition in zoos and other informal learning environments.

Figure 4: Graphical representation of the theoretical pathway from exhibit experience to behaviour.

To answer this overarching question, this thesis will answer four questions arising from the literature discussed in this chapter:
1. Does visiting tiger exhibits impact visitors’ perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation?

2. What personal factors (e.g. attitudes, perceived behavioural control, intention – see section 4.2.2 for detailed explanation) of the zoo visit have the greatest impact on zoo visitors’ behavioural intentions regarding tiger conservation?

3. What exhibit engagement factors relate to the personal factors that contribute to visitors’ behavioural intentions regarding tiger conservation?

4. What exhibit engagement factors relate to increased sense of connection to tigers?

As this review demonstrates, informal educational environments have the potential to influence the public understanding of science. They also have perhaps a greater potential to emotionally engage people to affect behaviour change than formal environments. Zoos are uniquely positioned in the community to facilitate an emotional connection between people and animals. Zoos are embracing social science methodologies in the design of behaviour change campaigns, and there are encouraging results from programs implemented within the last decade. Zoo exhibit design is an evolving discipline, and many professionals and researchers highlight the role of design as a potential tool for connecting zoo visitors with animals and affecting behaviour change.

This study will attempt to address the gap identified in this review, which is acknowledged and openly articulated by key researchers in the field. In addressing this gap, this thesis will examine the influence of visiting two tiger exhibits on the attitudes, emotional connection, cognition, perceived behavioural control, and behavioural intention related to tiger conservation. The next section will describe and discuss the two research sites used in this study, including the history of the zoos and design of the two exhibits that are the focus of this study.
3. Conservation context and research sites

As noted in Chapter 1, this study will use Sumatran tigers and their exhibits as the focal species and study sites. While this was largely an opportunistic choice (Taronga Zoo’s ‘Tiger Trek’ opened early in the scoping period for this study, presenting an attractive opportunity to examine a brand new exhibit designed using relevant social science principles), large carnivores are popular exhibit animals in zoo environments, and are demonstrated to be engaging species (Albert, Luque & Courchamp, 2018; Consorte-McCrea et al., 2019).

To identify whether there was a possible difference in visitor outcomes related to tiger conservation in visitors who attend different types of zoo exhibits, a case study approach was taken. The scope of this doctoral study permitted an in-depth study of two tiger exhibits. The full method and research design will be detailed in Chapter 4.

This chapter provides an overview of the conservation context in which the zoo exhibits and conservation messaging exist. Then, it provides an introduction to the two research sites at Taronga Zoo and Western Plains Zoo. Exhibit descriptions and images are provided.

3.1 Conservation context

Tigers (*Panthera tigris*) occur across Asia, from China to India, and are classified as endangered by the International Union for the Conservation of Nature (IUCN) Red List (IUCN, 2014). Current taxonomic sources recognise various subspecies, with the IUCN currently recognising six: the Amur tiger, Northern Indochinese tiger, Malayan tiger, Bengal tiger, South China tiger and Sumatran tiger (IUCN, 2014).

The Sumatran tiger (*Panthera tigris sumatrae*) is the subspecies selected for conservation management in the Australasian region (Zoo and Aquarium Association Australasia, 2017). The Zoo and Aquarium Association Australasia’s population management program aims to breed and maintain an assurance population against extinction in the wild, support increased scientific understanding of the species, and provide animals for “exhibition and educational programs to increase awareness of human impacts on wildlife and inspire support of conservation activities and actions” (Zoo and Aquarium Association, 2017 p. 1).
The IUCN estimates that the wild Sumatran tiger population is between 441-679 individuals, and is decreasing (IUCN, 2014). Threats to Sumatran tiger populations include hunting and trapping and other forms of human-wildlife conflict. Another major threat is habitat loss due to land clearing, including for palm oil plantations (Bateman, Fisher, Fitzherbert, Glew & Naidoo, 2010; Petenko, Paltseva & Searle, 2016, Luskin, Albert & Tobler, 2017).

The oil of the oil palm tree (Elaeis guineensis) is a versatile vegetable oil used in cooking, manufactured foods (e.g. confectionary and ice-cream), in cleaning and personal care products (e.g. shampoos, detergents) and to a more limited extent, biofuels. Popular sources frequently state that palm oil is used in more than half of all packaged products (e.g. WWF n.d.; Palm Oil Investigations, n.d.). It is a cheap and productive crop relative to other vegetable oils (WWF, n.d.), requiring roughly half the land area of other crops like soybeans to produce an equivalent amount of oil (Rosner, 2018). Palm oil can withstand high cooking heats, adds to creamy and smooth textures in cooked products and makeups, is relatively shelf stable and has a low odour (Roundtable on Sustainable Palm Oil, n.d.). The plant itself is native to Africa (Centre for Agriculture and Bioscience International, 2008) but is used in oil production plantations around the world. Beginning in the 1980s, commercial-scale oil palm plantations spread rapidly (primarily in Asia), tripling in size globally to almost 14 million hectares by 2007 (Shiel et al., 2009). Indonesia and Malaysia produce 87% of global palm oil (Palm Oil Investigations, n.d.).

The impact of palm oil production on wildlife and the environment has been a major environmental concern for over ten years. While a driver of significant economic growth, oil palm plantation expansions can cause widespread land clearing, leading to loss of biodiversity, land degradation and altered fire regimes (Maddox, 2007; Shiel et al., 2009). Animals often adjust poorly to the replacement of natural environments with palm oil plantations; Maddox (2007) found that less than 25% of mammal species normally encountered in primary forest also used palm oil plantations. Species of higher conservation value (e.g. endangered species like tigers, orangutans, pangolins and tapirs) were especially negatively affected by the change in landscape. Similarly, bird species diversity was found to decrease by 60% in plantations compared to primary forest (Aratrakorn, Thunhikorn & Donald, 2006). There are also in some cases social impacts on local communities, including where land conversion has occurred without consultation or permission from landowners or communities (Roundtable on Sustainable Palm Oil, n.d.). However, the plant’s high yield and
efficient production means that it is overall comparatively less environmentally impactful than other oils (Zoos Victoria, n.d.).

Palm oil in consumer products is rarely labelled as such, making consumer avoidance of the oil extremely difficult. Most commonly in food products it is simply labelled ‘vegetable oil’, although palmate, palmitate, palmolein, glyceryl, stearate, stearic acid and sodium lauryl lactylate/sulphate are all common (Zoos Victoria, n.d.). A campaign in Australia, beginning in 2009, has called for national labelling laws requiring mandatory clear labelling of palm oil as an ingredient where it is used (Zoos Victoria, n.d.). So far, no national labelling requirements have been introduced.

The Roundtable on Sustainable Palm Oil (RSPO) is a coalition of more than 4000 stakeholders including producers, processors, manufacturers, retailers, investors and non-governmental organisations that has developed global standards for sustainable palm oil (Roundtable on Sustainable Palm Oil, n.d.). Applied appropriately, the RSPO expects that these standards “can help to minimize the negative impact of palm oil cultivation on the environment and communities in palm oil-producing regions” (Roundtable on Sustainable Palm Oil, n.d., ‘About’ para 2). The RSPO can certify sustainable sources of oil (Certified Sustainable Palm Oil or CSPO) which meet their RSPO Principles and Criteria for Sustainable Palm Oil Production, established in 2008. Acknowledging the relative environmental impact of sustainable palm oil plantations when compared to other oil production methods, the RSPO recommends that consumers preferentially chose to purchase products that contains CSPO (Roundtable on Sustainable Palm Oil, n.d.), rather than lobbying for or choosing an alternate oil source.

Zoos in Australia have joined this call. Taronga Conservation Society Australia’s ‘Raise Your Palm’ initiative is central to the behaviour change campaign messaging that is the focus of the two exhibits that will be discussed in this thesis. Through Raise Your Palm, Taronga acknowledges companies that use CSPO in their products. Zoo visitors are called upon to help protect Sumatran tigers by choosing to purchase products from brands that use 100% CSPO, supporting these companies by thanking them through the WWF Palm Oil scorecard; and talking to their friends and family about CSPO (Taronga Conservation Society Australia, n.d.). The intent of the program is that “by educating, empowering and helping consumers, and those involved in the supply chain, to make better choices, Taronga will be communicating and encouraging the transition towards a more responsible palm oil industry”
(B. Fairbrother, manager of community conservation at Taronga Conservation Society Australia quoted in Palm Oil Action Australia, 2017).

By mid-2018 more than 30,000 zoo visitors had pledged their support to purchase RSPO-certified sustainable palm oil. In the same period, 60,000 emails had been sent to companies acknowledging their commitment to RSPO-certified palm oil (Taronga Conservation Society Australia, 2018a) and during 2018-19, Tiger Trek reached 100,000 emails sent (Taronga Conservation Society Australia, 2019). One company, Ferrero Australia, reports that they have received over 14,000 emails thanking them for using sustainable palm oil (NSW Department of Planning, Industry and Environment, 2020).

This thesis will attempt to understand how effectively the ‘Raise Your Palm’ initiative is communicated to zoo visitors at Taronga Conservation Society Australia’s two zoos, and specifically what role the zoo exhibits play in this messaging.

### 3.2 Site selection

In an effort to control for as many variables in the visitor experience as possible, this project aimed to find two comparison sites that, apart from the exhibit design, were as aligned as possible in terms of message, organisational and operational systems. Taronga Western Plains Zoo in Dubbo and Taronga Zoo in Mosman (Sydney), both in the state of New South Wales, Australia, are both run by Taronga Conservation Society Australia, meaning that there is consistency in organisational management and philosophy. Both zoos display Sumatran tigers, which controls for the potential (and in some other studies, evidenced, e.g. Albert et al., 2018) preference for large, iconic animals like tigers. In both locations the conservation messaging of the tiger exhibit is focussed on palm oil purchasing behaviour, although they are conveyed using completely different exhibit design techniques. Noting the success of zoo conservation campaign initiatives described in Chapter 2, and a strong visitor preference for and engagement with large carnivores like tigers, the sites used in this thesis allowed for appropriate, relevant exploration of the potential impact of exhibit design on the efficacy of zoo-based behaviour-change campaigns.

Taronga Zoo, located on the Sydney Harbour at Bradley’s Head, was opened on 7 October 1916. Operated by the Zoological Society of New South Wales, this was the second zoo site in Sydney. Prior to the Bradley’s Head site, the Society operated a public zoo at Moore Park, but the site became too small (Taronga Conservation Society Australia, n.d.).
The zoo is known for its views of iconic Sydney Harbour landmarks such as the Sydney Opera House and Sydney Harbour Bridge. Today, Taronga Zoo is 28 hectares in size, housing over 300 species of animals, a wildlife hospital, the Taronga Institute of Science and Learning, and an eco-retreat. In 2017-18, Taronga Zoo had 1.83 million visitors, with roughly an equal proportion of visitors coming from Sydney and from overseas (38% and 42% respectively). Smaller proportions of visitors come from other places in New South Wales (6%) and elsewhere in Australia (14%) (Taronga Conservation Society, 2018b).

Taronga Western Plains Zoo (henceforth referred to as Western Plains Zoo) was opened on 28 February 1977 on Obley Road, Dubbo, New South Wales, and was at the time the first Australian Zoo to be constructed on ‘open-range’ design principles (Taronga Conservation Society Australia, 2019). Traditional walls and fences are largely replaced by hidden moats dividing animals from visitors, and exhibits tend to be large and sparsely furnished. The zoo is around almost 760 hectares in size with 63 species (Taronga Conservation Society Australia, 2018b). Western Plains Zoo also houses a wildlife hospital and overnight, safari-style accommodation for guests. In 2017-18, Western Plains Zoo had over 260 000 visitors. Most visitors (47%) were from New South Wales. Almost a quarter of visitors were from Sydney (23%) and close to a third were from other places in Australia (29%). One percent of visitors came from overseas (Taronga Conservation Society Australia, 2018b).

3.3 Exhibit descriptions

3.3.1 Taronga Zoo, Sydney

Taronga Zoo’s ‘Tiger Trek’ (Figure 5; map designed using ‘Home Outside’ app for iPad) is an immersive Indonesian-themed exhibit complex displaying Sumatran tigers that was opened in August 2017. Interactive and interpretive elements in the exhibit inform visitors about the threats to tigers and what they can do to help protect tigers in the wild. During the data collection period for this study, four adult tigers were in Taronga Zoo’s collection. On most days, at least three tigers were on display in the exhibit complex. Two tigers (one female and one male) were always displayed alone during the research period, and the remaining male and female (mother and son) were usually displayed together.
Figure 5: Taronga Zoo ‘Tiger Trek’ exhibit map (designed by the researcher)
The exhibit complex is a ‘serial’ experience, with a choreographed linear story and layout (refer to section 2.5.3 for discussion of design concepts which are used in this section). There are some elements of ‘path-venue’ design, with small caves and window enclaves diverging off the main path.

The experience begins with a ‘journey to Sumatra’, where visitors take a simulated three-minute ‘flight’ from Sydney to Way Kambas National Park, in an enclosed (bound) space themed as the inside of a cargo aeroplane (Figure 6). This is also an example of bonding, as described by Stenglin (2009) – while visitors can understand they are not in a flying aeroplane, the imagery evokes the feeling of being so. Further, the sparse furnishings and large scale of the ‘cargo plane’ make it clear that the ‘journey’ is not one of leisure. During the ‘flight’ visitors are told (via a video of the ‘co-pilot’ which is played on the ‘cockpit door’) about the impacts of unsustainable palm oil plantations on the environment, and the conservation status of Sumatran tigers. Visitors are encouraged to help rangers track tigers in the national park, setting the scene for the interpretive story woven through the exhibit.

![Figure 6: Interior of aeroplane. Source: Taronga Conservation Society Australia](image)

Visitors emerge from the aeroplane into a simulated Indonesian village scene (Figure 7), which contains village shopfronts, a ranger station, and the ‘gateway to Way Kambas National Park’ (Figure 8; a scale replicate of the actual national park gate in Sumatra). The village and park gates are another example of bonding, by visually transporting visitors to
Sumatra, while the park gates are also an example of prominence, heralding the entrance to
the jungle. Behind the gates in Figure 8, mystery is invoked by a sharp, darkened and heavily
planted right turn on the path, hiding what is beyond.

At the time of data collection. there were no ‘villagers’ operating the stores, or ‘rangers’ in the
station. Visitors could not interact with any of the shopfronts or purchase food or drink. This
was a potential opportunity identified when designing this zone.

Figure 7: Tiger Trek Village. Source: author

Figure 8: Recreated ‘gates to Way Kambas National Park’. Source: author.
Tigers are displayed in three variably themed tiger exhibits throughout the complex.

The first (Tiger Habitat 1) is designed to represent a typical tiger habitat in areas damaged by palm oil production, viewed mainly from a large glass viewing window (Figure 9) on a bridge covered with a thatched awning that resembles an Indonesian style roof (Figure 10). While still quite open at its sides, the thatched bridge has the effect of slightly enclosing the space, evoking a quieter, more comforting ‘bound’ feeling. Visitors were observed to speak more quietly and move more slowly in this space.

Figure 9: Viewing window into Tiger Habitat 1 (covered bridge viewing). Source: author

Figure 10: View of Tiger Habitat 1, including thatched covered bridge viewing area. Source: author
Tiger Habitat 2 (Figure 11) is viewed from within a large building, themed as a tiger protection station (known as the Ranger Station; Figure 12). The major interpretive feature in this area is a large, floor-to-ceiling multimedia video display with positive messaging about sustainable palm oil. Also within this building is a prominent 4WD ‘ranger field vehicle’ (Figure 13) jutting into the tiger enclosure for guests to get a close up look of the tigers through the windscreens and side windows. The Ranger Station, while enclosed on three sides, and made of quite dark timber, has very high ceilings, somewhat confounding description of the space as either ‘bound’ or ‘unbound’. In a sense it is both – the high ceilings invoke an almost cathedral-like sense of reverence, whereas the reverberation of sound and crowding can make the space overwhelming and claustrophobic. This space was observed to be generally louder and more chaotic when compared to other zones containing viewing windows.

Figure 11: View into Tiger Habitat 2 from Ranger Station viewing area. Source: author
Figure 12: Ranger Station. Source: author

Figure 13: Ranger Vehicle, side view from Ranger Station viewing window.

Source: Sarah Gowland (supplied)
Tiger Habitat 3 is viewed from the outbound visitor pathway and two glass viewing windows. It is themed as an ideal tiger habitat, with lush vegetation and a single large, central *Ficus* tree which can be climbed by the tigers (Figure 14). The two viewing windows are slightly embedded into the exhibit, acting as destinations off the path, evoking the ‘path-venue’ concept.

![Figure 14: View into Tiger Habitat 3, with large *Ficus* in background. Source: author](image)

Tropical plants evoking a dense jungle are planted throughout the exhibit complex, including green shrubs, tall bamboo and trees. The visitor path is mainly compressed sand/dirt, and winds between rocks and rock-edged garden beds (Figure 15).
Departing the outdoor part of the Tiger Trek complex, visitors are surprised to find themselves turning a corner into a room simulating a modern, western supermarket with bright colours and loud pop music. On one wall there is a series of shopping carts (Figure 16), and virtual shelves featuring products that they would encounter during a normal supermarket visit. These carts often attract people who are curious as to their purpose, which suggests the interplay of both prominence and mystery concepts.

The shopping carts contain interactive touch screens that display categories of commonly purchased supermarket products (e.g., confectionary). Choosing a product on the screen displays an information about whether or not the product contains certified sustainable palm oil or palm oil without the RSPO sustainability certification. Visitors can opt to directly email companies whose products they use which do not have a sustainable palm oil policy, encouraging the company to commit to sustainably sourced palm oil. Alternatively, visitors can email a message of support to a company already using sustainable palm oil.
Figure 16: Supermarket Carts. Source: author.

A large electronic ‘hero board’ (Figure 17) keeps a tally of the number of emails sent. As each new email is sent, the person’s name appears briefly on the board.

Figure 17: Supermarket 'Hero Board'. Source: author
The exhibit complex was designed using the Connect-Understand-Act Framework (Taronga Conservation Australia, 2017) discussed in section 2.5.2. The Framework, and the relevant exhibit areas designed to form its stages, are outlined in Figure 18.

Figure 18: Connect Understand Act model, with outline of Tiger Trek design

3.3.2 Western Plains Zoo

Western Plains Zoos’ ‘Tiger Forest’ complex (Figure 19) was opened on 3 April 1998. It consists of two tiger enclosure spaces, laid out almost perpendicular to each other; one space (Tiger Habitat 1 referred to here at the ‘Forest Exhibit’) runs roughly south-west to north-east, and the other (Tiger Habitat 2; the ‘Woodland Exhibit’) roughly north-south. The exhibit complex is extremely open or ‘unbound’, with the exception of the Interpretation Hut which is discussed below.
‘Tiger Forest’
Taronga Western Plains Zoo Dubbo
(not to scale)

Figure 19: Western Plains Zoo 'Tiger Forest' exhibit map (designed by the researcher)
Visitors can arrive at the exhibit complex from three access points. Most visitors enter from the main road (Figure 20; by far the primary way visitors access the exhibit) which situates visitors at the point where the visitor path diverges towards Exhibits 1 and 2, referred to as the Forest Exhibit and the Woodland Exhibit. The Forest Exhibit is also accessible via a footpath from the adjacent gibbon and siamang islands, or from the path that runs around the edge of the hippopotamus exhibit adjacent to the tiger exhibit. Visitors can walk along the visitor paths that stretch the length of both tiger enclosures. There are no interactive elements of the exhibit. The exhibit complex can be experienced as both a linear space (for those who enter from the gibbon/siamang exhibit side) or an orbital space (with the Interpretation Hut at the centre for those who enter from the main path), although this is not an obviously deliberate design choice.

![Figure 20: Main entry to Tiger Forest complex. Source: author](image)

Each tiger exhibit is separated from visitors by a wide water-filled moat and wooden stand-off barrier (Figures 21 and 22). Both exhibits are long, roughly rectangular shapes, planted with grasses, large trees and reeds. During the data collection period for this study, three tigers were in Western Plains Zoo’s collection. Only two tigers were on exhibit per day: one in each exhibit.
Visitor spaces in both exhibits are wide, open dirt paths, bounded by Australian native trees and shrubs to the rear (when facing the tiger enclosures) and the exhibit stand-off barrier (Figure 23). Each exhibit has one basic interpretative sign conveying basic biological information about tigers.
Adjacent to the Forest Exhibit is a small ‘information hut’ displaying large poster-style interpretive signs and photographs (Figures 24 and 25). Unlike the rest of the exhibit, the Interpretation Hut is very enclosed, dark and ‘bound’, and does seem to encourage a quieter contemplation of the information provided on the signage. It is reasonably prominent in the landscape, attracting people to it. However, there are few elements of bonding in the exhibit complex; the complex is mostly evocative of the Australian bush environment, rather than the Sumatran jungle.
In summary, this chapter has presented the context of the conservation challenges facing Sumatran tigers, and introduced the two study sites. Both sites present information about the threats to tigers, and how preferential purchasing of products containing certified sustainable
palm oil can help protect tigers in the wild. However, the two exhibit complexes themselves are designed very differently. The relatively new ‘Tiger Trek’ at Taronga Zoo has been designed using social science principles and some immersive design principles. The result is a naturalistic, somewhat immersive exhibit complex that takes visitors on a ‘journey to Sumatra’ with a series of interactive elements. In contrast, the older ‘Tiger Forest’ at Western Plains Zoo is a more traditionally designed, older exhibit complex typical of the 1990s, displaying tigers in fairly open field-like exhibits, with visitor separated from animals by a large open moat. Information about tiger conservation and palm oil is conveyed on static signage. This study will compare the effectiveness of each exhibit in impacting zoo visitors’ attitudes, perceived behavioural control, cognition, connection and behavioural intention regarding tiger conservation.

The next chapter will present the research design and method used in both of these sites to answer the overarching research questions of this thesis.
4. Research Design and Methodology

4.1 Overview

The preceding chapters outlined the existing research about the role and impact of zoos as informal science education facilities, and the potential for using emotion and connection as a tool to motivate behaviour change. They highlight the gaps in knowledge and research regarding the impact of zoo design on outcomes of behaviour-change campaigns. While there is likely to be an abundance of anecdotal or practice-based knowledge in the field, there is little to no existing published or peer-reviewed research on the role of physical zoo design in contributing to the efficacy of zoo-based behaviour change campaigns. Thus, the methodology for this project is, to the best of the author’s knowledge, novel in the field.

The previous chapter introduced the two research sites studied in this thesis, Taronga Zoo’s Tiger Trek and Western Plains Zoo’s Tiger Forest. The purpose of this chapter is to justify and describe the research design.

This study set out to understand whether zoo exhibit design can impact the efficacy of zoo-based behaviour change campaigns. As noted in section 2.6, this question is answered via a series of research sub-questions:

1. Does visiting tiger exhibits impact visitors’ perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation?
2. What personal factors of the zoo visit have the greatest impact on zoo visitors’ behavioural intentions regarding tiger conservation?
3. What exhibit engagement factors relate to the personal factors that contribute to visitors’ behavioural intentions regarding tiger conservation?
4. What exhibit engagement factors relate to increased sense of connection to tigers?

This chapter begins by outlining the rationale for the design and content of the research methodology for collection of data directly from zoo visitors (visitor surveys), based on existing studies and established survey procedures (section 4.2). It goes on to describe and justify the methodology for collection of observational data on exhibit engagement (section 4.3) and outlines data management procedures (section 4.4). The approach used in statistical
analysis is outlined (section 4.5), and finally the limitations of the method discussed (section 4.6). Section 4.7 summarises this chapter.

4.2 Research methodology

This study has three core components, collectively answering the four research sub-questions. Firstly, zoo visitors were surveyed about their perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation, both directly before and directly after they experienced the exhibit. Visitors who supplied an email address to the researcher were also contacted to participate in an online follow up survey three months after their visit.

Secondly, the visitors involved in the surveys were observed during their time in the exhibits to understand how they engaged with the zoo exhibits. The results of these two elements of the study are analysed and presented separately.

Finally, in the third element of the study, the results of the survey and observational analyses are combined and analysed, to evaluate the relationships between the survey responses and exhibit engagement. Conducting this study at two zoos (as introduced in Chapter 3) allows for comparison of the two sites.

4.2.1 Rationale for data collection methods

As outlined in the previous chapters, research on specific zoo exhibits and the impact of visits to those specific exhibits on visitor conservation behaviours is very limited. Most existing studies look at the impact of whole-zoo visits or multi-zoo visits (e.g. Moss et al., 2014; Moss, Jensen & Gusset, 2015; 2017; Clayton et al., 2017; 2018) or are limited to post-visit surveys. Many studies in this field are also based on broad conservation attitudes or beliefs (e.g. that it is important to conserve animals or biodiversity) rather than on specific, behaviour-based conservation programs like Taronga Zoo’s palm-oil purchasing behaviour campaign. The exceptions include some work from Zoos Victoria (e.g. Clayton et al., 2013; Pearson et al., 2014; Mellish et al., 2016), although those studies do not consider the impact of zoo exhibit design on visitor outcomes. Similarly, Moss et al. (2008) studied visitor engagement with an elephant exhibit but did not examine the impact of that engagement on visitors’ attitudes or the like.
According to Corbetta (2003, p.117):

… if we wish to examine a given social phenomenon… we basically have two ways of
gathering information: observing and asking. While observation is the most direct and
immediate way of studying openly manifested behaviours, the only way we can
explore motivation, attitudes, beliefs, feelings, perceptions and expectations is by
asking.

The techniques involved in this research design address both of Corbetta’s suggested
approaches: asking (surveys) and observing (covert visitor observations). Surveys were used
to collect data from visitors on their attitudes, perceived behavioural control, cognition, and
feeling of connection, all related to tiger conservation. Surveys are an ideal tool for large-
group data collection and measuring variables like those measured in this study (Corbetta,
2003), and flexible tools for gathering a wide range of variables across a cohort (Singleton &
Straits, 2005). In this study, the surveys took the form of a written questionnaire, which was
determined to be the most practical format in which to collect objective data. As the research
context was not experimental, and research subjects were genuinely attending the zoo (rather
than having been invited or paid), it was important that data collection was quick and simple
for people standing in an open-air environment, without imposing too much on people’s time
or enjoyment. It also limited the need for assistance or engagement by the researcher,
maintaining objectivity and reducing the likelihood of inadvertent researcher impact on
results (Corbetta, 2003).

Repeated-measures approaches can control for factors that lead to variability between subjects
and can be powerful tools even with small sample sizes. They are also a simple way of
measuring change over time (Shuttleworth, 2009). As such, repeat measures surveys are
commonly used in social science research (Dunlap, Cortina, Vaslow & Burke, 1996;
Corbetta, 2003; Bakeman, 2005) and in evaluating educational interventions (Crowder &
Hand, 1990). In this study, repeated-measures surveys provided an opportunity to identify a
baseline for 10 measured variables (via a pre-visit survey) which could be meaningfully
compared against results immediately after (immediate post-visit survey) and three months
after the zoo visit (delayed post-visit survey). The survey questions aimed to measure changes
in the reported attitudes, perceived behavioural control, cognition and connection of zoo
visitors before and after their zoo visits.
4.2.2 Survey design

Survey instrument characteristics

The visitor surveys mostly consisted of Likert scale items, on a seven-point scale (strongly disagree to strongly agree). Likert scales are simple and generally quite familiar to the general public, as they are very commonly used (Singleton & Straits, 2005). The Likert scale was developed by Likert (1931), for the assessment of attitudes (Croasmun & Ostrum, 2011). According to Maurer and Pierce (1998), the scale can also be a reliable tool for measuring self-efficacy.

Opinions vary on the preference for a 5-point or 7-point scale, and both are used throughout the literature. Early research suggested that reliability is optimal with a 7-point scale (Symonds, 1924), and Lewis (1993) found stronger t-test correlations in data collected on 7-point scales. Generally, it is agreed that a 7-point scale is at the reaches of the scale’s statistical reliability and value (Croasmun & Ostrum, 2011) and provides a balance between having enough points of discrimination without overwhelming survey respondents with too many options. Due to an expected relatively small survey cohort, the researcher opted for the 7-point scale to allow for finer scale analysis of variation across the cohort. The 7-point scale also facilitated the use of parametric statistical analyses which will be discussed later in this chapter.

Survey statements were all written so that the ‘desirable’ response was at the positive end of the scale. For example, the desired outcome of Taronga Conservation Society’s Sumatran tiger campaign is that zoo visitors feel like they can help protect tigers, so the statement for that measure is ‘I can help protect tigers in the wild’. A stronger degree of agreement with that statement is the desirable response. Maintaining this structure throughout the survey avoided confusion on the scales, although may have had the oppositive effect of making it easier for visitors to consistently provide responses to one side or the other of the scale. On balance, noting this limitation, it was decided that scale consistency and simplicity was preferred. Related questions were grouped together. For example, two questions about connection were grouped together. These approaches are suggested by Corbetta (2003) as ways to improve the usefulness of responses.
From a practical point of view, given that participation in the study required zoo visitors to volunteer their time during their zoo visit, it was decided that the survey should be no longer than two, single-sided A4 pages. This was simple to complete on a standard clipboard and did not require participants to shuffle pages. Page design was also considered – to avoid overcrowding, it was decided that a maximum of ten Likert-scale questions could be asked on each of the pre-visit and immediate post-visit surveys. This limited number of questions also limited the total time required to complete the survey to 2-3 minutes per participant, deemed an acceptably limited intrusion on visitors’ time.

**Survey question content justification**

The main body of the survey instruments contained statements developed to identify self-reported attitudes, perceived behavioural control and behavioural intention. One further statement measured cognition of the educational messages conveyed in the exhibit. These are considered the primary ‘personal factors’ of the visitor experience. This terminology is used throughout this thesis.

To limit the scope of this study, the attitude and perceived behavioural control variables of the Theory of Planned Behaviour were chosen as a focus, leaving aside the third variable, subjective norms. The two exhibits chosen as part of this study do not specifically target subjective norms, and meaningful study on norms would require a longer survey instrument, and a temporally broader social analysis than was practicable in a doctoral program, because it would require analysis of existing and emerging community norms. Finally, it was noted that Taronga Conservation Society Australia was involved in a contemporary research project looking at values and potentially norms in zoo visitor cohorts, and the researcher opted not to duplicate study effort.

Overall, statements were designed to be as specific as possible. Some studies have found that more specific measures (particularly for behavioural intentions) more accurately predict behaviour (e.g. Ajzen, 1989). Where possible or relevant, the statements contained the word ‘tiger’ to focus visitor responses on the target species (and not on other animals they may see during their zoo visit). Consistent references were made to ‘protect[ing] tigers in the wild’ so that it was as clear as possible that the questions related to wild tiger conservation and not the welfare or safety of zoo animals. Further, the word ‘protect’ was selected over ‘conserved’ or
‘preserved’, based on a popular online thesaurus analysis of simpler synonyms for the more technical ‘conservation’ term. With the exception of one statement (statement seven, see explanation below), all repeated-measures questions were asked using identical language on each survey.

A pilot study of the survey and observation portions of the method was carried out at Taronga Zoo several months prior to the actual research being conducted. The pilot study resulted in some minor language adjustments to survey statements. The questions regarding connection to tigers and the natural world were worded ‘I feel a sense of emotional connection’ in the pilot study. The word ‘emotional’ was removed for the main study, as visitor feedback suggested that participants found that this word made it harder for them to answer the question. Despite substantial literature looking at so-described ‘emotional connections’ between zoo visitors and zoo animals, it is possible that people have trouble describing the sense of connection they have with the natural world as ‘emotional’. Emotional connections between humans are generally described as a shared, reciprocated feeling or perception between people (Di Cerbo, undated). These preliminary results suggest that while people seem happy to extend the notion of an emotional connection towards a non-human animal, the idea of a ‘reciprocated’ feeling between people and the natural world may be a step too far for some people.

The word ‘very’ was added to the statement ‘It is [very] important that tigers are protected in the wild’ following the pilot study. This modification was intended to ameliorate some of the ceiling effect (Salkind, 2010) observed in the pilot study, where most participants strongly agreed with the statement.

The pilot study also facilitated refinement of observational methods and data collection sheets. Methods were otherwise as reported for the main study. The data from the pilot study was not included in the larger study dataset.

Many of the survey statements were designed based on previous research, much of which is discussed in this thesis’ literature review. References to statement numbers below correlate with the statement numbers on the pre-visit and immediate post-visit survey.
Cognition question

Although it is well established that cognitive understanding or knowledge of conservation issues does not directly translate to pro-conservation behaviours (Schultz, 2011), most zoo-based studies of conservation attitudes and behaviour (e.g. Ballantyne et al., 2011) seek to identify a baseline measure of visitor knowledge of the issue. Therefore, to align with these existing studies, and to further understand whether there is a cognitive impact of the zoo visit, statement 1 asked visitors how strongly they agreed that they understood the threats to tigers in the wild.

Attitude questions

Based on understanding that an attitude is an “organization of beliefs, feelings, and behavioral tendencies” (Hogg & Vaughan, 2005, p. 150) and thus is personal to the individual, all attitude questions were personalised using ‘I’ statements. Further, attitudes are also considered to be responsive to an attitude object (Fishbein & Ajzen, 1975; Ajzen, 2000), so all attitude questions specified the attitude object (tigers).

Statement 2 was designed to register how strongly visitors agreed that protection of wild tigers was important to them. The premise of zoo-based conservation messaging, and conservation in general, is that conservation of wild animals is extremely important. However, it may be that this does not reflect the attitude in the general community, or even in zoo-going people. It was also hypothesised that visitors who did not strongly agree that protecting tigers was important would not be strongly motivated to take actions to help tigers (nor report an intention to do so). Finally, an understanding of the broad sentiment from the entire visitor cohort about the importance of tiger conservation was considered a useful indicator of visitor engagement with the broader conservation messages of zoos. Statement 3 is described in the following section.

Myers and Saunders (2002) note that connection with animals can be a pathway to developing a relationship with the natural world. On this basis, the question of ‘connection’ was extended to investigating visitors’ relationship with the natural world (statement 4). This is further supported by the work of Schultz (2001; 2011) who found that self-reported connection to nature correlated with an increased likelihood of engagement in conservation behaviours.
Additionally, asking about connection to the natural world provided for the possible examination of the effect of the variable exhibit design styles (immersive and naturalistic at Taronga Zoo, compared to less natural at Western Plains Zoo) on this factor.

Statement 5 was adapted from Grajal et al. 2017 (p. 6), who asked “Do you feel a sense of connection to the animals you see at a zoo/aquarium?”. The authors found that reported sense of connection predicted certainty about climate change occurring, and concern about the impact of climate change. It also predicted a sense of personal efficacy related to personal impact on addressing climate change and self-reported pro-conservation behaviours. While the survey approach in this study required slight language adjustment to focus on tigers specifically, it was considered that it should measure the same factor amongst zoo visitors. Clayton, Fraser and Saunders (2009) also asked whether visitors felt a sense of connection to the animals they had seen, identifying this as an ‘attitudinal item’ on their scale. In the Clayton et al. (2009) study, people who reported a connection to the animal were more likely to report that the animal made them feel happy or interested. Measurement of this factor is also supported by Falk and Gillespie (2009) who identified a role for emotional arousal in learning.

Statement 6 was taken directly from Clayton, Fraser and Saunders’ 2009 study on Conversations, Connections and Concern for Animals, which included it as a measure of attitudes towards protecting the target animal (which varied) and their species. Directly adopting this survey question allowed for comparison of results.

Perceived behavioural control questions

There is no formally established, consistently used format for perceived behavioural control survey questions. In studies using Likert strongly agree-strongly disagree scales, some use simple ‘I can…’ statements (e.g. Paris & Van den Broucke, 2008). Others seek to more deeply understand the features of perceived behavioural control by using statements such as “For me to [perform the behaviour] would not be difficult” or “It is completely up to me whether I [perform the behaviour]” (Kraft, Rise, Sutton & Roysamb, 2005 p. 479). In this study, given the intention to make the survey simple and quick to complete, the simpler, ‘I can…’ language was used for all perceived behavioural control questions.
To establish whether visitors generally felt a general sense of perceived behaviour control about helping protect tigers, a direct question was asked in statement 3. This follows other studies investigating the influence of zoos on pro-environmental behaviour which ask this general question (e.g. Clayton et al., 2017) in an effort to measure the influence of general perceived control (or efficacy) on behavioural intentions and environmental concern.

Building on statement 7 (described in the next section), statement 8 was designed to measure whether zoo visitors agreed that they could influence their family and friends about ways to help protect tigers. It is established that parents can influence their children’s attitudes and behaviours related to environmental issues (Grønhøj & Thøgersen, 2012; Matthies, Selge & Klöckner, 2012; Mead, Roser-Renouf, Rimal, Flora, Maibach & Leiserowitz, 2012). The Theory of Planned Behaviour (Ajzen, 1991) posits that social norms influence behavioural intention (although this study does not directly examine social norms). As only a small subset of the global community visits zoos, one potential way that people who do not attend a zoo may be impacted to change their behaviours in favour of wildlife is through being influenced by family and friends. Therefore, it was considered useful to understand whether visitors thought that they had an ability to influence others regarding tiger conservation and whether the zoo visit could impact this perceived ability.

Statement 9 is novel to this study and is designed to measure any change in visitor perceived behavioural control in ability to speak directly with companies about palm oil following their zoo visit. This statement was selected as the Taronga Conservation Society Australia’s Behaviour Outcomes Framework (Taronga Conservation Society Australia, 2017) identifies visitor requests to companies about sustainable palm oil products as a key visitor behaviour outcome. The Supermarket in Tiger Trek facilitates this behaviour, by allowing visitors to email companies directly from the supermarket carts, although there is no such option at Western Plains Zoo. Measurement of this item will allow measurement of the success of the Supermarket in achieving its intended impact. It may also identify a role for more traditional sign-based interpretation, based on outcomes at Western Plains Zoo for this factor.

The ability of visitors to help protect tigers by altering the products they purchase is the central message of both tiger exhibits. Accordingly, statement 10 seeks to understand whether visitors feel a sense of control about making product purchases that help protect tigers in the wild. However, it is necessarily vague about the target behaviour (i.e. it omits the specificity
about palm-oil containing products) in order to minimise priming in the pre-visit survey. Responses to this statement indicate a shift in perceived behavioural control specific to the target behaviour but may also indicate an enhanced or new cognitive understanding of the way in which people can help protect tigers in their daily lives.

*Behaviour and Intention questions*

Statement 7 was inspired by a study by Clayton et al. (2014) on the role of connection to nature on behaviour in response to climate change. Clayton and colleagues investigated ‘talking to others about the importance of addressing climate change’ as a key behaviour in addressing climate change. Considering that zoo visits are considered social experiences (Pekarik, Doering and Karns, 1999; Fraser & Sickler, 2009) statement 7 sought to understand whether visitors talked to their friends and family about behaviours that would help conserve tigers. Uniquely amongst the main-body survey items, this statement was modified between the pre-visit and immediate post-visit study. This facilitated a comparison between the baseline of people who report that they already speak to their friends and family about tiger conservation behaviours before their visit and people who reported an intention to do so after their visit.

Finally, statement 11 is a simple measure of behavioural intention, based on the Taronga Conservation Society Behaviour Outcomes Framework outcome that ‘visitors indicate an intention to make sustainable palm oil product choices’. This statement was included on the immediate post-visit survey but was not asked on the pre-visit survey. If this question had been included on the pre-visit survey, it could have primed visitors to focus on the issue of palm-oil product purchasing behaviour. This may have resulted in an increased likelihood that visitors would pay attention to the messaging in the exhibit (Moss et al., 2015; Hjortskov, 2017) and undermined the ability of the survey to register the impact of the zoo visit on this behavioural intention.

*Delayed post-visit study questions*

The ability to do longitudinal research on zoo visitors is limited and as such it is relatively uncommon. Three questions were modified on the delayed post-visit survey to determine
whether the visitors had performed the behaviours targeted by the exhibit messaging (questions seven, nine and ten). Responses were yes or no. This was intended to facilitate analysis of whether reported intention or perceived behavioural control directly after the zoo visit translated to actual (or least reported) behaviour three months later. One additional question (question three) was added to the delayed post-visit survey to measure cognitive retention of the messages conveyed in the exhibit. Questions 2 and 11 were not asked on the delayed post-visit survey. Question 11 was omitted because it was designed to measure intention at the immediate post-visit stage to make more sustainable palm oil product choices (and was therefore not required at the delayed post-visit stage). Instead, visitors were asked whether they had undertaken this behaviour since their zoo visit. Question 2 was omitted to limit the length of the delayed post-visit survey.

Table 3 outlines the questions asked via surveys. The survey instruments are reproduced in full in Appendices B, C and D.
Table 3: Survey statements asked on the pre-visit, immediate post-visit and delayed post-visit surveys.

Unless otherwise indicated, responses to statements are given on 7-point Likert scale. ✔ indicates that the statement was included on that survey instrument.

* = question edited in actual survey to include the name of the zoo the visitor was surveyed.

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<tr>
<th>Survey Statement</th>
<th>Pre-visit Survey</th>
<th>Immediate Post-visit Survey</th>
<th>Delayed Post-Visit Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I understand the threats to tigers in the wild</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>2. It is very important that tigers are protected in the wild</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>3. I can help protect tigers in the wild</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>4. I feel a sense of connection to the natural world</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>5. I feel a sense of connection to tigers</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>6. If I could, I would like to do something to protect tigers in the wild</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>7. I speak to my friends/family about what they can do to help protect tigers in the wild</td>
<td>✔</td>
<td>I intend to speak to my friends/family about what they can do to help protect tigers in the wild.</td>
<td>Have you spoken to friends/family about what they can do to help tigers in the wild since your visit to [zoo]*? (Yes/No)</td>
</tr>
<tr>
<td>8. I can influence my friends/family about what they can do to help protect tigers in the wild</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>9. I can speak directly with companies about the impact their products have on wildlife</td>
<td>✔</td>
<td>✔</td>
<td>Have you spoken directly to companies about the impact their products have on tigers in the wild since your visit to [zoo]*? (Yes/No)</td>
</tr>
<tr>
<td>10. I can make product purchases that help protect tigers in the wild</td>
<td>✔</td>
<td>✔</td>
<td>Have you made more sustainable palm oil-containing product choices since your visit to [zoo]*? (Yes/No)</td>
</tr>
<tr>
<td>11. I intend to make more sustainable palm oil product choices in the future</td>
<td>-</td>
<td>✔</td>
<td>-</td>
</tr>
</tbody>
</table>
Multiple choice questions

The pre-visit and immediate post-visit surveys also included several multiple-choice questions (Table 4) which sought to gather information about the visitor regarding the motivation for their zoo visit, the social group they were part of that day, how the exhibit made them feel, and their demographic information.

Table 4: Multiple choice questions on the pre-visit and immediate post-visit surveys

<table>
<thead>
<tr>
<th>Pre-Visit Survey</th>
<th>Immediate Post-visit survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why did you visit the zoo today (Select all that apply)?</td>
<td>What is your age?</td>
</tr>
<tr>
<td>• Entertainment/recreation,</td>
<td>• 18-25</td>
</tr>
<tr>
<td>• Social occasion,</td>
<td>• 26-35</td>
</tr>
<tr>
<td>• Education/learning,</td>
<td>• 36-45</td>
</tr>
<tr>
<td>• Other (free text)</td>
<td>• 46-55</td>
</tr>
<tr>
<td></td>
<td>• 55+</td>
</tr>
<tr>
<td></td>
<td>The tiger exhibit made me feel (select all that apply):</td>
</tr>
<tr>
<td></td>
<td>• Relaxed</td>
</tr>
<tr>
<td></td>
<td>• Tense</td>
</tr>
<tr>
<td></td>
<td>• Happy</td>
</tr>
<tr>
<td></td>
<td>• Sad</td>
</tr>
<tr>
<td></td>
<td>• Interested</td>
</tr>
<tr>
<td></td>
<td>• Bored</td>
</tr>
<tr>
<td>Who are you with at the zoo today?</td>
<td>What is your gender?</td>
</tr>
<tr>
<td>• Family group including children</td>
<td>• Female</td>
</tr>
<tr>
<td>• Family group not including children</td>
<td>• Male</td>
</tr>
<tr>
<td>• Friends/other</td>
<td>• Other</td>
</tr>
<tr>
<td>• Alone</td>
<td></td>
</tr>
<tr>
<td>Where do you live most of the time?</td>
<td>Did you see a tiger in the exhibit today?</td>
</tr>
<tr>
<td>• In Australia</td>
<td>• Yes</td>
</tr>
<tr>
<td>• Overseas</td>
<td>• No</td>
</tr>
</tbody>
</table>

In addition to asking visitors whether they saw a tiger at all during their visit, data on tiger visibility at each zone in the exhibit was collected by the researcher in the visitor observations (section 4.3).

4.3 Data collection procedures

4.3.1 Surveys

Research was conducted in accordance with Australian National University Human Research Ethics Committee approval (protocol 2017/925).

Paper-based surveys were deployed to zoo visitors immediately before they entered the target exhibit (‘pre-visit survey’), and immediately after (‘immediate post-visit survey’). The same visitor was covertly observed during their time in the exhibit. Only visitors who completed at
least the pre-visit survey, covert observation and immediate post-visit stages were included in the analyses in this thesis. Some of those visitors also completed the ‘delayed-post visit’ stage (detailed below). Surveys and covert observations were completed entirely by the primary researcher.

At both zoo sites, data collection typically did not start until after 10:30am and continued until 4-5pm. Both zoo exhibits are located some distance from the zoo entrance, and as such visitors typically took at least one hour after the zoo opening time (9:30am at Taronga Zoo, 9am at Western Plains Zoo) to make their way there. During the pilot study, it was noted that if any fewer than 15 adults were present in the Taronga Zoo exhibit, the researcher was more noticeable, and the covert nature of the observations could be undermined. Therefore, data collection at Taronga Zoo did not begin until there were at least 15 adults present in the queue at the exhibit entrance and ceased at any point during the day if numbers fell below this threshold.

No maximum sample size was set, although sample size was constrained by presence of suitable candidates for recruitment, visitor numbers, how long visitors chose to stay in the exhibit, and hours of operation of the zoos. In turn, these factors were impacted by weather, day of the week and whether the day was in the school holidays or not. Data collection occurred between 17 September and 13 October 2018 at Taronga Zoo and between 4 and 19 November 2018 at Western Plains Zoo. Project budget (for accommodation) and availability of leave from paid employment limited the length of time the researcher was able to spend at Western Plains Zoo.

Recruitment of participants

Only adults were approached to participate in the project. If age was not clear, the researcher politely asked the potential participant if they were over 18 years of age. Participation was voluntary at all stages. A participant information sheet was distributed to all participants (Appendix E). For the pre-visit and immediate post-visit survey stages, the researcher sought the visitors’ consent to participate in the study before handing the participant a clipboard and pen, along with a project information sheet as required by ethics approvals. Visitors were left to complete their survey and the researcher returned several minutes later to collect it.

The recruitment process at Taronga Zoo involved approaching potential participants while they waited in line to enter Tiger Trek. This is a normal part of the experience, as visitors enter the exhibit in groups several minutes apart. Potential survey participants were identified randomly. A number (n) between 1 and 6 was selected each day by roll of a dice. Each nth
visitor was approached to ask to participate in the survey; if visitor ‘n’ refused, the researcher approached each successive visitor thereafter.

The recruitment process at Western Plains Zoo involved approaching visitors as they approached the target exhibit, whenever practicable (i.e. researcher was not occupied with another visitor). Visitor numbers at Western Plains Zoo are significantly smaller and visitors typically arrived in small groups. Visitors arrived at the exhibit randomly with no influence from the researcher, so this approach still maintained the randomness of recruits.

To minimise disruption to carers, groups that appeared to have more children than adults were excluded, as were adults holding/restraining children or physically assisting another person with their mobility. People with obvious physical incapacities that would inhibit them safely completing a paper-based survey (e.g. crutches, using walking frame, significantly vision-impaired) were not approached. Participants at Western Plains Zoo who were riding bicycles were asked to dismount before completing the survey. A written introduction to the survey was on hand for people with hearing-based disabilities (or anyone else) who opted to read the introductory spiel, although this was not used.

At Taronga Zoo, approximately 10 visitors were surveyed and observed per day. A total of 207 participants were approached on 22 days over a four-week period. Seven visitors refused to participate when approached, leaving a total of 200 participants. At Western Plains Zoo, between five and 12 visitors were surveyed and observed per day dependent on weather conditions and visitor numbers. A total of 103 participants were surveyed and covertly observed on 14 days over a two-week period. No visitors refused to participate, and three visitors did not correctly complete the immediate post-visit survey. Results from these incomplete participants were not included in the final analyses.

Eighty-eight visitors attended the exhibit only, and twelve also attended the keeper talk. Visitors who also attended the keeper talk were removed from the main analysis, as the impact of keeper talks is not the focus of this study. Further, the talk was hypothesised to influence visitors’ survey responses in addition to the impact of the exhibit itself, which is the focus of this study. This was confirmed by a brief preliminary analysis, not included in this thesis. The analysis, although using only a small cohort of 12 visitors, demonstrated that visitors who attended the keeper talk had higher mean immediate post-visit survey responses (that is, they more strongly agreed with the statement) on seven of the 11 survey questions, including those related to desire to help tigers, connection to natures and tiger, and ability and intention to make more sustainable product purchases. These small scale findings justified the
exclusion of these results to ensure, as far as possible, the impact of the exhibit is the only factor being analysed. The final cohort for Western Plains Zoo is therefore 88 participants.

Participant numbers represent very small relative proportions of total annual visitors to each property - 0.01% of Taronga Zoo visitors and 0.04% of Western Plains Zoo visitors, based on 2017-18 visitor numbers (Taronga Conservation Society, 2018). However, a review of the literature reveals that similar studies recorded survey participation in the order of 250-400 participants across multiple sites (e.g. Saunders et al., 1997; Adelman et al., 2000; Swanagan, 2000; Dierking et al., 2004; Clayton et al., 2018) which is comparable to this study which had 288 included participants.

A small incentive (a chance to win an AU$100 gift card) was offered for survey participants who provided their email address to allow the investigator to administer the delayed post-visit online survey. Another identical incentive was offered for those participants who completed and submitted the delayed post-visit online survey. Small incentives appear to increase recruitment in surveys (Church, 1993; Hawley, Cook and Jensen-Doss, 2009). The prizes were purchased by the primary investigator and sent to selected participants in February 2019 after all survey data was collected.

Survey participants who had provided their email addresses during the immediate post-visit survey were all included in the recruited cohort for the delayed post-visit survey. For Taronga Zoo, this was 81 participants, representing 40.5% of total visitors surveyed at the pre-visit and immediate post-visit stage. For Western Plains Zoo, n=37, representing 37% of total visitors surveyed. The delayed post-visit survey was conducted online and took approximately five minutes. Participants were emailed the survey link approximately 12 weeks after their visit and were given between two and three weeks to complete the survey. In the email inviting their participation in the online survey, participants were provided a unique code number assigned to them. Participants were instructed to use this code to answer a final administrative question on the online survey. This allowed their responses to the delayed online survey to be associated with the responses to those given during the two on-site surveys.

Of the Taronga Zoo cohort that was emailed the survey invitation, 46 people completed the delayed post-visit survey, representing 23% of the total participant cohort. Of the Western Plains Zoo cohort, 19 completed the survey. Two of those responses came from visitors who had attended the keeper talk and were eliminated (see explanation above and in section 4.4). The remaining 17 were from visitors who attended the exhibit only (representing 19.3% of that cohort).
4.3.2 Covert observations

Covert or unobtrusive visitor tracking studies, often called “timing and tracking” studies (Yalowitz & Bronnenkant, 2009 p. 47), are frequently employed in public institutions such as museums to provide quantitative behavioural data while minimising the impact of the researchers on visitor behaviour. This approach has been used in previous zoo visitor studies (e.g. Moss et al., 2008). Covert observations avoid researcher interference with the visitor’s exhibit engagement (Therkelsen & Lottrup, 2015). Yalowitz & Bronnenkant (2009, p. 47) call observational measures a “staple of visitor studies”. Further, they say that “visitor behavior is… routinely investigated, both as part of an overall approach to evaluating an exhibition, or as an important focus of research in its own right” (p. 48).

The variables recorded in observational studies are frequently divided into four categories (Serrell, 1998; Yalowitz & Bronnenkant, 2009):

- Stopping behaviours (e.g. timing of a stop, number of stops, number of people who stop at a certain area)
- Other behaviours (e.g. social interactions, using interactive elements)
- Demographics (e.g. age, number in group, gender)
- Situational variables (e.g. date and time, degree of crowding, presence of staff).

Covert observations were used to record how visitors who had completed the pre-visit survey engaged with the zoo exhibit complex. Visitors were covertly observed for the duration of their time in the exhibit complex. Only one person was observed at a time.

Maintaining the covert nature of the observations was an important ethical factor of the study. The Australian National University Human Research Ethics Committee agreed that the use of covert observations was legitimate in this study, on the condition that they were truly covert. To ensure that the covert nature of the observations was maintained, the researcher used various techniques to conceal themselves from visitors, including using vantage points in other parts of the exhibit complexes. These techniques were employed on a case-by-case basis dependent on the target visitor’s behaviour in the exhibit. No target visitor at either zoo site indicated to the researcher that they suspected they were being observed.

Data was collected on observation sheets about whether a visitor stopped at a particular zone (zones described in Section 4.3.3), (yes/no). A stop was defined as per Serrell (1998 p.12): “a visitor’s stopping with … head or eyes pointed in the direction of the element for two to three seconds or more”. Data was also collected on how long they stopped/dwelled in a zone.
‘dwell time’, recorded in seconds to the nearest five seconds). The researcher noted whether they interacted with any element of that zone e.g. read a sign (yes/no) and whether they appeared to see a tiger from their position in that zone (yes/no). What constituted an ‘interaction’ with the major interactive elements of the Tiger Trek exhibit (village motorbikes, ranger vehicle, supermarket carts) were clearly defined before observations commenced. If a study participant showed a child how to ‘drive’ the motorbike, or commented directly about the motorbike, they were recorded as engaging with that element. If a study participant entered the Ranger Vehicle themselves or commented directly on it, they were recorded as engaging with it. Photographing the vehicle or helping a child into it were not recorded as interactions. Participants were recorded as engaging with the supermarket carts if they used the interactive screens themselves, or significantly assisted another to use them (including discussing things that were on the screen, reading form the screen, or encouraging another person to select products or send an email). Visitors did not need to climb into the Ranger Vehicle to be recorded as within that zone. Visitors who were within 1m of the Ranger Vehicle and/or supervising or engaging with other people in the Ranger Vehicle were recorded as being in that zone.

The visibility of animals, particularly in naturalistic zoo exhibits, can be a complex design consideration. Designers must balance the needs of the animals (potentially to be less visible) with the desire of visitors to see animals (Davey, 2006). Attitudes are responsive to an attitude object (Ajzen, 2000) and zoos can facilitate the emotional connection with animals required for successful science learning by physically displaying animals (Bell et al., 2009; Barongi et al., 2015). Therefore, the visibility of tigers to visitors in this study was considered an important exhibit engagement factor to measure.

Total dwell time in the entire exhibit complex was also recorded in minutes by recording the time the visitor entered the exhibit and the time when they departed. Information was also recorded on date, weather, type of day (weekday, weekend, school holiday, public holiday), whether a zoo docent was present in the exhibit and whether the visitor interacted with the docent.

A copy of the observation sheets is included in Appendix F.
4.3.3 Exhibit zones

*Taronga Zoo*

The Taronga Zoo exhibit complex was designated into 19 discrete zones (Figure 26, Table 5), and the Western Plains Zoo exhibit (Figure 27, Table 6) into seven zones. Visitor observation studies routinely designate zones (or similar) to allow for analysis of engagement with particular elements of a larger exhibit, or to study patterns of movement (e.g. Serrell, 1997; Moss et al., 2008; Yalowitz & Bronnenkant, 2009).

Zone boundaries were generally determined based on the physical features of a space – for example, a ‘cave’ off the main path of the exhibit, containing a viewing window into Taronga Zoo’s Tiger Habitat 1 was considered a discrete zone. Other areas were determined based on their relative location to an exhibit – for example, the path that runs alongside Tiger Habitat 1 at Taronga Zoo was divided into three zones: inbound path, main viewing window, and outbound path. These zones are clearly delineated by the Covered Bridge feature over the main viewing window (see description in section 3.3.1).

Where a visitor space was uninterrupted by physical features, such as the main viewing areas for both tiger exhibits at Western Plains Zoo, the areas were broken into multiple zones based on the entry and exit points of the space. For example, the visitor space along the path facing Tiger Habitat 1 at Western Plains Zoo was separated into three roughly equally sized zones. Visitors were observed to access these zones by separate entrance points: Zone 1 by the access point from the adjacent gibbon and siamang islands, and Zone 2 from the path that runs around the edge of the hippopotamus exhibit adjacent to the tiger exhibit. These access points are more clearly described in section 3.3.2.
Figure 26: Taronga Zoo ‘Tiger Trek’ exhibit complex map showing exhibit zones.
Table 5: Taronga Zoo exhibit complex zones and description

<table>
<thead>
<tr>
<th>Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Plane – Cockpit door (video screen, plays during ‘flight’)</td>
</tr>
<tr>
<td>1B</td>
<td>Plane windows (video screens, play during ‘flight’)</td>
</tr>
<tr>
<td>2A</td>
<td>Village – shopfronts</td>
</tr>
<tr>
<td>2B</td>
<td>Village – motorbikes</td>
</tr>
<tr>
<td>2C</td>
<td>Ranger Hut/ Way Kambas National Park Gate</td>
</tr>
<tr>
<td>3A</td>
<td>Inbound path to Tiger Habitat 1</td>
</tr>
<tr>
<td>3B</td>
<td>Cave viewing window, Tiger Habitat 1</td>
</tr>
<tr>
<td>4A</td>
<td>Inbound path from Tiger Habitat 1</td>
</tr>
<tr>
<td>4B</td>
<td>Covered Bridge, Tiger Habitat 1 main viewing window</td>
</tr>
<tr>
<td>4C</td>
<td>Outbound path to of Tiger Habitat 1</td>
</tr>
<tr>
<td>5A</td>
<td>Ranger Station Tiger Habitat 2 - main viewing window</td>
</tr>
<tr>
<td>5B</td>
<td>Ranger Station Tiger Habitat 2 – Ranger Vehicle</td>
</tr>
<tr>
<td>5C</td>
<td>Ranger Station Tiger Habitat 2 – Video Screen</td>
</tr>
<tr>
<td>6A</td>
<td>Inbound Path Tiger Habitat 3</td>
</tr>
<tr>
<td>6B</td>
<td>Tiger Habitat 3 Viewing Window 1 and adjacent path</td>
</tr>
<tr>
<td>6C</td>
<td>Tiger Habitat 3 Viewing Window 2 and adjacent path</td>
</tr>
<tr>
<td>6D</td>
<td>Outbound path to of Tiger Habitat 3</td>
</tr>
<tr>
<td>7A</td>
<td>Supermarket – ‘shopping carts’ – interactive tablet screens (Left hand side of room)</td>
</tr>
<tr>
<td>7B</td>
<td>Supermarket – Posters of Foods and Supermarkets products containing palm oil; and ‘Hero Board’</td>
</tr>
</tbody>
</table>
Figure 27: Western Plains Zoo ‘Tiger Forest’ exhibit complex map showing exhibit zones.
Table 6: Western Plains Zoo exhibit complex zones and description

<table>
<thead>
<tr>
<th>Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forest Exhibit visitor viewing area (distal to main entrance)</td>
</tr>
<tr>
<td>2</td>
<td>Forest Exhibit visitor viewing area (middle)</td>
</tr>
<tr>
<td>3</td>
<td>Forest Exhibit visitor viewing area (proximal to main entrance)</td>
</tr>
<tr>
<td>4</td>
<td>Information Hut</td>
</tr>
<tr>
<td>5</td>
<td>Path between Tiger Habitats 1 and 2</td>
</tr>
<tr>
<td>6</td>
<td>Woodland Exhibit visitor viewing area (proximal to entrance)</td>
</tr>
<tr>
<td>7</td>
<td>Woodland Exhibit visitor viewing area (distal to entrance)</td>
</tr>
</tbody>
</table>

4.4 Data management

All survey and observational data were transposed manually from paper data sheets to a Microsoft Excel spreadsheet. Each target visitor was assigned an alpha-numeric code, based on the zoo they visited (TZ for Taronga Zoo, WZ for Western Plains Zoo). Responses to the delayed post-visit survey were exported from the Survey Monkey survey platform to an Excel spreadsheet.

Responses on the Likert scale statements were coded numerically, with ‘strongly disagree’ equalling one, and ‘strongly agree’ equalling seven. ‘Yes’ responses on the surveys or for observation data were allocated a value of two, and ‘no’ a value of one. Other survey responses (e.g. motivation for zoo visit, demographic information) were also numerically coded and codes recorded in an Excel codebook (Appendix A). The length of time that visitors stopped at each zone was entered into the database to the closest five seconds. The date of the survey/observation start and end times, type of day (e.g. school holiday, weekday) and general weather observations were also added during data input.

Before analysis, data from Western Plains Zoo were divided into two groups: those visitors who attended the exhibit and watched/listened to the daily keeper presentation (n=12) and those that attended the exhibit and did not see/hear the keeper presentation (n=88). The keeper presentation is an informal 6-16 minute talk from a tiger keeper, held at 12:10pm daily. The presentations varied in content by keeper, but generally covered basic tiger biology and threats in the wild and detailed the names and ages of the tigers held at Western Plains Zoo.
4.5 Data processing and statistical analyses

Once data collection and transposition were complete for each site, all data was copied into two datasets in SPSS v.25 (one for each zoo site). All quantitative analyses were conducted in SPSS except where otherwise noted. The following analyses were conducted and reported for Taronga Zoo and Western Plains Zoo separately unless otherwise stated.

Statistical analyses sought to understand whether there was a measurable impact of the zoo visits on the personal factors (as reported on the surveys). Further, analysis sought to understand which of these personal factors contributed significantly to visitor behavioural intention to make more sustainable palm oil product purchases in the future. Finally, analyses were conducted to determine whether any factors of exhibit engagement related to an observed change in the personal factors that contributed to behavioural intention.

4.5.1 Personal factors

Impact of the zoo visit

‘Shift scores’ for all repeated-measures items (numerical degree of change between pre-visit, immediate post-visit and delayed post-visit surveys) were calculated in Excel. For example, if a participant answered ‘mostly agree’ on the pre-visit survey (which had a value of six on the Likert scale) and ‘strongly agree’ on the immediate post-visit survey (seven on the scale) then their ‘shift score’ was equal to one. The results were transposed into the SPSS datasets to be used in later analyses.

Survey data was then analysed with paired-samples t-tests. T-tests showed the change in scores for the same person at each survey stage. A test between the pre-visit and immediate post-visit surveys showed the change immediately following the zoo visit, compared to the baseline score at the pre-visit survey point. Given its immediacy, this could be most directly attributed to the impact of the visitor’s time in the exhibit that day. A test between the immediate post-visit and delayed post-visit showed any change over the three-month period between the zoo visit and the delayed survey, which could be attributed to external (non-zoo) effects that could be separate to or compound to the effect of the zoo visit. Finally, a test between the pre-visit and delayed post-visit surveys showed the overall change in visitors to the zoos, three months after their visit, which again could be a combination of zoo and non-zoo effects. Effect size (Cohen’s d) was calculated for significant results and categorised
using Cohen’s (1988) criteria for effect size (0.1 = small effect, 0.3 = moderate effect, >0.5 = large effect).

Two final direct analyses of survey responses looked at

1. whether reported behavioural intention to make more sustainable palm oil product choices in the future (immediate post-visit survey) resulted in actual behavioural outcomes reported on the delayed post-visit survey; and
2. whether perceived behavioural control about being able to make these purchases directly predicted actual behaviour.

Participants were grouped based on whether they reported that they had made more sustainable palm oil choices since their zoo visit (‘yes’ group) and those that hadn’t (‘no’ group). Independent-samples t-tests were conducted on the two groups.

**Personal factors that contribute to behavioural intention**

Having established the impact of the zoo visits on the personal factors measured in the visitor surveys, multiple regression sought to identify the key personal factors (independent variables) that contribute significantly to reported behavioural intention about sustainable palm oil product purchases (dependent variable).

Personal factors included responses to the immediate post-visit survey, ‘shift score’ between the pre-visit and immediate post-visit survey and demographic information (age, gender, motivation for zoo visit, group type and country of primary residence). Preliminary basic correlation analysis was used to eliminate personal factors uncorrelated (or less strongly correlated) with behavioural intention. Total dwell time in the exhibit was also included in the preliminary analyses.

The coefficient of determination from these correlation analyses explains how much variance in the dependent variable is explained by the independent variables. To limit analysis to the most highly correlated variables, variables with a coefficient of determination of 0.3 (indicating that 30% of variance is explained) or less were excluded from further analysis (approximately 30% of variance is described in Pallant, (2016. p. 216), as a “respectable amount of variance”). This also brought the ratio of cases (participants) to independent variables to within recommended thresholds based on sample size (Tabachnick & Fidell, 2013; Pituch & Stevens, 2016). These sources recommend that the minimum number of participants required for this analysis be greater than 50+8m, where m=number of variables.
included in the analysis (Tabachnick & Fidell, 2013 p. 123). For Tarongan Zoo, the recommended minimum number of participants is 98 (which is less than the actual sample size of 200). For Western Plains Zoo the recommended number of participants is 74, less than the actual sample size of 88. Therefore, the sample sizes for both zoo cohorts are appropriate.

An initial multiple regression was run using the significantly correlated variables (six for Tarongan Zoo, three for Western Plains Zoo). Residual scatterplots and normal probability plots were examined to ensure the normal assumptions (linearity, normality and homoscedasticity) of multiple regression were met (Tabachnick & Fidell, 2013; Pallant, 2016). No substantial multicollinearity (bivariate covariate of correlation above 0.7 between variables; threshold advised in Pallant, 2016) was observed as highly correlated personal factors were eliminated in the preliminary analysis discussed above.

R-squared values indicated how much of the variation in behavioural intention could be explained by the personal factors retained in the model. Beta-coefficients indicated how much each independent variable contributed to the model, and hence which personal factors are predictors of behavioural intention. This initial regression was used to identify independent variables that did not significantly contribute to the variation in the dependent variable. These variables were eliminated, and one further multiple regression run to identify a model in which all independent variables significantly contribute to the variation in the dependent variable. The key personal factor variables in the second model were retained as the basis for the remainder of the statistical analyses in this study, which looked at relationships between exhibit engagement and key personal factors that contribute to behavioural intention.

4.5.2 Exhibit engagement

Initial analyses were conducted to look at patterns of overall dwell time in each exhibit complex. Dwell time was categorised into five minute blocks (zero to four minutes and 59 seconds, five to nine minutes and 59 seconds etc.) and the number of participants in each block displayed on a bar graph to show frequency of dwell time.

At this stage, the two zones inside the plane at Tarongan Zoo (1A and 1B) were excluded from further analysis. All participants in the study stayed in the plane for the same period of time, as guests are moved from the waiting queue outside the exhibit complex into the plane area and not released into the exhibit until after the ‘plane flight’ simulation has been completed. Most guests stood and watched the ‘window’ video screens which showed the ‘view from the plane’ or ‘cockpit door’ video screen but did not engage with other elements of the space. An
analysis of the impact of this zone would require an experimental methodology, with, for example, some participants taking the ‘plane flight’ and some not. This was not possible in this study and would potentially be complex from a visitor management perspective.

Examination of the observational data on visitor engagement with all the remaining 17 exhibit complex zones at Taronga Zoo and seven at Western Plains Zoo (recalling that the rationale for designation of zones is described in section 4.3.3) would not allow for an in-depth analysis of exhibit engagement. It was further hypothesised that the more popular or engaging zones of the exhibit would contain a range of typically used exhibit design elements (such as large windows or other viewing areas, or interactive elements). As this study aimed to understand the impact of exhibit engagement on the efficacy of behaviour change campaigns, it was hypothesised it would be efficient to focus on these areas and design elements (rather than, for example, a basic path only used to move between more engaging exhibit zones).

Therefore, it was determined that a number of focal exhibit zones would need to be identified, on which the remaining analyses would focus.

To identify these ‘focal zones’, a ‘Focal Zone Score’ was calculated.

For each zone, the following were calculated:

1. cumulative dwell time for all visitors at that zone (seconds);
2. number of visitors that stopped at the zone (‘attraction power’ per Serrell, 1998); and
3. average duration of the stop (‘holding power’ per Serrell, 1998) (seconds).

Each zone was ranked from largest to smallest for each of the above criteria, and assigned a rank score. These rank scores were added together to form the ‘Focal Zone Score’ for each zone. The zones were then ranked from largest Focal Zone Score to smallest. The Focal Zone analysis is reported in section 5.3.2.

Initially it was planned to take the zones that ranked in the top 20% of zones as focal zones for both zoos. This resulted in four Taronga Zoo zones being retained for further analysis, which was determined to provide a sufficient range of exhibit design styles and elements. However, this approach would have resulted in only three focal zones being selected for Western Plains Zoo and would have eliminated the sole major information source in the exhibit complex (the Interpretation Hut). Therefore, the top five zones were retained from Western Plains Zoo, representing zones that scored in the top 50% of zones on the Focal Zone Score.
Heat maps for each exhibit were then developed, including all zones. Heat maps are commonly used by museums and science centres to visually display the variance in engagement, patronage, or dwell time in a space such as an exhibit or building (Friendly, 2009; Yalowitz & Bronnenkant, 2009; Zenko, 2018). Mechanisms vary for indicating differences between these factors, but colouration (as used here) or patterning of spaces are commonly used. When colours are used, a scale from red (‘hot’ – most engaging) through orange (‘moderate) to green (‘cool’ – least engaging) is often used.

Engagement with these focal zones, combined with the key personal factors identified as contributing to behavioural intention, formed the basis of the next phase of analysis.

4.5.3 Relationship between personal and exhibit engagement factors

This series of analyses sought to identify relationships between exhibit engagement, and the key personal factors that contribute to behavioural intention (reflecting on the theoretical pathway illustrated in Figure 4 in section 2.6). Separately, the same analyses were run on reported sense of connection to tigers. Although connection to tigers was earlier excluded as a key personal factor predicting behavioural intention emotional connection has been established (see section 2.3.4) as a key factor in informal science learning. Zoos routinely identify ‘connection with animals’ as one of their key strategies for affecting attitudes towards conservation. Therefore, in order to explore whether a visit to Taronga Zoo or Western Plains Zoo can affect connection to tigers, it was considered reasonable to pursue this personal factor as well, separately to the other analyses.

Both the immediate post-visit survey scores and the shift scores for each key personal factor and connection to tigers was included in each of the following analyses. This was designed to assist in identifying whether the immediate post-visit score itself, or the degree of change reported by the participant was more significantly associated with the exhibit engagement. Behavioural intention (response to the survey statement ‘I intend to make more sustainable palm oil product choices in the future’ on the immediate post-visit survey) was also included, to identify any direct relationship between exhibit engagement and behavioural intention.

Pearson product-moment correlations were undertaken to identify relationships between total dwell time in the exhibit (the time between entering the exhibit complex and leaving) and the personal factors. The coefficient of determination was calculated for significant results, to show how much variance the two variables share. In other words, how much of the variance
in the personal factors is explained by dwell time at the focal zones. Percentage variance can be calculated by multiplying the coefficient of determination ($r^2$) by 100.

A series of independent-samples t-test were conducted to identify whether there was a relationship between the key personal factors (or reported connection to tigers) and stopping at the Focal Zones in each exhibit. As in earlier analyses, effect size (Cohen’s $d$) was calculated for significant results.

A series of Pearson product-moment correlations were undertaken to identify relationships between dwell time at the focal zones and the personal factors (or reported connection to tigers). The coefficient of determination was calculated for significant results.

An analysis of the relationship between seeing a tiger at the hot zones of the exhibit was only possible for Taronga Zoo, as all visitors ($n=88$) to Western Plains Zoo saw a tiger in at least one exhibit. Tigers could only be seen from three of the four Taronga Zoo focal zones: The Covered Bridge, Ranger Station, and Ranger Vehicle. A series of independent-samples t-test for difference between groups (visitors who saw a tiger from the focal zone vs did not see a tiger from this zone) was conducted to determine if seeing a tiger at the focal zone was related to the personal factors (or reported connection to tigers). Effect size was calculated to show the magnitude of the relationship. This test was intended to help understand the relationship between zoo exhibit design and the personal factors; the different zones had different design elements and features, and any findings may support design recommendations. For example, if a space with large windows or an interactive element was more strongly related to increased perceived behavioural control, it could be suggested that zoos use these design elements in their exhibit complexes.

4.6 Limitations and affordances of the methodology

There are a number of limitations to this methodology, which relate to the data collection approach, sample size, subject matter, and focus of analysis. Broadly, this study can only be presented as a two-site case study. While there is a reasonable justification for this approach, and the ability to control for between-organisation variation is definitely an advantage of using two zoos run by the same organisation, the results cannot be considered to be representative of all zoos. Further, although the two zoos are run by the same organisation, they do have somewhat different visitor profiles in terms of demographic factors (see section 3.2). Although the scope of this study did not allow for a deeper analysis of how social and demographic factors may influence the reception of and response to conservation messaging,
it is entirely possible that these factor, or others (e.g. the identity-related motivations discussed by Falk, Heimlich & Bronnenkant, 2008) may play into the differential results at the two zoos. Further, data was collected at different times of year (including during school holidays at Taronga Zoo). This may have affected the results of the study.

Secondly, results are limited to analysis of zoo visitors’ behaviour and survey responses at Sumatran tiger exhibits. As discussed separately, tigers are considered amongst the most popular animals in captive animal collections (Powell & Bullock, 2014; Albert et al., 2018) and it is very likely that different results would be seen for a less ‘charismatic’ animal. However, this in itself is relevant to zoo exhibit design and broader zoo management. Zoo collection managers must consider which animals are the best ambassadors for the wild and the most effective animals to display to achieve behaviour change in their visitors. While it might be nice to imagine a world where a fish, frog or lizard would be as attractive or engaging to the general zoo-going public as a tiger, this is not reality.

The results of this study also cannot be considered to attribute causality, only measured association or correlation between aspects of the zoo visit and reported attitudes, perceived behavioural control, cognition and connection. There are no control groups, and the study is not experimental. The research could be extended to be somewhat experimental (e.g. by manipulating parts of the exhibit complexes or manipulating tiger visibility) although the ethics of doing so are complex. If the welfare of the tigers was in any way affected, that would automatically rule out any such experimental design. Further, manipulating the visitor experience in a way that might make their zoo visit ‘worse’ e.g. deliberately ensuring they did not see a tiger, or limiting their access to parts of a zoo complex, would be problematic. Zoo visitors usually pay for an expected experience and zoos would not want to risk unfavourable reviews from unhappy guests.

Surveys routinely suffer from social desirability bias, an inclination of survey respondents to represent themselves (via their survey responses) favourably or aligned with socially acceptable principles (Nederhof, 1985; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Grimm, 2010; Krumpal, 2013). This can bias responses and misrepresent or inflate the impact of the affective experience being measured. This may be particularly the case in this study, as visitors who are voluntarily attending a zoo exhibit and voluntarily participating in social research may feel social or environmental pressure to appear to be aligned with the zoo’s message. In the context of a zoo, tiger conservation likely becomes a particularly ‘socially sensitive’ issue, which may compound the social desirability bias (van de Mortel, 2008). It is
also possible that survey respondents provide positively biased responses to questions of attitude and behavioural intention, and that consequently the likelihood of behaviour change is inflated. This study could have benefitted from the application of a social desirability scale to improve the validity of the survey-based research (van de Mortel, 2008). Reported behaviour (as in the delayed post-visit survey) is also a less reliable indicator than observed actual behaviour but is the best available option in the absence of a method that allowed for follow up of purchasing behaviour in zoo visitors. A recent study by Zoos Victoria (looking at the impact of a zoo-based campaign related to marine litter from balloons; Mellish et al., 2019) found that visitors who completed a pre-visit survey were more likely to report favourable subjective norms and positive attitudes than visitors who did not. This indicates that the pre-visit survey may have some influence on engagement with pro-environmental campaign information at the zoo. It may be that this is the case in this study as well.

Having said all of this, direct survey methods are an inexpensive, flexible and relatively quick way of gathering large amounts of data. Further, survey respondents were aware that their responses were anonymous and confidential, which may go some way to addressing the social desirability bias (McLeod, 2018). Surveys also allow for more complex questions (Jones, Baxter & Khanduja, 2013), and the selected data analysis techniques are well established and straightforward (Pallant, 2016).

Using Likert-type items as survey statements has the advantage of familiarity, and it is unlikely that any visitors surveyed in this study were seeing a Likert scale for the first time. This makes the questions relatively straightforward to answer. Furthermore, framing all survey statements positively made the questions more straightforward to respond to. A seven point scale with a neutral option (‘neither agree or disagree’) accommodated neutral or undecided responses. However, respondents are less likely to choose the extreme ends (in this case, strongly agree and strongly disagree) leading to an ‘anchor bias’ towards the central options on the scale (Guildford, 1954; Gehlbach & Barge, 2012). This may not have been a large factor in this study (the Results section will show that several median responses to survey statements were on the positive extreme of the scale), but it is worth noting.

Multi-question surveys which focus on a single topic or concept can be affected by internal influence; that is, one question can prime the respondent for future questions by making them more prominent or setting the tone for the rest of the survey (Podsakoff et al., 2003). This can lead to artificial relationships amongst the factors measured in the survey, which may impact the validity of analyses which set out to look at these relationships, such as regression.
analysis. In this study, it may be that the proximity of the statement ‘I can make product purchases that help protect tigers in the wild’ to the statement ‘I intend to make more sustainable palm oil product choices in the future’ may suffer from this priming bias, affecting visitors’ responses to the behavioural intention statement and inflating true behavioural intention.

Several questions on the delayed post-visit survey were designed to measure whether a particular desirable behaviour had been carried out. To make this simple, yes/no questions were asked. In particular, the question ‘Have you made more sustainable palm oil product purchases since your visit to [zoo]’ was asked in this format. Ultimately, this question format limited the statistical analyses that could be used to assess the impact of the zoo visit on this behavioural outcome. With hindsight, it would have been preferable to ask this question (and others) on the same 7-point Likert scale employed in the earlier surveys. Further, a better opportunity or incentive to provide expanded open-ended responses to the survey would have provided an opportunity to better understand post-visit behaviour (options for open-ended responses was provided, but few participants provided detailed responses). However, asking behavioural questions in a ‘yes/no’ format is very clear, and allows for little deception on behalf of the visitor and a very clear understanding of the proportion of zoo visitors that undertake target behaviours after their zoo visit. A final limitation related to the delayed post-visit study is that the small sample size limited the types of analysis possible. This also limited the benefit of separately presenting pre-visit and immediate post-visit survey responses and analysis for that small subset who competed the post-visit survey (46 participants for Taronga Zoo and 17 for Western Plains Zoo). A separate study could examine this sub-cohort specifically to see if they differ in any way from the broader cohort.

The sheer amount of observational data collected, particularly at Taronga Zoo, necessitated analyses being limited to a small number of exhibit zones. Doing otherwise would have demanded a much longer thesis and a much longer data analysis period, not allowed for in a three-year doctoral program. This does limit the focus of the research to those more engaging zones, and the impact of engaging with the other zones is consequently unknown. It could be that engagement with these zones shows an association with survey results. Basic descriptive analysis of engagement are provided in section 5.3.1 for all zones, including those not selected as focal zones. Further research could address this, building on the baseline established in this novel study. Further, the data collected on how participants were engaging with the exhibit (e.g. looking at exhibit, reading signs, talking to a docent) could not be used
as it did not allow for a granular enough analysis of engagement. For example, more than 90% of participant behaviour observations indicated that the participant was ‘looking at exhibit’. A study that had a more granular ethogram (e.g. ‘looking at exhibit and speaking to companion’) might provide a more useful data set for this kind of analysis, particularly to provide some more depth to conclusions made later in this thesis about the relative value of getting zoo visitors to stop at a zone compared to dwell time at that zone.

Associated with this, the sample sizes for each case study are not the same. Putting aside the limitations of budget and time for data collection, vastly different visitor numbers at the two zoos meant that it was simply not possible to engage the same number of participants within the same timeframe. The number of daily visitors and frequency of visits to the tiger exhibit at Western Plains Zoo was expected but impacted the ability to increase the sample size in the data collection period. Accordingly, the sample size was roughly half that of the Taronga Zoo sample. Further separation of this cohort into two parts (visitors who attended the daily tiger keeper talk, and those who did not) and discarding data for visitors who attended the talk made the Western Plains Zoo cohort even smaller relative to Taronga Zoo. Where possible, effect sizes have been used to adjust for sample size differentiation and facilitate better case-study comparison. Future research at zoos that have lower numbers of visitors, may wish to plan for a much longer data collection period to allow a more robust comparison with urban or high-visitation sites to confirm or contradict the findings presented in this thesis.

4.7 Summary of research design and methodology

This chapter has outlined the methods used in this study, and justified the approach taken. The methods are a combination of direct surveying, covert observations, and quantitative analysis of survey and observational data.

The methods are described in stages, first justifying the survey statements using existing literature. Data collection methods were described, including participant recruitment, survey deployment and observation techniques. This was followed by a summary of statistical analyses undertaken on survey responses and observational data. Following this, a series of analyses using both the survey and observational data were described, using the research questions to contextualise and explain their application. The same methodological approach was taken across both zoo sites, although some additional statistical analyses were conducted on data from Taronga given variability in tiger visibility at that site. Finally, the limitations of the methodology were considered.
The next chapter will discuss the results of the statistical analyses in the context of articulating the impact of zoo design on the efficacy of zoo-based behaviour campaigns.
5. Results

5.1 Overview

This chapter outlines the results of the study, in an attempt to answer the main research question: does zoo exhibit design impact the efficacy of zoo-based behaviour change campaigns? More specifically, it sets out analyses that aim to identify what factors of the zoo visit experience have the greatest impact on visitor perceived behavioural control, attitudes, connections, cognition and behavioural intentions related to tiger conservation.

Section 5.2 of this chapter identifies and quantifies the impact of the zoo visit by analysing the pre-visit, immediate post-visit and delayed post-visit visitor surveys at each zoo exhibit site using quantitative statistical analyses. The survey responses, and changes in survey responses between the surveys, are considered the ‘personal factors’ of the zoo visit. Having identified any impact of the zoo visit on the personal factors, this section will go on to identify which of these personal factors contributes to behavioural intention to make more sustainable palm oil product choices (section 5.2.3).

Section 5.3 outlines and analyses the direct covert visitor observation data, including stopping, dwell time, tiger visibility and exhibit engagement patterns. These elements of the study are termed ‘exhibit engagement factors’. It also outlines the results of the focal zone analysis, which identifies key exhibit zones retained for further analysis in sections 5.4 and 5.5. Section 5.4 outlines the analysis of the relationships between exhibit engagement factors and the key personal factors identified in section 5.2.3. Correlative analyses are conducted, identifying relationships between the key personal factors that contribute to intention to make sustainable palm oil purchases, and exhibit engagement. Section 5.5 outlines the analysis of the relationship between tiger visibility and connection to tigers, to attempt to understand how these factors may relate.

Results are generally presented in separate subsections for each zoo. Results for Taronga Zoo are reported first, followed by results for Western Plains Zoo. The statistically significant level set for all analyses is p<0.05. Throughout this chapter, light grey boxes in tables indicate non-significant results. Where relevant, effect size (Cohen’s d, marked ‘d’ in tables and text)
or coefficient of determination ($r^2$) are only calculated for significant results. Effort has been made to avoid tables breaking across pages, but in places this is necessary.

5.2 Visitor Surveys

5.2.1 Demographic and basic survey data summary

Table 7 presents the survey responses to demographic, social and motivational questions. It also outlines the type of day on which data was collected, and the proportion of visitors who saw a tiger during their visit.

Overall, visitors surveyed at Taronga Zoo were younger than those surveyed at Western Plains Zoo. The gender bias towards females was roughly the same across both sites. Similarly, the social group with which surveyed visitors attended the zoo were in roughly the same proportion. The proportion of visitors living primarily outside of Australia was higher at Taronga Zoo, which aligns with a much higher proportion of international visitors to that site. However, this proportion is not representative of the actual proportion of overseas visitors to Taronga Zoo annually. Around 42% of Taronga Zoo visitors are from overseas (Taronga Conservation Society Australia, 2018b) compared to 14% in this survey cohort.

A large proportion of visitors at each site attended the zoo for entertainment or recreation purposes. Most visitors to both sites reported that the exhibits made them feel interested, with smaller proportions reporting that they felt happy and relaxed. While this question indicated that visitors could a select all responses that applied to them, 96% of visitors surveyed selected only one option, which likely explains the small number of visitors who indicated that the exhibit made them feel happy, relaxed, or one of the other options. That, is, it was not that the exhibit specially did not make them feel, for example, happy, it is simply that they preferredne ‘interested’. Smaller numbers of visitors reported that the exhibit at Taronga Zoo made them feel sad or bored. All surveyed visitors at Western Plains Zoo reported that they saw a tiger in the exhibit. 187 visitors to Taronga Zoo (93.5%) reported that they had seen a tiger.
Table 7: Overview of survey responses for demographic, social & motivational questions

<table>
<thead>
<tr>
<th>Category</th>
<th>Response</th>
<th>Taronga Zoo (n=200)</th>
<th>Western Plains Zoo (n=88)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td>Female</td>
<td>145 (72.5%)</td>
<td>70 (79.5%)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>55 (27.5%)</td>
<td>18 (20.5%)</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>18-25</td>
<td>64 (32%)</td>
<td>7 (7.9%)</td>
</tr>
<tr>
<td></td>
<td>26-35</td>
<td>49 (24.5%)</td>
<td>23 (26.1%)</td>
</tr>
<tr>
<td></td>
<td>36-45</td>
<td>57 (28.5%)</td>
<td>40 (45.5%)</td>
</tr>
<tr>
<td></td>
<td>46-55</td>
<td>19 (9.5%)</td>
<td>9 (10.2%)</td>
</tr>
<tr>
<td></td>
<td>55+</td>
<td>11 (5.5%)</td>
<td>9 (10.2%)</td>
</tr>
<tr>
<td><strong>Group at zoo</strong></td>
<td>Family group with children</td>
<td>115 (57.5%)</td>
<td>48 (54.5%)</td>
</tr>
<tr>
<td></td>
<td>Family group without children</td>
<td>44 (22%)</td>
<td>22 (25%)</td>
</tr>
<tr>
<td></td>
<td>Friends/Other</td>
<td>28 (14%)</td>
<td>15 (17%)</td>
</tr>
<tr>
<td></td>
<td>Alone</td>
<td>13 (6.5%)</td>
<td>3 (3.4%)</td>
</tr>
<tr>
<td><strong>Primary residence</strong></td>
<td>Australia</td>
<td>172 (86%)</td>
<td>84 (95.5%)</td>
</tr>
<tr>
<td></td>
<td>Overseas</td>
<td>28 (14%)</td>
<td>4 (4.5%)</td>
</tr>
<tr>
<td><strong>Reason for attending zoo</strong></td>
<td>Entertainment/recreation</td>
<td>177 (88.5%)</td>
<td>86 (97.7%)</td>
</tr>
<tr>
<td></td>
<td>Education/learning</td>
<td>7 (3.5%)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Social occasion</td>
<td>11 (5.5%)</td>
<td>2 (2.3%)</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>5 (2.5%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Day surveyed</strong></td>
<td>Weekday</td>
<td>76 (38%)</td>
<td>69 (78.4%)</td>
</tr>
<tr>
<td></td>
<td>Weekend day</td>
<td>4 (2%)</td>
<td>19 (21.6%)</td>
</tr>
<tr>
<td></td>
<td>School holiday weekday</td>
<td>71 (35.5%)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>School holiday weekend day</td>
<td>39 (19.5%)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Public holiday</td>
<td>10 (5%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Exhibit made the visitor feel</strong></td>
<td>Interested</td>
<td>169 (84.5%)</td>
<td>69 (78.4%)</td>
</tr>
<tr>
<td></td>
<td>Happy</td>
<td>20 (10%)</td>
<td>12 (13.6%)</td>
</tr>
<tr>
<td></td>
<td>Relaxed</td>
<td>15 (7.5%)</td>
<td>8 (10%)</td>
</tr>
<tr>
<td></td>
<td>Sad</td>
<td>12 (6%)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Bored</td>
<td>4 (2%)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Tense</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Saw at least one tiger in exhibit</strong></td>
<td>Yes</td>
<td>187 (93.5%)</td>
<td>88 (100%)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>13 (6.5%)</td>
<td>0</td>
</tr>
</tbody>
</table>

5.2.2 Survey results – Personal Factors

This section reports the survey responses that were collected on Likert scales (10 items for the pre-visit survey, 11 for the immediate post-visit survey and six for the delayed post-visit survey). As noted earlier, these are considered the primary ‘personal factors’ of the visitor experience.
The next two subsections present the survey results, including median response and response range. The results of a paired-samples t-test for each pair of surveys (pre-visit/immediate post-visit, immediate post-visit/delayed post-visit, pre-visit/delayed post-visit) is also presented. The results of the paired-samples t-tests indicate whether there is a significant difference in the results between the paired surveys. Thus, whether there is any appreciable change in visitor response (henceforth described as ‘shifts’) to any survey statements.

To assist with formatting and brevity, the survey statements have been assigned code names. These terms are used throughout the remainder of this thesis.

1. I understand the threats to tigers in the wild – ‘Understand Threats’
2. It is very important that tigers are protected in the wild – ‘Important Protect’
3. I can help protect tigers in the wild - ‘Help Protect’
4. I feel a sense of connection to the natural world - ‘Connection Nature’
5. I feel a sense of connection to tigers - ‘Connection Tigers’
6. If I could, I would like to do something to protect tigers in the wild – ‘Like to Help’
7. I (intend to) speak to my friends/family about what they can do to help protect tigers in the wild – ‘Speak Friends Family’
8. I can influence my friends/family about what they can do to help protect tigers in the wild – ‘Influence Friends Family’
9. I can speak directly with companies about the impact their products have on wildlife - ‘Speak Companies’
10. I can make product purchases that help protect tigers in the wild – ‘Purchase’
11. I intend to make more sustainable palm oil product choices in the future - ‘Intention Purchase’.

**Taronga Zoo**

Table 8 displays survey results for Taronga Zoo, and the results of paired-samples t-tests identifying changes between the pre-visit, immediate-post visit, and delayed post-visit stages. The pre-visit and immediate post visit surveys were completed by 200 people, and 46 people completed the delayed online post-visit survey. Completion of the delayed post-visit survey was entirely voluntary, and possibly motivated by desire to contribute to conservation.
research. Therefore, it is likely that the people who completed this survey would have an inherent pro-conservation bias, which may have played out in the results. This will be discussed in Chapter 6.

Table 8: Results of paired-samples t-tests for Taronga Zoo.
Dark grey boxes indicate that the test was not possible (as the question was not repeated on the relevant survey). 0.00* means p=<0.005. [t = size of the difference relative to the variation; p = probability value; d = effect size (Cohen’s d)]

<table>
<thead>
<tr>
<th>Survey Statement</th>
<th>Pre-visit N=200 Mean (SD)</th>
<th>Post-visit N=200 Mean (SD)</th>
<th>Delayed post-visit N=46 Mean (SD)</th>
<th>Pre-visit to Immediate Post-Visit t p d</th>
<th>Immediate Post-Visit to Delayed Post-Visit t p d</th>
<th>Pre-Visit to Delayed Post-Visit t p d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand Threats</td>
<td>4.99 (1.10)</td>
<td>5.96 (0.77)</td>
<td>6.15 (0.82)</td>
<td>15.60 0.00* 1.10 0.50 0.62 -</td>
<td>6.32 0.00* 0.93</td>
<td></td>
</tr>
<tr>
<td>Important Protect</td>
<td>6.53 (.80)</td>
<td>6.71 (0.57)</td>
<td>-</td>
<td>3.88 0.00* 0.27 - - - - - - - -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Help Protect</td>
<td>4.55 (.88)</td>
<td>5.65 (1.07)</td>
<td>6.28 (0.83)</td>
<td>17.35 0.00* 1.23 5.11 0.00* 0.75 10.20 0.00* 1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection Nature</td>
<td>4.82 (1.22)</td>
<td>5.05 (1.30)</td>
<td>5.26 (1.22)</td>
<td>4.43 0.00* 0.31 1.27 0.21 - 1.53 0.13 -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection Tiger</td>
<td>4.59 (1.12)</td>
<td>5.06 (1.17)</td>
<td>5.48 (1.17)</td>
<td>10.80 0.00* 0.76 3.90 0.00* 0.58 6.58 0.00* 0.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like to Help</td>
<td>6.08 (.92)</td>
<td>6.47 (0.75)</td>
<td>6.65 (0.64)</td>
<td>7.24 0.00* 0.51 1.40 0.17 - 3.97 0.00* 0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speak Friends Family</td>
<td>3.04 (1.28)</td>
<td>4.36 (1.54)</td>
<td>-</td>
<td>18.14 0.00* 1.28 - - - - - -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influence Friends</td>
<td>3.57 (1.37)</td>
<td>3.94 (1.35)</td>
<td>4.76 (1.14)</td>
<td>4.08 0.00* 0.29 2.00 0.05 0.30 6.39 0.00* 0.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speak Companies</td>
<td>2.79 (1.26)</td>
<td>3.94 (1.34)</td>
<td>-</td>
<td>16.13 0.00* 1.14 - - - - - -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase</td>
<td>5.04 (1.05)</td>
<td>5.89 (0.87)</td>
<td>-</td>
<td>12.414 0.00* 0.88 - - - - - -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention Purchase</td>
<td>6.01 (0.91)</td>
<td>-</td>
<td>-</td>
<td>- - - - - - - - - - - -</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Paired-samples t-tests revealed a statistically significant difference (p=<0.005) between survey responses across all repeat-measured statements between the pre-visit survey and immediate post-visit survey. This suggests that a visit to Tiger Trek can have a significant immediate impact on all the measured factors. The mean immediate post-visit survey responses were higher, indicating that visitors more strongly agreed with the statement...
following their visit. Effect size (marked ‘d’ in Table 8) indicates that the difference in responses was large for seven of the 10 repeat-measures tests, suggesting a very significant shift in the measured personal factors. There was some notable sustained change or even increased agreement with some of the survey statements observed on the delayed post-visit survey.

Reported cognitive understanding of the threats to tigers (Understand Threats) significantly increased between the pre-visit and post-visit time stages. It does not change significantly between the immediate post-visit and delayed post-visit stages, but there is a significant difference with very large effect between the pre-visit and delayed post-visit stages. This suggests that the shift in cognitive understanding observed immediately after the visit persists over the three month period.

The mean responses to the measure of perceived ability to help protect tigers in the wild (Help Protect) increased significantly across all three time stages. Between the pre-visit and immediate post-visit stages, and the pre-visit and delayed post-visit stages, the effect size of the shift was very large (1.23 and 0.75 respectively). This suggests a very large impact from the zoo visit on perceived behavioural control about ability to help protect tigers. Notably, there is a significant shift between the immediate and delayed post-visit surveys, indicating that reported perceived behavioural control for Help Protect also increased in this period.

Similarly, the reported feeling of connection to tigers (Connection Tiger) increased across the three time stages, with a significant difference between all surveys. Although the smallest degree of change and smallest effect, there was a significant shift in Connection Tiger between the immediate and delayed post-visit surveys. This indicates that the visitors who completed the delayed post-visit surveys felt a higher degree of connection to tigers three months after their visit in comparison to immediately after their visit. Also following this pattern were responses to Influence Friends Family.

A desire to help protect tigers if possible (Like to Help), increased significantly between the pre-visit and immediate post-visit stages, but did not shift significantly after the visit to the zoo. There was an overall significant difference between the pre-visit and delayed post-visit stages, suggesting that the effect of the zoo visit on this factor was sustained three months after the visit for those visitors.
There was a significant difference in reported connection to the natural world (Connection Nature) between the pre-visit and immediate post-visit surveys, but no difference between the immediate and delayed post-visit stages. There was also no significant sustained difference between the pre-visit and the delayed post-visit stages, indicating that the impact of the zoo visit on connection to nature immediately after a visit is not sustained over three months.

Important Protect, Speak Friends Family, Speak Companies, and Purchase all showed a significant shift between the pre- and immediate post-visit stages but were not measured on the delayed post-visit survey. Speak Friends Family, Speak Companies, and Purchase all shifted with large effect, indicating that the zoo visit had a large impact on these factors. Small effect was observed between the pre-visit and immediate post-visit time stages for Important Protect, but the mean response on the pre-visit survey was already very high (M=6.53). On average, visitors more strongly agreed with this statement than any other on both surveys. The small effect size is likely attributable to the ceiling effect (Salkind, 2010) but it is notable that even give this, there is a significant difference in responses at these two time points.

**Western Plains Zoo**

Table 9 displays survey results for Western Plains Zoo. These results represent only those guests who did not also attend the keeper talk (i.e. they attended the exhibit only). Eighty-eight people completed the pre- and immediate post-visit surveys, and 17 completed the delayed post-visit survey.

Paired-samples t-tests revealed significant differences between the pre-visit and immediate post-visit surveys for eight of the ten measured factors. Two measured factors (Like to Help and Influence Friends Family) did not shift significantly from the pre-visit stage. As with Taronga Zoo, these differences all reflect higher mean responses on the immediate post-visit survey, indicating that visitors more strongly agreed with the statements on the immediate post-visit survey. These significant differences are overall of a smaller magnitude than Taronga Zoo, reflected in the smaller effect sizes. There is only one significant difference between the immediate post-visit and delayed post-visit surveys, and three between the pre-visit and delayed post-visit surveys. The small sample size for the delayed post-visit survey (n=17) may be a factor in this. As with Taronga Zoo, self-motivated completion of the online
delayed post-visit survey may create a pro-conservation bias in this group, and this may be reflected in the results.

Table 9: Results of paired-samples t-tests for Western Plains Zoo.
Dark grey boxes indicate that the test was not possible (as the question was not repeated on the relevant survey). 0.00* means \( p<0.005 \) [\( t = \) size of the difference relative to the variation; \( p = \) probability value; \( d = \) effect size (Cohen’s d)]

<table>
<thead>
<tr>
<th>Survey Statement</th>
<th>Pre-visit N=88 Mean (SD)</th>
<th>Post-visit N=88 Mean (SD)</th>
<th>Delayed Post-Visit N=17 Mean (SD)</th>
<th>Pre-Visit to Immediate Post-Visit t p d</th>
<th>Immediate Post-Visit to Delayed Post-Visit t p d</th>
<th>Pre-Visit to Delayed Post-Visit t p d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand Threats</td>
<td>4.93 (0.64)</td>
<td>5.22 (0.79)</td>
<td>5.47 (0.87)</td>
<td>5.31 0.00* 0.57</td>
<td>1.00 0.33 -</td>
<td>2.75 0.01 0.67</td>
</tr>
<tr>
<td>Important Protect</td>
<td>6.64 (0.59)</td>
<td>6.67 (0.56)</td>
<td>-</td>
<td>2.04 0.05 0.22</td>
<td>- - - -</td>
<td>- - - -</td>
</tr>
<tr>
<td>Help Protect</td>
<td>4.38 (0.73)</td>
<td>4.55 (0.84)</td>
<td>6.00 (0.87)</td>
<td>3.92 0.00* 0.42</td>
<td>6.47 0.00* 1.57</td>
<td>7.53 0.00* 1.83</td>
</tr>
<tr>
<td>Connect Nature</td>
<td>4.36 (0.85)</td>
<td>4.42 (0.84)</td>
<td>4.65 (0.70)</td>
<td>2.29 0.02 0.24</td>
<td>0.00 1.00 -</td>
<td>0.00 1.00 -</td>
</tr>
<tr>
<td>Connect Tiger</td>
<td>4.39 (0.72)</td>
<td>4.72 (0.91)</td>
<td>5.12 (0.70)</td>
<td>6.23 0.00* 0.67</td>
<td>1.73 0.10 -</td>
<td>4.40 0.00* 1.07</td>
</tr>
<tr>
<td>Like to Help</td>
<td>6.52 (0.76)</td>
<td>6.53 (0.77)</td>
<td>6.76 (0.44)</td>
<td>0.38 0.71 -</td>
<td>0.00 1.00 -</td>
<td>0.00 1.00 -</td>
</tr>
<tr>
<td>Speak Friends Family</td>
<td>3.23 (0.96)</td>
<td>3.78 (1.15)</td>
<td>-</td>
<td>8.39 0.00* 0.89</td>
<td>- - - -</td>
<td>- - - -</td>
</tr>
<tr>
<td>Influence Friends Family</td>
<td>3.52 (1.08)</td>
<td>3.55 (1.12)</td>
<td>3.47 (1.23)</td>
<td>1.42 0.16 -</td>
<td>-0.90 0.38 -</td>
<td>0.57 0.58 -</td>
</tr>
<tr>
<td>Speak Companies</td>
<td>2.89 (1.09)</td>
<td>2.98 (1.10)</td>
<td>-</td>
<td>2.37 0.02 0.25</td>
<td>- - - -</td>
<td>- - - -</td>
</tr>
<tr>
<td>Purchase Intention Purchase</td>
<td>4.59 (0.97)</td>
<td>4.77 (0.93)</td>
<td>5.09 (1.00)</td>
<td>3.31 0.00* 0.35</td>
<td>- - - -</td>
<td>- - - -</td>
</tr>
</tbody>
</table>

Visitors reported changes in Help Protect across all three stages, with a significant shift observed between all survey stages. While the effect size of the shift between the pre-visit and immediate post-visit surveys is only moderate (0.42), the effect size of the immediate to delayed post-visit surveys, and the overall shift from pre-visit to delayed post-visit are very large (1.57 and 1.83 respectively). This indicates a sizeable impact of the zoo visit on reported
visitor feelings of being able to help protect tigers, noting that this effect is on the 17 participants who voluntarily completed the delayed post-visit survey. It is also indicative that post-visit factors may contribute to or build upon the shift seen in this factor immediately after the visit.

Cognitive understanding of the threats to tigers (Understand Threats) shifted significantly between the pre-visit and immediate post-visit stages, with large effect (0.57). There is no significant change between the immediate and delayed post-visit stages. The difference between the pre-visit and delayed post-visit stages suggests that the shift in understanding of threats to tigers is maintained after three months in the group that completed the three-month delayed survey.

Visitors’ reported connection to tigers (Connection Tiger) and nature (Connection Nature) are both significantly increased immediately following the zoo visit. Connection Tiger shifts with large effect (0.67), while Connection Nature is a comparably smaller change (0.24). Only the reported feeling of connection to tigers is sustained after three months. There is no change between the immediate and delayed post-visit responses for either connection factor.

As with Taronga Zoo, Important Protect, Speak Friends Family, Speak Companies, and Purchase showed a significant shift between the pre- and immediate post-visit stages but were not measured on the delayed post-visit survey, as preference was given to asking visitors whether they had actually undertaken these behaviours. The reported feeling of being able to speak to friends and family about helping protect tigers displayed the largest shift between pre-visit and immediate post-visit surveys of all 10 measured factors, both in t-score and effect size. The remaining three measures showed small or moderate effect.

Relationship with post-visit reported behaviour, intention and perceived behavioural control.

When asked whether they had made more sustainable palm oil-containing product choices since their visit to Taronga Zoo, 30 (of 46 responses) indicated that they had, representing 65% of the cohort responding to the delayed post-visit survey. An independent-samples t-test revealed that the group who reported that they had made more sustainable palm oil purchasing choices since their visit to Taronga Zoo more strongly agreed (M=6.20, n=30) during the
immediate-post visit survey that they intended to do so than those who reported that they hadn’t made the change (M=5.56, n=16), [t=-2.464, p=0.02, d=0.77].

Of the Western Plains Zoo cohort, five respondents (of 17 responses, representing 29%) indicated that they had made more sustainable palm oil-containing product choices since their visit to Western Plains Zoo. An independent-samples t-test revealed no significant difference in survey responses regarding reported intention to make more sustainable palm oil purchasing choices between those who reported that they had made this change (M=5.60, n=5) and those who reported that they hadn’t (M=5.08, n=12), [t=-1.18, p=0.26]. Effect size was not calculated due to non-significance.

Perceived behavioural control about being able to make sustainable palm oil purchases that help protect tigers in the wild did not predict actual behaviour in visitors to either zoo. There was no significant difference in perceived behavioural control in the Taronga Zoo group that reported that they had made more sustainable purchases (M=6.07, n=30) and those that did not (M=5.56, n=16) (t=-1.712, p=.094). Similarly, there was no difference in perceived behavioural control in the Western Plains Group that reported that they’d made more sustainable palm oil product choices (M=5.40, n=5) and those that reported that they had not (M=4.83, n=12) (t=-1.39, p=0.19).

5.2.3 Predictors of behavioural intention
The responses to the immediate post-visit survey give a picture of visitors’ reported current state (relevant to the personal factors measured) after the ‘affective’ treatment (exhibit visit) had been applied. Results reported earlier in this chapter show that there is a statistically significant difference between visitors before and after their visit on many of these factors. Measuring which of these personal factors contribute most to reported behavioural intention immediately after the zoo visit should assist in pinpointing which factors should be the focus of visitor engagement during the zoo visit.

Taronga Zoo

Pearson product-moment correlation analyses using all personal factors measured on the immediate post-visit survey were performed to reduce the number of independent variables
for a subsequent multiple regression. Age, gender, motivation for the zoo visit, group type, country of primary residence, total dwell time in the exhibit, and the numerical degree of change (‘shift’) observed between the pre-visit and immediate post-visit survey personal factors were all eliminated as contributors to reported behavioural intention in this preliminary analysis, as there was no correlation between these factors and reported behavioural intention. Speak Friends Family was omitted from the analysis as it is a behavioural intention item itself. This left responses to the immediate post-visit survey as the available personal factors to be used as independent variables for the next analysis.

There was a positive, significant correlation between all remaining independent variables and the dependent variable (Table 10). All relationships are highly significant (p<0.005). The coefficient of determination ($r^2$) for each explain the proportion of variance in the dependent variable explained by that independent variable. These range from 0.67 (67% of variance explained by the visitors’ response to Purchase) to 0.11 (11% of variance explained by visitor response to Speak Companies). As noted in section 4.5.1, to limit analysis to the most highly correlated variables, variables with a coefficient of determination of 0.3 or less were excluded from further analysis (Important Protect, Understand Threats, Like to Help, and Speak Companies).

Table 10: Correlation analysis between reported behavioural intention and immediate post-visit survey responses (personal factors); Taronga Zoo.
p=>0.005 for all analyses.

<table>
<thead>
<tr>
<th>Independent Variable (Personal Factors)</th>
<th>r</th>
<th>Coefficient of determination ($r^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>0.82</td>
<td>0.67</td>
</tr>
<tr>
<td>Help Protect</td>
<td>0.71</td>
<td>0.51</td>
</tr>
<tr>
<td>Influence Friends Family</td>
<td>0.68</td>
<td>0.46</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>0.65</td>
<td>0.42</td>
</tr>
<tr>
<td>Connection Tiger</td>
<td>0.58</td>
<td>0.33</td>
</tr>
<tr>
<td>Important Protect</td>
<td>0.56</td>
<td>0.30</td>
</tr>
<tr>
<td>Understand Threats</td>
<td>0.46</td>
<td>0.21</td>
</tr>
<tr>
<td>Like to Help</td>
<td>0.43</td>
<td>0.19</td>
</tr>
<tr>
<td>Speak Companies</td>
<td>0.34</td>
<td>0.11</td>
</tr>
</tbody>
</table>
A linear multiple regression analysis was run in SPSS with the six remaining independent variables. The r-square value for Model 1 (Table 11) was 0.73 (p=.000), suggesting that 73% of variance in visitor intention to make more sustainable palm-oil purchases following their visit to Taronga Zoo is predicted by a model containing these five variables.

Table 11: Results of multiple regression analyses for Taronga Zoo

<table>
<thead>
<tr>
<th>Model</th>
<th>Variable</th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficient</th>
<th>t</th>
<th>p</th>
<th>Part correlation coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 R²=.73, p=0.000</td>
<td>(Constant)</td>
<td>0.63</td>
<td>0.27</td>
<td>-</td>
<td>2.37</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td>Purchase</td>
<td>0.60</td>
<td>0.06</td>
<td>0.56</td>
<td>10.16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Help Protect</td>
<td>0.20</td>
<td>0.05</td>
<td>0.23</td>
<td>3.99</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Connection Nature</td>
<td>0.11</td>
<td>0.05</td>
<td>0.15</td>
<td>2.43</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Connection Tiger</td>
<td>0.02</td>
<td>0.05</td>
<td>0.02</td>
<td>0.38</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td>Influence Friends Family</td>
<td>0.00</td>
<td>0.04</td>
<td>0.01</td>
<td>.07</td>
<td>0.94</td>
</tr>
<tr>
<td>2 R²=.74, p=0.000</td>
<td>(Constant)</td>
<td>0.64</td>
<td>0.24</td>
<td>-</td>
<td>2.67</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Purchase</td>
<td>0.61</td>
<td>0.06</td>
<td>0.56</td>
<td>10.80</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Help Protect</td>
<td>0.21</td>
<td>0.05</td>
<td>0.23</td>
<td>4.48</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Connection Nature</td>
<td>0.12</td>
<td>0.04</td>
<td>0.17</td>
<td>3.42</td>
<td>0.00</td>
</tr>
</tbody>
</table>

The largest independent contributor to explaining visitor intention to make more sustainable palm oil purchases in the future is Purchase. Therefore, stronger positive perceived behavioural control about being able to make product purchases that help protect tigers in the wild contributes most strongly to an intent to make more sustainable palm oil purchases. Help Protect and Connection Nature are considerably smaller but still significant contributors. Part correlation coefficients (Table 11) indicate that variation in Purchase contributes the most to the model (approximately 14%, found by multiplying the part correlation coefficient by itself). The remaining three variables in Model 1 are not making significant individual contributions to the protection of behavioural intention.

A second multiple regression was run (Model 2, Table 11), excluding those independent variables that did not make a significant contribution to Model 1, leaving Purchase, Help
Protect, and Connection Nature. These personal factors are perceived ability to make product purchases that help protect tigers in the wild (Purchase), a more general feeling of being able to help protect tigers (Help Protect), along with reported post-visit connection to the natural world (Connection Nature). The R-squared value for the revised model is .74 (p=.000), indicating that this model explains 74% of variance in the behavioural intention about palm oil purchasing. This remains very close to the amount of variation explained by Model 1.

**Western Plains Zoo**

Unlike for Taronga Zoo, a Pearson product-moment correlation analysis did not exclude all demographic categories and numerical degree of change between the pre-visit and immediate post-visit surveys from analysis. Table 12 shows the results of the correlation analysis.

**Table 12: Correlation analysis between reported behavioural intention and immediate post-visit survey responses (personal factors), Western Plains Zoo.**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>r</th>
<th>p</th>
<th>Coefficient of Determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>0.89</td>
<td>0.000</td>
<td>0.79</td>
</tr>
<tr>
<td>Like to Help</td>
<td>0.58</td>
<td>0.000</td>
<td>0.34</td>
</tr>
<tr>
<td>Understand Threats</td>
<td>0.55</td>
<td>0.000</td>
<td>0.30</td>
</tr>
<tr>
<td>Help Protect</td>
<td>0.53</td>
<td>0.000</td>
<td>0.29</td>
</tr>
<tr>
<td>Important Protect</td>
<td>0.50</td>
<td>0.000</td>
<td>0.25</td>
</tr>
<tr>
<td>Connection Tiger</td>
<td>0.49</td>
<td>0.000</td>
<td>0.24</td>
</tr>
<tr>
<td>Influence Friends Family</td>
<td>0.47</td>
<td>0.000</td>
<td>0.22</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>0.47</td>
<td>0.000</td>
<td>0.22</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.35</td>
<td>0.001</td>
<td>0.12</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.32</td>
<td>0.002</td>
<td>0.10</td>
</tr>
<tr>
<td>Speak Companies</td>
<td>0.30</td>
<td>0.005</td>
<td>0.09</td>
</tr>
<tr>
<td>Shift Influence Friends Family</td>
<td>0.29</td>
<td>0.006</td>
<td>0.08</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.27</td>
<td>0.011</td>
<td>0.07</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.26</td>
<td>0.015</td>
<td>0.07</td>
</tr>
<tr>
<td>Shift Understand Threats</td>
<td>0.24</td>
<td>0.023</td>
<td>0.06</td>
</tr>
<tr>
<td>Shift Speak Friends Family</td>
<td>0.21</td>
<td>0.049</td>
<td>0.04</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.21</td>
<td>0.049</td>
<td>0.04</td>
</tr>
</tbody>
</table>

As with Taronga Zoo, independent variables with a coefficient of determination larger than 0.30 were retained for a multiple regression (Model 1, Table 13). Purchase and Like to Help contributed significantly to this model, while Understand Threats did not. Purchase is the largest contributor to behavioural intention. A second multiple regression (Model 2, Table 13)
retaining only Purchase and Like to Help identifies a model that explains 80% ($R^2=0.80$) of behavioural intention to make sustainable palm oil purchases.

Table 13: Results of multiple regression analyses for Western Plains Zoo

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Variable</th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficient</th>
<th>t</th>
<th>p</th>
<th>Part correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Constant)</td>
<td>-0.50</td>
<td>-</td>
<td>-1.03</td>
<td>0.30</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Purchase</td>
<td>0.85</td>
<td>0.78</td>
<td>11.28</td>
<td>0.00</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>Like to Help</td>
<td>0.18</td>
<td>0.14</td>
<td>2.33</td>
<td>0.02</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>Understand Threats</td>
<td>0.07</td>
<td>0.06</td>
<td>0.96</td>
<td>0.34</td>
<td>0.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2</th>
<th>Variable</th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficient</th>
<th>t</th>
<th>p</th>
<th>Part correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Constant)</td>
<td>-0.27</td>
<td>-</td>
<td>-0.64</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Purchase</td>
<td>0.88</td>
<td>0.81</td>
<td>13.94</td>
<td>0.00</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>Like to Help</td>
<td>0.17</td>
<td>0.13</td>
<td>2.27</td>
<td>0.03</td>
<td>0.24</td>
</tr>
</tbody>
</table>

At both zoos, perceived behavioural control about being about to make product purchases that help protect tigers in the wild (Purchase) are the most significant contributors. At Taronga Zoo, when combined with a perceived ability to help protect tigers more generally and a connection to nature, these variables explain 74% of variation in behavioural intention. At Western Plains Zoo, Purchase combined with a desire to help protect tigers in the wild if possible (Like to Help), explains 80% of variation in behavioural intention.

Having identified these key personal factors that contribute to behavioural intention, it is now important to understand how these factors are influenced by visitor engagement with the zoo exhibit. The next section (5.3) of this chapter examines the way visitors engaged with each exhibit. The subsequent section (5.4) examines relationships between this exhibit engagement and the key personal factors identified in this sub-chapter.

**5.3 Visitor Observations**

This section will provide general and qualitative results of the visitor observation portion of the project. General observations are made, including total dwell time in each exhibit complex. Basic observations are then used to identify key visitor engagement zones in each
exhibit complex, termed ‘focal zones’, on which the remainder of this thesis’ analyses will focus.

5.3.1 General Observations – Exhibit Engagement

_Taronga Zoo_

The average duration of time spent by visitors (‘dwell time’) in the entire Tiger Trek exhibit complex (including the aeroplane journey) was 14 minutes and 32 seconds. The minimum dwell time was three minutes, and the maximum was 34 minutes. Most visitors dwelled in the exhibit complex for between 10 and 20 minutes (n=145), with the most frequent duration of dwell being between 10 and 15 minutes (n=85). Figure 28 shows the dwell duration pattern for all visitors, categorised into five minute intervals. A small number of visitors (n=2) dwelled for less than five minutes, and only 27 visitors dwelled for more than 20 minutes.

![Figure 28: Total dwell time (minutes) in Taronga Zoo ‘Tiger Trek’ complex](image)

Tiger Trek is a linear exhibit complex (Stenglin, 2009), designed with the intention that visitors move through it in a defined order from the village, past Tiger Habitats one to three, and then through the supermarket. Taronga Zoo visitors usually moved through the exhibit complex in a linear way, following the intended serial path from start to finish. Generally, visitors tended not to stop for more than five seconds until they clearly saw a tiger. Most visitors gave at least a cursory glance through each obvious viewing window. Occasionally, visitors would double back, particularly from Tiger Habitat 2 to Tiger Habitat 1, most commonly because a tiger was visible in proximity to the exit of the Ranger Station (Zone 4C
on the map, Section 5.3.2). Adult visitors infrequently independently engaged with the ‘village’ shopfronts and stalls. However, children were drawn to the motorbikes and adults supervising them consequently dwelled in the village longer than average.

Different zones of the exhibit complex engage visitors in differing proportions. Figure 29 shows the percentage of visitors that stopped at each zone. This can be treated as a simple map of zone ‘attraction power’, as used in the focal zone analysis above. Overall, zone attraction power (based on proportion of visitors that stopped at each zone; Serrell, 1998) was higher in the ‘middle’ section of the exhibit, and mostly related to areas where tigers could be viewed from. The zone with the highest degree of attraction power was the Ranger Station (Zone 5A), followed by the Covered Bridge (4B) and a viewing window into Tiger Habitat 3 (6B). Notably low attraction power was observed for all zones within the village (2A-2C), the video screen, the outbound path of Tiger Habitat 3, and the signage and screen within the Supermarket. This is supported by anecdotal observations that almost all visitors to Tiger Trek (including those not directly studied) did not stop or engage with the Village or stop to watch the video screened within the Ranger Station.

Figure 29: Percentage of visitors that stopped at each zone at Tiger Trek

Preliminary analyses were conducted to look at the impact of seeing a tiger on visitor behaviour within the exhibit. One hundred and eighty seven of the 200 visitors surveyed reported seeing a tiger at Taronga Zoo on their immediate post-visit survey. Accordingly, this
cohort was used to assess the impact of seeing a tiger on visitor behaviour and engagement with the exhibit. Within this cohort, data on whether a tiger was visible to the participant in each specific zone was collected on the visitor observation sheets by the researcher.

Figure 30 shows the proportion of visitors who stopped when a tiger was visible vs not visible, (based on visitor observation data), to increase understanding of the attracting power of the zone itself, separate to the attracting power of a visible tiger. Zone 3B is the first viewing window into Tiger Habitat 1. Visitors who stopped at Zone 3B did so largely regardless of whether a tiger is visible to them or not (57.7% of people who stopped did not see a tiger), although more than half of visitors observed did not stop at all. As this is the first potential opportunity to see a tiger in the exhibit complex, this may explain why people may stop at that zone when a tiger is not obviously present. However, for the remainder of the zones that provide viewing opportunities into Tiger Habitat 1 (Zones 4A, 4B and 4C), and for those zones that provide viewing opportunities into Tiger Habitat 2, visitors were less likely to stop if a tiger was not visible to them. This changes again when considering visitors who stopped at zones that provide views into Tiger Habitat 3: most notably, 62% of visitors stopped at Zone 6B even though a tiger was not visible.

![Figure 30: Proportion of visitors stopping at each zone at Taronga Zoo’s Tiger Trek when tiger was visible compared to no tiger visible](image-url)
There are three major interactive exhibit elements within Tiger Trek. In the Village, there are two stationary motorbikes which can be climbed on. In the Ranger Station complex, visitors can climb into the Ranger Vehicle (Zone 5B), including into the driver’s seat. Finally, within the Supermarket, the supermarket carts have interactive touch screens (Zone 7A). While these elements primarily attract children, parents or other caregiving adults that participated in the study were recorded as associating with those interactive elements when they engaged with the element (as per definitions in methods chapter section 4.3.2). Of the visitors who stopped at the motorbikes (n=19), 47% were observed to engage with them (n=9). Only 26% (n=23) of visitors who stopped (n=87) at the Ranger Vehicle engaged with it. The Supermarket carts had the highest degree of interaction: of the 93 visitors who stopped at this zone, 88% (n=82) interacted with them.

*Western Plains Zoo*

The average total dwell time in the ‘Tiger Forest’ complex at Western Plains Zoo (Figure 31) was six minutes. The minimum dwell time was two minutes, and the maximum 37 minutes. Only two visitors dwelled longer than 15 minutes; those visitors dwelled for 32 and 37 minutes respectively.

![Figure 31: Total Dwell time (minutes) in Tiger Forest, Western Plains Zoo](image-url)
Most visitors to ‘Tiger Forest’ in Western Plains visited both tiger habitats, the majority (69%) having entered the exhibit complex via the main entrance (off the main arterial zoo path used by cars, carts, bikes and pedestrians). As might be expected, visitors generally only walked as far as necessary to see a tiger, meaning that the distal ends of the two tiger habitats (Zones 1 and 7 on the map in Section 5.3.2) were less visited. Generally, study participants visited the Forest Habitat first, probably because it is most obviously visible from the main entrance (and adjacent to the two secondary entrances). The Woodland Exhibit 2 is up a slight slope from the main entrance.

Unlike Tiger Trek, Tiger Forest is not a linear exhibit complex, and it has three entrances. As a result, visitors did not always follow the same pattern or movement through the exhibit complex. More than half (64%) of visitors visited both the Woodland Exhibit and the Forest Exhibit, but the remaining visitors were observed to only visit one exhibit or the other.

Figure 32 shows the percentage of visitors that stopped at each zone in Tiger Forest. As above for Taronga Zoo, this can be treated as a simple map of zone ‘attraction power’. The Woodland Exhibit (right hand side) (Zone 6, 61.4%) had the highest attraction power, followed by the left-hand side of the Forest Exhibit (3; 44.3%) and the Interpretation Hut (4; 39.8%). Attraction power notably dropped in the ‘outer edges’ of the exhibit (Zones 1 and 7) and no visitors were observed to stop along the path between the two exhibits (Zone 5). This may be attributable to their distance from the primary entrance (between Zones 4 and 5 on the map at Figure 33).

There are no major interactive elements within Tiger Forest. The interpretation Hut contains a number of large signs, and a small display containing metal sculptures comparing human, horse and tiger skulls and dentition. None of the participants in this study interacted with the skull sculptures, although the researcher did observe children engaging with them during the study period.
Figure 32: Percentage of visitors that stopped at each zone at Tiger Forest

As noted throughout this chapter, all visitors to Tiger Forest saw a tiger during their visit. Accordingly, the analysis of visitor engagement based on tiger visibility conducted above for Taronga Zoo was not possible for this cohort.

5.3.2 Focal Zone analysis and exhibit engagement

The Focal Zone analysis, described in section 4.5.2 of the methods chapter, aimed to allow for in-depth analysis of engagement with several exhibit zones. Table 14 shows the focal zones of the Tiger Trek exhibit. The four top scoring zones were retained for discussion for the rest of the thesis.

Taronga Zoo

For the purposes of clarity, for the remainder of this thesis the four identified focal zones at Taronga Zoo will be referred to as the ‘Covered Bridge’ (4B), the ‘Ranger Station’ (5A), ‘Ranger Vehicle’ (5B) and the ‘Supermarket’ (7A). A heat map representing the data in Table 14 is shown in Figure 32. The numbers represent the codes assigned to the zones during data collection. The key is based on the ‘focal zone’ score from Table 14.
Table 14: Focal Zone analysis for Taronga Zoo.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Cumulative dwell time (s)</th>
<th>Number visitors stop</th>
<th>Average Stop Duration (s)</th>
<th>Focal Zone Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5A Ranger Station</td>
<td>15175</td>
<td>17</td>
<td>147</td>
<td>75.88</td>
</tr>
<tr>
<td>5B Ranger Vehicle</td>
<td>12450</td>
<td>16</td>
<td>87</td>
<td>62.25</td>
</tr>
<tr>
<td>4B Covered Bridge</td>
<td>9910</td>
<td>14</td>
<td>159</td>
<td>49.55</td>
</tr>
<tr>
<td>7A Supermarket – carts</td>
<td>10955</td>
<td>15</td>
<td>93</td>
<td>54.78</td>
</tr>
<tr>
<td>4C Tiger Habitat 1 – outbound</td>
<td>3820</td>
<td>10</td>
<td>147</td>
<td>19.1</td>
</tr>
<tr>
<td>6B Tiger Habitat 3 – Viewing window 1</td>
<td>3995</td>
<td>12</td>
<td>112</td>
<td>19.98</td>
</tr>
<tr>
<td>6C Tiger Habitat 3 – Viewing window 2</td>
<td>4505</td>
<td>13</td>
<td>102</td>
<td>22.53</td>
</tr>
<tr>
<td>3B Tiger Habitat 1 – viewing window 1</td>
<td>3935</td>
<td>11</td>
<td>76</td>
<td>19.68</td>
</tr>
<tr>
<td>4A Tiger Habitat 1 – inbound</td>
<td>3520</td>
<td>9</td>
<td>52</td>
<td>17.6</td>
</tr>
<tr>
<td>2A Village – shopfronts</td>
<td>520</td>
<td>5</td>
<td>5</td>
<td>2.6</td>
</tr>
<tr>
<td>2B Village – motorbikes</td>
<td>910</td>
<td>8</td>
<td>19</td>
<td>4.55</td>
</tr>
<tr>
<td>6A Tiger Habitat 3 – inbound</td>
<td>775</td>
<td>7</td>
<td>28</td>
<td>3.88</td>
</tr>
<tr>
<td>7B Supermarket – Signs</td>
<td>595</td>
<td>6</td>
<td>20</td>
<td>2.98</td>
</tr>
<tr>
<td>6D Tiger Habitat 3 – outbound</td>
<td>430</td>
<td>4</td>
<td>7</td>
<td>2.15</td>
</tr>
<tr>
<td>5C Tiger Habitat 2 – Video</td>
<td>350</td>
<td>2</td>
<td>5</td>
<td>1.75</td>
</tr>
<tr>
<td>2C Way Kambas gate/ranger station</td>
<td>380</td>
<td>3</td>
<td>13</td>
<td>1.9</td>
</tr>
<tr>
<td>3A Tiger Habitat 1 – inbound</td>
<td>140</td>
<td>1</td>
<td>10</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Figure 33: Taronga Zoo 'Tiger Trek' heat map.
Western Plains Zoo

At Western Plains Zoo, as demonstrated in Table 15, the focal zones were two zones of the main viewing areas in each of the two tiger habitats (Zones 6 and 7, and 2 and 3) and the Interpretation Hut (Zone 4). A ‘heat map’ representing the data in Table 15 is shown in Figure 3.4. The numbers represent the codes assigned to the zones during data collection. As above, the key is based on the focal score from Table 15.

Table 15: Focal Zone analysis for Western Plains Zoo

<table>
<thead>
<tr>
<th>ZONE</th>
<th>Cumulative stop duration (s)</th>
<th>Number visitors stop</th>
<th>Average Stop Duration (s)</th>
<th>Focal Zone Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Seconds</td>
<td>Rank</td>
<td>n</td>
<td>Rank</td>
</tr>
<tr>
<td>6</td>
<td>Woodland Exhibit, Right Side</td>
<td>8800</td>
<td>7</td>
<td>54</td>
</tr>
<tr>
<td>3</td>
<td>Forest Exhibit, Left Side</td>
<td>3125</td>
<td>5</td>
<td>39</td>
</tr>
<tr>
<td>7</td>
<td>Woodland Exhibit, Left Side</td>
<td>3870</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>Forest Exhibit, Middle</td>
<td>2745</td>
<td>4</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>Interpretation Hut</td>
<td>2205</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>1</td>
<td>Forest Exhibit, Right Side</td>
<td>1865</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Path between exhibits</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Figure 34: Heat map, 'Tiger Forest' Western Plains Zoo.
5.4 Impact of exhibit engagement on key personal factors

This section examines the relationship between personal factors (survey response) and exhibit engagement. It will establish whether visitor engagement with any of the focal zones established in the previous section relate to the personal factors, looking particularly at the impact of stopping, dwell time, and seeing a tiger at the focal zones.

As established in Section 5.2.3 of this chapter, the identified personal factors that contribute to behavioural intention at Taronga Zoo are the responses to the following immediate post-visit survey statements:

1. I can make product purchases that help protect tigers in the wild (‘Purchase’)
2. I can help protect tigers in the wild (‘Help Protect’)
3. I feel a sense of connection to the natural world (‘Connection Nature’)

The identified personal factors that contribute to behavioural intention at Western Plains Zoo were:

1. I can make product purchases that help protect tigers in the wild (‘Purchase’)
2. If I could, I would like to help protect tigers in the wild (‘Like to Help’).

The following analysis also uses the ‘shift scores’ for all of these key personal factors, to analyse the relationship between exhibit engagement and the change in survey responses between the pre-visit and post visit stages. As described in section 4.5.1, ‘shift scores’ for all repeated-measures items are the numerical degree of change between pre-visit and immediate post-visit. These values are described as ‘Shift [Variable name]’ e.g. ‘Shift Connection Nature’. The shift scores were included alongside the post-visit survey scores, in order to begin to understand whether exhibit engagement is more directly related to post-visit outcomes (e.g. the strength of perceived behavioural control) or to the shift in these factors for each individual participant (e.g. the degree to which the participant increased their sense of behavioural control).

5.4.1 Stopping

As noted in the methods chapter, ‘stopping’ or ‘a stop’ is defined as per Serrell (1998) who describes a stop as “a visitor’s stopping with … head or eyes pointed in the direction of the element for two to three seconds or more” (p. 12)). The following analyses look at whether
there are any relationships between stopping at the focal zones and the key personal factors at each zoo.

**Taronga Zoo**

The results of analysis of the relationship between stopping at the Taronga Zoo focal zones and the personal factors is shown in Table 16. Differences between groups could be hypothesised to be suggestive of some association between the zoo experience and visitor responses.

Table 16: Results of independent-samples t-tests, Taronga Zoo.

P=0.00* = p<0.005. Table continues over page.

<table>
<thead>
<tr>
<th>Stop Covered Bridge</th>
<th>Didn’t Stop (n=53)</th>
<th>Stopped (n=147)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help Protect</td>
<td>M 5.51 SD 1.03</td>
<td>M 5.69 SD 1.08</td>
<td>-0.52, 0.15</td>
<td>-1.08</td>
<td>198.00</td>
<td>0.28</td>
<td>-</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.64 0.68</td>
<td>1.12 0.93</td>
<td>-0.75, -0.20</td>
<td>-3.39</td>
<td>198.00</td>
<td>0.00*</td>
<td>0.59</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>4.96 1.16</td>
<td>5.07 1.34</td>
<td>-0.50, 0.27</td>
<td>-0.58</td>
<td>105.42</td>
<td>0.56</td>
<td>-</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.08 0.43</td>
<td>0.21 0.73</td>
<td>-0.30, 0.03</td>
<td>-1.60</td>
<td>156.15</td>
<td>0.11</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>5.83 0.80</td>
<td>5.91 0.90</td>
<td>-0.36, 0.19</td>
<td>-0.58</td>
<td>198.00</td>
<td>0.56</td>
<td>-</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.62 0.86</td>
<td>0.90 1.03</td>
<td>-0.59, 0.03</td>
<td>-1.78</td>
<td>198.00</td>
<td>0.08</td>
<td>-</td>
</tr>
<tr>
<td>Intention</td>
<td>6.00 0.81</td>
<td>5.97 0.98</td>
<td>-0.24, 0.31</td>
<td>0.25</td>
<td>110.86</td>
<td>0.81</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Ranger Station</th>
<th>Didn’t Stop (n=41)</th>
<th>Stopped (n=159)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help Protect</td>
<td>M 5.83 SD 1.07</td>
<td>M 5.60 1.06</td>
<td>-0.14, 0.60</td>
<td>1.24</td>
<td>198.00</td>
<td>0.21</td>
<td>-</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.66 0.73</td>
<td>1.08 0.92</td>
<td>-0.72, -0.11</td>
<td>-2.70</td>
<td>198.00</td>
<td>0.01</td>
<td>0.51</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>4.80 1.36</td>
<td>5.11 1.27</td>
<td>-0.77, 0.17</td>
<td>-1.28</td>
<td>59.16</td>
<td>0.21</td>
<td>-</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.02 0.65</td>
<td>0.21 0.67</td>
<td>-0.42, 0.04</td>
<td>-1.65</td>
<td>63.53</td>
<td>0.10</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>5.90 0.92</td>
<td>5.89 0.86</td>
<td>-0.29, 0.32</td>
<td>0.10</td>
<td>198.00</td>
<td>0.92</td>
<td>-</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.56 0.71</td>
<td>0.90 1.05</td>
<td>-0.61, -0.06</td>
<td>-2.45</td>
<td>90.18</td>
<td>0.02</td>
<td>0.38</td>
</tr>
</tbody>
</table>

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Only a small number of differences between the stopping and non-stopping groups across the personal factors were observed. There was no significant difference between groups in behavioural intention about making more sustainable palm oil purchases in the future and stopping at any of the exhibit focal zones. There was a significant difference in Shift Protect between groups at the Covered Bridge \( (p<0.005) \) and the Ranger Station \( (p=0.01) \). Similarly, there was a significant difference with moderate effect in Shift Protect between groups stopping or not stopping at the Supermarket \( (p<0.005) \). There was a significant difference in responses with moderate effect in Protect between groups stopping or not stopping at the

<table>
<thead>
<tr>
<th>Intention Palm Oil</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Didn’t Stop</td>
<td>5.90</td>
<td>1.02</td>
<td>5.99</td>
<td>0.92</td>
<td>-0.44, 0.26</td>
<td>-0.52</td>
<td>57.80</td>
<td>0.60</td>
<td>-</td>
</tr>
<tr>
<td>Stopped</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Ranger Vehicle</th>
<th></th>
<th></th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help Protect</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>-0.72, -0.13</td>
<td>-2.85</td>
<td>198.00</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>1.04</td>
<td>0.89</td>
<td>0.92</td>
<td>0.91</td>
<td>-0.13, 0.38</td>
<td>0.98</td>
<td>198.00</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>5.00</td>
<td>1.31</td>
<td>5.10</td>
<td>1.28</td>
<td>-0.47, 0.26</td>
<td>-0.56</td>
<td>198.00</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.19</td>
<td>0.68</td>
<td>0.15</td>
<td>0.66</td>
<td>-0.14, 0.23</td>
<td>0.47</td>
<td>198.00</td>
</tr>
<tr>
<td>Purchase</td>
<td>5.80</td>
<td>0.87</td>
<td>6.01</td>
<td>0.87</td>
<td>-0.46, 0.03</td>
<td>-1.74</td>
<td>198.00</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.73</td>
<td>1.05</td>
<td>0.95</td>
<td>0.90</td>
<td>-0.49, 0.05</td>
<td>-1.59</td>
<td>195.73</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>5.87</td>
<td>0.93</td>
<td>6.11</td>
<td>0.93</td>
<td>-0.51, 0.02</td>
<td>-1.86</td>
<td>184.92</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Supermarket</th>
<th></th>
<th></th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help Protect</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>-0.38, 0.218</td>
<td>-0.53</td>
<td>198.00</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.82</td>
<td>0.78</td>
<td>1.18</td>
<td>0.99</td>
<td>-0.61, -0.11</td>
<td>-2.89</td>
<td>198.00</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>4.94</td>
<td>1.22</td>
<td>5.16</td>
<td>1.37</td>
<td>-0.59, 0.14</td>
<td>-1.19</td>
<td>198.00</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.02</td>
<td>0.55</td>
<td>0.35</td>
<td>0.75</td>
<td>-0.50, -0.15</td>
<td>-3.58</td>
<td>166.83</td>
</tr>
<tr>
<td>Purchase</td>
<td>5.80</td>
<td>0.86</td>
<td>5.99</td>
<td>0.88</td>
<td>-0.43, 0.06</td>
<td>-1.50</td>
<td>198.00</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.74</td>
<td>0.92</td>
<td>0.94</td>
<td>1.07</td>
<td>-0.53, -0.13</td>
<td>-3.24</td>
<td>144.20</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>5.94</td>
<td>0.95</td>
<td>6.01</td>
<td>0.93</td>
<td>-0.33, 0.20</td>
<td>-0.50</td>
<td>198.00</td>
</tr>
</tbody>
</table>
Ranger Vehicle (p<0.005). There was a significant difference with large effect for Shift Connection Nature between groups at the Supermarket (p<0.005). There was a significant difference in Shift Purchase between groups at the Ranger Station (p=.02; moderate effect) and stopping at the Supermarket ((p<0.005); small effect).

In all cases reported above, the means for the group that stopped at the exhibit zone were higher than the group that did not stop, indicating that those who stopped at the focal zones gave more positive responses on the survey or demonstrated a greater mean shift in survey response between the pre-visit and immediate post-visit surveys.

**Western Plains Zoo**

The results of the independent-samples t-tests for Western Plains Zoo are presented in Table 17. There are no significant differences between groups who stopped and did not stop at the focal zones at Western Plains Zoo, suggesting no relationship between stopping at the focal zones and survey responses or shifts between the pre- and immediate post-visit surveys. There are also no significant differences between the groups for reported behavioural intention relating to making more sustainable palm oil purchases.

Overall, stopping at exhibit focal zones is patchily related to the key personal factors that contribute to behavioural intention to make more sustainable palm oil purchases, and only at Taronga Zoo. Stopping at the Supermarket at Taronga Zoo had the largest number of correlations with shifts in the key personal factors.
Table 17: Results of independent-samples t-tests, Western Plains Zoo.
Table continues over page.

<table>
<thead>
<tr>
<th></th>
<th>Stop Woodland Exhibit, Right Side</th>
<th>Stop Forest Exhibit, Left Side</th>
<th>Stop Woodland Exhibit Left Side</th>
<th>Stop Forest Exhibit Middle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Didn’t Stop (n=33)</td>
<td>Stopped (n=55)</td>
<td>95%CI for mean difference</td>
<td>t</td>
</tr>
<tr>
<td>Like to Help</td>
<td>M 6.42 SD 0.90</td>
<td>M 6.60 SD 0.68</td>
<td>-0.51, 0.16</td>
<td>-1.03</td>
</tr>
<tr>
<td>Shift Like to Help</td>
<td>M 0.03 SD 0.17</td>
<td>M 0.00 SD 0.33</td>
<td>-0.09, 0.15</td>
<td>0.48</td>
</tr>
<tr>
<td>Purchase</td>
<td>M 4.67 SD 0.82</td>
<td>M 4.84 SD 1.00</td>
<td>-0.57, 0.24</td>
<td>-0.83</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>M 0.12 SD 0.49</td>
<td>M 0.22 SD 0.53</td>
<td>-0.32, 0.13</td>
<td>-0.85</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>M 4.94 SD 0.97</td>
<td>M 5.18 SD 1.04</td>
<td>-0.68, 0.20</td>
<td>-1.09</td>
</tr>
</tbody>
</table>
### 5.4.2 Dwell time

The following section will examine whether there is a relationship between total dwell time in the exhibit and dwell time at the focal zones, and key personal factors that contribute to behavioural intention to make more sustainable palm oil purchases in the future.

Positive correlations with the key personal factors indicate that longer dwell time was associated with more strongly agreeing with the immediate post-visit survey statement. For the shifts, positive correlations indicate that longer dwell time correlates with a larger shift between the pre-visit and immediate post-visit surveys.

**Taronga Zoo**

Only a small number of correlations between dwell time and personal factors was identified (Table 18). Total dwell time did not correlate significantly with any of the post-visit key personal factors, but correlated positively with Shift Help Protect, Shift Connection Nature, and Shift Purchase, all with small effect size.

Dwell time at the Covered Bridge significantly positively correlated with Shift Help Protect and Shift Connection Nature, both with small effect size. Dwell time at the Ranger Station significantly positively correlated with Connection Nature, again with small effect. Dwell time at the Ranger Vehicle significantly positively correlated with Shift Purchase, with medium effect. There was again no direct correlation between exhibit engagement (dwell time) and Intention Palm Oil.

---

<table>
<thead>
<tr>
<th>Stop Interpretation Hut</th>
<th>Didn’t Stop (n=62)</th>
<th>Stopped (n=36)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like to Help</td>
<td>6.42</td>
<td>0.87</td>
<td>6.69</td>
<td>0.58</td>
<td>-0.58, 0.04</td>
<td>-1.76</td>
</tr>
<tr>
<td>Shift Like to Help</td>
<td>0.02</td>
<td>0.37</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.10, 0.14</td>
<td>0.31</td>
</tr>
<tr>
<td>Purchase</td>
<td>4.62</td>
<td>0.95</td>
<td>5.00</td>
<td>0.86</td>
<td>-0.78, 0.01</td>
<td>-1.94</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.15</td>
<td>0.36</td>
<td>0.22</td>
<td>0.68</td>
<td>-0.32, 0.18</td>
<td>-0.55</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>4.96</td>
<td>1.03</td>
<td>5.28</td>
<td>0.97</td>
<td>-0.75, 0.12</td>
<td>-1.45</td>
</tr>
</tbody>
</table>
The coefficients of determination reported in Table 18 indicate that despite these significant correlations, dwell time only explains a very small amount of variance in the personal factors.

Table 17: Results of Pearson product-moment correlations with personal factors and dwell time, Taronga Zoo.

<table>
<thead>
<tr>
<th>Personal Factor</th>
<th>Total Exhibit Complex Dwell Time</th>
<th>Coefficient of Determination ($r^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help Protect</td>
<td>-0.002</td>
<td>0.97</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.19</td>
<td>0.01</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>0.10</td>
<td>0.18</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.15</td>
<td>0.04</td>
</tr>
<tr>
<td>Purchase</td>
<td>0.08</td>
<td>0.28</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.16</td>
<td>0.03</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>0.05</td>
<td>0.46</td>
</tr>
<tr>
<td>Dwell Time - Covered Bridge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Help Protect</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.20</td>
<td>0.005</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>-0.02</td>
<td>0.80</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.17</td>
<td>0.02</td>
</tr>
<tr>
<td>Purchase</td>
<td>0.02</td>
<td>0.77</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.10</td>
<td>0.14</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>Dwell Time - Ranger Station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Help Protect</td>
<td>0.07</td>
<td>0.31</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.06</td>
<td>0.38</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>0.15</td>
<td>0.04</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.11</td>
<td>0.12</td>
</tr>
<tr>
<td>Purchase</td>
<td>0.05</td>
<td>0.51</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.07</td>
<td>0.35</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>0.05</td>
<td>0.49</td>
</tr>
<tr>
<td>Dwell Time - Ranger Vehicle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Help Protect</td>
<td>0.09</td>
<td>0.20</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.20</td>
<td>0.09</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>0.05</td>
<td>0.51</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Purchase</td>
<td>0.04</td>
<td>0.61</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.21</td>
<td>0.00</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>0.01</td>
<td>0.88</td>
</tr>
<tr>
<td>Dwell Time - Supermarket</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results of the analysis for Western Plains Zoo is shown in Table 19. No relationship was identified between total exhibit complex dwell time, dwell time at the Forest Exhibit (Left Side), or the Woodland Exhibit (Left side) and any of the personal factors. There were small positive correlations between dwell time at the Woodland Exhibit (right side) and Purchase and Shift Purchase. There was a small positive correlation between dwell time at the Interpretation Hut and Purchase and Intention Palm Oil. Unlike at Taronga Zoo, there were two direct correlations between dwell time and behavioural intention related to palm oil purchases (Intention Palm Oil). Dwell time at the Woodland Exhibit (right hand side) and the Interpretation Hut both correlated with this factor. Again, the coefficients of determination (.05 and .04 respectively) suggest that dwell time only explains a very small amount of variation in these personal factors.

As with the previous analysis, dwell time is only patchily correlated with the key personal factors. Where there is a significant correlation, indicating some relationship, the coefficients of determination indicate that only a small amount of variation in the personal factors (<8%) is explained by the dwell time at the focal zones.
Table 18: Results of Pearson product-moment correlations with personal factors dwell time, Western Plains Zoo.

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>p</th>
<th>Coefficient of Determination ($r^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Exhibit Complex Dwell Time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like to Help</td>
<td>0.15</td>
<td>0.17</td>
<td>-</td>
</tr>
<tr>
<td>Shift Like to Help</td>
<td>0.03</td>
<td>0.82</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>0.20</td>
<td>0.06</td>
<td>-</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.10</td>
<td>0.35</td>
<td>-</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>0.15</td>
<td>0.17</td>
<td>-</td>
</tr>
<tr>
<td><strong>Dwell Time - Woodland Exhibit, Right Side</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like to Help</td>
<td>0.08</td>
<td>0.45</td>
<td>-</td>
</tr>
<tr>
<td>Shift Like to Help</td>
<td>0.04</td>
<td>0.74</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>0.23</td>
<td>0.03</td>
<td>.05</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.21</td>
<td>0.005</td>
<td>.04</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>0.21</td>
<td>0.05</td>
<td>.04</td>
</tr>
<tr>
<td><strong>Dwell Time - Forest Exhibit, Left Side</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like to Help</td>
<td>0.05</td>
<td>0.67</td>
<td>-</td>
</tr>
<tr>
<td>Shift Like to Help</td>
<td>-0.02</td>
<td>0.87</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>-0.05</td>
<td>0.68</td>
<td>-</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.06</td>
<td>0.60</td>
<td>-</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>-0.02</td>
<td>0.87</td>
<td>-</td>
</tr>
<tr>
<td><strong>Dwell Time - Woodland Exhibit Left Side</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like to Help</td>
<td>-0.14</td>
<td>0.18</td>
<td>-</td>
</tr>
<tr>
<td>Shift Like to Help</td>
<td>0.07</td>
<td>0.52</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>-0.11</td>
<td>0.33</td>
<td>-</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>-0.11</td>
<td>0.60</td>
<td>-</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>-0.07</td>
<td>0.55</td>
<td>-</td>
</tr>
<tr>
<td><strong>Dwell Time - Forest Exhibit Middle</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like to Help</td>
<td>-0.14</td>
<td>0.18</td>
<td>-</td>
</tr>
<tr>
<td>Shift Like to Help</td>
<td>0.07</td>
<td>0.52</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>-0.11</td>
<td>0.33</td>
<td>-</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>-0.11</td>
<td>0.60</td>
<td>-</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>-0.07</td>
<td>0.55</td>
<td>-</td>
</tr>
<tr>
<td><strong>Dwell Time - Interpretation Hut</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like to Help</td>
<td>0.12</td>
<td>0.28</td>
<td>-</td>
</tr>
<tr>
<td>Shift Like to Help</td>
<td>-0.02</td>
<td>0.83</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>0.27</td>
<td>0.01</td>
<td>.08</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.03</td>
<td>0.82</td>
<td>-</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>0.28</td>
<td>0.01</td>
<td>.08</td>
</tr>
</tbody>
</table>
5.4.3 Tiger Visibility

Analysis of the impact of seeing a tiger was only possible for Taronga Zoo as all visitors at Western Plains Zoo saw a tiger during their visit. Most Western Plains Zoo visitors saw a tiger from all focal zones.

Tiger visibility at Taronga Zoo at focal zones appears to be related (Table 20) to several personal factors (and shifts in personal factors) identified as contributing to behavioural intention around sustainable palm oil purchasing behaviour. Visitors who saw a tiger at the Covered Bridge or the Ranger Station demonstrated a larger shift between the pre-visit and post-visit surveys than the group that did not (with large and moderate effect respectively). Visitors who saw a tiger from the Ranger Vehicle zone significantly more strongly agreed with the post-visit statements for all three key personal factors (Protect, Connection Nature, and Purchase).

There was a significant difference between groups on the Shift Purchase measure. Visitors who saw a tiger at the Ranger Vehicle zone demonstrated a higher mean shift on this factor between the pre-visit and post-visit surveys (M=1.04 and M=0.71 respectively). Finally, visitors who saw a tiger from this zone reported a stronger mean intention to make sustainable palm oil purchases in the future than visitors who did not see a tiger at this zone (M=6.18 and M=5.86 respectively).
Table 20: Results of independent-samples t-tests, between groups that saw tigers/didn’t see tigers at focal zones, Taronga Zoo.

P=0.00* = p<0.005.

### See Tiger - Covered Bridge

<table>
<thead>
<tr>
<th></th>
<th>No (n=83)</th>
<th>Yes (n=117)</th>
<th>95% CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help Protect</td>
<td>5.54 0.97</td>
<td>5.72 1.13</td>
<td>-0.48, 0.12</td>
<td>-1.15</td>
<td>198.00</td>
<td>0.25</td>
<td>-</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.73 0.81</td>
<td>1.17 0.91</td>
<td>-0.68, -0.19</td>
<td>-3.48</td>
<td>198.00</td>
<td>0.00*</td>
<td>0.51</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>5.05 1.30</td>
<td>5.04 1.30</td>
<td>-0.36, 0.37</td>
<td>0.03</td>
<td>198.00</td>
<td>0.98</td>
<td>-</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.10 0.46</td>
<td>0.23 0.78</td>
<td>-0.31, 0.04</td>
<td>-1.53</td>
<td>191.97</td>
<td>0.13</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>5.86 0.80</td>
<td>5.91 0.93</td>
<td>-0.31, 0.19</td>
<td>-0.47</td>
<td>198.00</td>
<td>0.64</td>
<td>-</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.78 0.91</td>
<td>0.86 1.05</td>
<td>-0.36, 0.20</td>
<td>-0.56</td>
<td>198.00</td>
<td>0.58</td>
<td>-</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>5.99 0.90</td>
<td>5.97 0.96</td>
<td>-0.24, 0.29</td>
<td>0.16</td>
<td>198.00</td>
<td>0.87</td>
<td>-</td>
</tr>
</tbody>
</table>

### See Tiger - Ranger Station

<table>
<thead>
<tr>
<th></th>
<th>No (n=89)</th>
<th>Yes (n=111)</th>
<th>95% CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help Protect</td>
<td>5.66 1.11</td>
<td>5.63 1.04</td>
<td>-0.27, 0.33</td>
<td>0.21</td>
<td>198.00</td>
<td>0.83</td>
<td>-</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.82 0.75</td>
<td>1.13 0.98</td>
<td>-0.55, -0.07</td>
<td>-2.50</td>
<td>197.48</td>
<td>0.01</td>
<td>0.36</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>4.91 1.40</td>
<td>5.15 1.19</td>
<td>-0.61, 0.13</td>
<td>-1.30</td>
<td>173.00</td>
<td>0.20</td>
<td>-</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.12 0.74</td>
<td>0.22 0.61</td>
<td>-0.28, 0.10</td>
<td>-0.97</td>
<td>198.00</td>
<td>0.33</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>5.83 0.94</td>
<td>5.94 0.81</td>
<td>-0.36, 0.14</td>
<td>-0.84</td>
<td>174.29</td>
<td>0.41</td>
<td>-</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.76 0.93</td>
<td>0.88 1.04</td>
<td>-0.40, 0.16</td>
<td>-0.84</td>
<td>198.00</td>
<td>0.40</td>
<td>-</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>5.92 1.04</td>
<td>6.02 0.85</td>
<td>-0.37, 0.17</td>
<td>-0.71</td>
<td>169.53</td>
<td>0.48</td>
<td>-</td>
</tr>
</tbody>
</table>

### See Tiger - Ranger Vehicle

<table>
<thead>
<tr>
<th></th>
<th>No (n=129)</th>
<th>Yes (n=71)</th>
<th>95% CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help Protect</td>
<td>5.49 1.08</td>
<td>5.93 0.99</td>
<td>-0.75, -0.14</td>
<td>-2.85</td>
<td>198.00</td>
<td>0.00*</td>
<td>0.43</td>
</tr>
<tr>
<td>Shift Help Protect</td>
<td>0.94 0.82</td>
<td>1.08 1.03</td>
<td>-0.43, 0.13</td>
<td>-1.04</td>
<td>119.59</td>
<td>0.30</td>
<td>-</td>
</tr>
<tr>
<td>Connection Nature</td>
<td>4.84 1.27</td>
<td>5.41 1.27</td>
<td>-0.93, -0.19</td>
<td>-3.01</td>
<td>198.00</td>
<td>0.00*</td>
<td>0.45</td>
</tr>
<tr>
<td>Shift Connection Nature</td>
<td>0.16 0.71</td>
<td>0.20 0.60</td>
<td>-0.230, 0.16</td>
<td>-0.35</td>
<td>198.00</td>
<td>0.73</td>
<td>-</td>
</tr>
<tr>
<td>Purchase</td>
<td>5.77 0.88</td>
<td>6.11 0.82</td>
<td>-0.60, -0.10</td>
<td>-2.72</td>
<td>198.00</td>
<td>0.01</td>
<td>0.40</td>
</tr>
<tr>
<td>Shift Purchase</td>
<td>0.71 0.98</td>
<td>1.04 0.99</td>
<td>-0.62, -0.04</td>
<td>-2.27</td>
<td>198.00</td>
<td>0.02</td>
<td>0.34</td>
</tr>
<tr>
<td>Intention Palm Oil</td>
<td>5.86 0.96</td>
<td>6.18 0.87</td>
<td>-0.59, -0.05</td>
<td>-2.36</td>
<td>198.00</td>
<td>0.02</td>
<td>0.40</td>
</tr>
</tbody>
</table>
5.5 Connection with Tigers

Reported feeling of connection to tigers was not identified as a key personal factor contributing to intention to make more sustainable palm oil purchases at either Taronga Zoo or Western Plains Zoo. However, as discussed earlier, emotional connection has been established as a key factor in informal science learning, and zoos routinely identify ‘connection with animals’ as one of their key strategies for affecting attitudes towards conservation. On that basis, the same analyses as conducted above on the key personal factors was undertaken. These tests were used to identify whether there was any relationship between exhibit engagement and immediate post-visit connection to tigers (Connection Tiger) or shift in connection to tigers between the pre and immediate post-visit surveys (Shift Connection Tiger).

5.5.1 Stopping

Taronga Zoo

Significant differences (Table 21) were observed between groups who engaged with the Covered Bridge and Ranger Station focal zones. Visitors who stopped at the Covered Bridge or the Ranger Station had a larger mean shift in connection to tigers than those who did not stop, with moderate and large effect respectively. Stopping at the Ranger Vehicle and Supermarket was not related to connection to tigers.
Table 21: Results of independent-samples t-tests, for connection to tigers between groups that stopped/didn’t stop at focal zones, Taronga Zoo.

<table>
<thead>
<tr>
<th>Stop Covered Bridge</th>
<th>Didn’t Stop (n=53)</th>
<th>Stopped (n=147)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Connection Tiger</td>
<td>5.11</td>
<td>1.17</td>
<td>5.03</td>
<td>1.18</td>
<td>-0.29</td>
<td>0.45</td>
<td>0.42</td>
</tr>
<tr>
<td>Shift Connection</td>
<td>0.26</td>
<td>0.59</td>
<td>0.53</td>
<td>0.66</td>
<td>-0.48</td>
<td>-0.06</td>
<td>-2.73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Ranger Station</th>
<th>Didn’t Stop (n=41)</th>
<th>Stopped (n=159)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Connection Tiger</td>
<td>4.78</td>
<td>1.22</td>
<td>5.13</td>
<td>1.16</td>
<td>-0.75</td>
<td>0.6</td>
<td>-1.69</td>
</tr>
<tr>
<td>Shift Connection</td>
<td>0.17</td>
<td>0.38</td>
<td>0.53</td>
<td>0.68</td>
<td>-0.52</td>
<td>-0.21</td>
<td>-4.52</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Ranger Vehicle</th>
<th>Didn’t Stop (n=113)</th>
<th>Stopped (n=87)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Connection Tiger</td>
<td>4.96</td>
<td>1.21</td>
<td>5.17</td>
<td>1.12</td>
<td>-0.54</td>
<td>0.12</td>
<td>-1.25</td>
</tr>
<tr>
<td>Shift Connection</td>
<td>0.44</td>
<td>0.67</td>
<td>0.48</td>
<td>0.63</td>
<td>-0.22</td>
<td>0.14</td>
<td>-0.44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Supermarket</th>
<th>Didn’t Stop (n=107)</th>
<th>Stopped (n=93)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Connection Tiger</td>
<td>5.06</td>
<td>1.16</td>
<td>5.05</td>
<td>1.20</td>
<td>-0.33</td>
<td>0.33</td>
<td>0.01</td>
</tr>
<tr>
<td>Shift Connection</td>
<td>0.50</td>
<td>0.68</td>
<td>0.41</td>
<td>0.61</td>
<td>-0.09</td>
<td>0.28</td>
<td>1.05</td>
</tr>
</tbody>
</table>
Western Plains Zoo

No significant difference between groups (Table 22) was identified. In fact, while not significantly different between groups, in several cases the group that did not stop at the exhibit focal zone actually had a higher mean survey score or shift on the connection to tiger measure.

Table 22: Results of independent-samples t-tests, for connection to tigers between groups that stopped/didn’t stop at focal zones, Western Plains Zoo.

<table>
<thead>
<tr>
<th>Stop Woodland Exhibit, Right Side</th>
<th>Didn’t Stop (n=33)</th>
<th>Stopped (n=55)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>-2.81, .608</td>
<td>0.74</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.33</td>
<td>0.54</td>
<td>0.33</td>
<td>0.47</td>
<td>-2.13, .225</td>
<td>0.06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Forest Exhibit, Left Side</th>
<th>Didn’t Stop (n=48)</th>
<th>Stopped (n=40)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>-0.497, .280</td>
<td>-0.55</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.35</td>
<td>0.53</td>
<td>0.30</td>
<td>0.46</td>
<td>-0.158, .266</td>
<td>0.51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Woodland Exhibit, Left Side</th>
<th>Didn’t Stop (n=74)</th>
<th>Stopped (n=14)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>-0.443, .616</td>
<td>0.33</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.31</td>
<td>0.50</td>
<td>0.43</td>
<td>0.51</td>
<td>-0.406, .170</td>
<td>-0.81</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Forest Exhibit, Middle</th>
<th>Didn’t Stop (n=62)</th>
<th>Stopped (n=26)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>-0.608, .238</td>
<td>-0.87</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.31</td>
<td>0.47</td>
<td>0.38</td>
<td>0.57</td>
<td>-0.309, .153</td>
<td>-0.67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stop Interpretation Hut</th>
<th>Didn’t Stop (n=62)</th>
<th>Stopped (n=36)</th>
<th>95%CI for mean difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>-0.235, .496</td>
<td>0.71</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.38</td>
<td>0.53</td>
<td>0.25</td>
<td>0.44</td>
<td>-0.079, .348</td>
<td>1.26</td>
</tr>
</tbody>
</table>
5.5.2 Dwell Time

Taronga Zoo

There was a significant positive correlation between dwell time at the Covered Bridge and shift in connection to tigers (Shift Connection Tiger) (Table 23). Dwell time at the Ranger Station significantly positively correlated with both post-visit connection to tigers (Connection Tiger; p=0.05) and Shift Connection Tiger (p=0.00). Dwell time at the Ranger Vehicle significantly positively correlated with Connection Tiger p=0.04). There was no correlation between dwell time at the Supermarket and the connection to tiger factors. As with the dwell time analysis on the other key personal factors, the amount of variation in the personal factor explained by dwell time is very small, between two and five percent in this analysis (see r² value).

Table 23: Results of Pearson product-moment correlation for connection to tiger and dwell time, Taronga Zoo.

<table>
<thead>
<tr>
<th></th>
<th>Dwell Time - Covered Bridge</th>
<th></th>
<th>Dwell Time - Ranger Station</th>
<th></th>
<th>Dwell Time - Ranger Vehicle</th>
<th></th>
<th>Dwell Time - Supermarket</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r   p</td>
<td>Coefficient of Determination (r²)</td>
<td></td>
<td>r   p</td>
<td>Coefficient of Determination (r²)</td>
<td></td>
<td>r   p</td>
</tr>
<tr>
<td>Connection Tiger</td>
<td>0.02 0.82</td>
<td>-</td>
<td></td>
<td>0.14 0.05</td>
<td>0.02</td>
<td></td>
<td>0.15 0.04</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.23 0.00</td>
<td>0.05</td>
<td></td>
<td>0.20 0.00</td>
<td>0.04</td>
<td></td>
<td>0.11 0.13</td>
</tr>
</tbody>
</table>
As shown in Table 24, there was a single correlation between dwell time and reported connection to tigers observed at Western Plains Zoo. Dwell time at the middle section of the Forest Exhibit significantly positively correlated with reported post-visit connection to Tigers (Connection Tiger; \( p=0.03 \)). However, only 5.2% of the variation in this personal factor is explained by dwell time.

Table 24: Results of Pearson product-moment correlation for connection to tiger and dwell time, Western Plains Zoo.

<table>
<thead>
<tr>
<th>Dwell Time - Woodland Exhibit, Right Side</th>
<th>r</th>
<th>p</th>
<th>Coefficient of Determination (( r^2 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>0.15</td>
<td>0.18</td>
<td>-</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.09</td>
<td>0.39</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dwell Time - Forest Exhibit, Left Side</th>
<th>r</th>
<th>p</th>
<th>Coefficient of Determination (( r^2 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>-0.01</td>
<td>0.97</td>
<td>-</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>-0.15</td>
<td>0.18</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dwell Time - Woodland Exhibit, Left Side</th>
<th>r</th>
<th>p</th>
<th>Coefficient of Determination (( r^2 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>0.02</td>
<td>0.83</td>
<td>-</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.02</td>
<td>0.83</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dwell Time - Forest Exhibit, Middle</th>
<th>r</th>
<th>p</th>
<th>Coefficient of Determination (( r^2 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>0.23</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>0.19</td>
<td>0.07</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dwell Interpretation Hut</th>
<th>r</th>
<th>p</th>
<th>Coefficient of Determination (( r^2 ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Tiger</td>
<td>-0.06</td>
<td>0.59</td>
<td>-</td>
</tr>
<tr>
<td>Shift Connection Tiger</td>
<td>-0.01</td>
<td>0.92</td>
<td>-</td>
</tr>
</tbody>
</table>
5.5.3 Tiger Visibility

There was a significant difference in reported shift in connection to tigers (Table 25) between visitors that saw a tiger and those that did not at the Ranger Station. Those visitors that saw a tiger had a higher mean response to Connection Tiger than those that did not. This analysis had a very large effect size (Cohen’s d=0.75), indicating a strong relationship between seeing a tiger at the Ranger Station and shift in connection to tigers. Visitors who saw a tiger at the Ranger Vehicle zone had a higher mean response to Connection Tiger and a higher mean Shift Connection tiger than those that did not. The moderate and large (respectively) effect sizes for these two tests further suggest strong relationship between tiger visibility and reported connection to tigers.

Table 25: Results of independent-samples t-test for connection to tiger between groups who saw tiger/didn’t see tiger at focal zones, Taronga Zoo.

<table>
<thead>
<tr>
<th></th>
<th>See Tiger - Covered Bridge</th>
<th>See Tiger - Ranger Station</th>
<th>See Tiger - Ranger Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
<td>M  SD</td>
</tr>
<tr>
<td>No (n=83)</td>
<td>5.22 1.19</td>
<td>4.94 1.15</td>
<td>4.93 1.19</td>
</tr>
<tr>
<td>Yes (n=117)</td>
<td>4.94 1.15</td>
<td>5.12 1.15</td>
<td>5.28 1.11</td>
</tr>
<tr>
<td>Conn Tiger</td>
<td>-0.05, 0.61</td>
<td>-0.47, 0.19</td>
<td>-0.69, -0.01</td>
</tr>
<tr>
<td>Shift Conn Tiger</td>
<td>-0.29, 0.08</td>
<td>-0.61, -0.28</td>
<td>-0.57, -0.19</td>
</tr>
<tr>
<td></td>
<td>-1.65 198.00 0.10</td>
<td>-0.83 198.00 0.40</td>
<td>-2.04 198.00 0.04</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>0.75</td>
<td>0.30</td>
</tr>
</tbody>
</table>

5.6 Summary of results

Reflecting on the overarching research question, this chapter examines whether zoo exhibit design can impact the efficacy of zoo-based behaviour-change campaigns. In particular, it discusses whether the attitudes, perceived behavioural control, cognition and connection factors (collectively termed ‘personal factors’) of zoo visitors can be affected by visiting and engaging with the two zoo exhibits.
It is certainly true that the two zoos in this study, which have very different design styles, have differing impacts on the personal factors of the visitor experience. Analysis of survey responses from visitors to Taronga Zoo’s Tiger Trek reveal significant shifts from the pre-visit stage to the immediate post-visit stage for all measured personal factors. Many of the significant effects of the visit appear to be sustained, to varied degrees, three months after the visit. Notably, the visit is also evidenced to impact on visitor intention to purchase products containing sustainable palm oil. This reported intention ultimately resulted in actual behavioural outcome; those visitors who more strongly intended to make more sustainable palm oil products choices reporting that they had done so since their zoo visit.

Visiting the Tiger Forest at Western Plains Zoo also has a positive impact on many of the personal factors measured in the surveys. However, when compared to Taronga Zoo, this impact was smaller, and in some cases not significant. The apparent impact of a visit to Western Plains Zoo is also much smaller three months after the visit, although a strong reported feeling of general ability to help protect tigers in the wild remains.

The study then explored which of these personal factors contributed to reported behavioural intention to make more sustainable palm oil product choices. For both sites, the single personal factor that contributes most to this intention was a feeling of perceived behavioural control that the visitor could actually make product purchases that help protect tigers. The secondary contributing factors varied between the two zoos. These findings, which will be discussed further in the next chapter, suggest that it is these contributing personal factors that should be the focus of visitor behaviour-change campaigns and on-site interventions.

The second element of the research project looked to understand how visitor engagement with the exhibit relates to these personal factors. Put simply, does exhibit engagement have any perceivable relationship to the key personal factors? Visitor observations (stopping, dwell time and tiger visibility) found a small number of relationships. Only a small number of differences between the stopping and non-stopping groups across the personal factors were observed, and this was limited to Taronga Zoo. Dwell time showed patchy and often small correlations, often explaining only small amounts of variation in survey responses. Visibility of tigers at Tiger Trek, particularly from the zone with the Ranger Vehicle, did seem to correlate positively with survey responses, suggesting that tiger visibility may be a key
consideration for impactful behaviour change messaging. Overall, and perhaps unsurprisingly, it appears that seeing a tiger is the most important exhibit engagement factor in reported sense of connection (or shift in sense of connection) to tigers, at least at Taronga Zoo.

The results of this study will next be considered and discussed in the context of designing zoo visitor interventions that best capitalise on a zoo’s ability to impact pro-environmental behaviours of zoo visitors. This will include considering how zoos can best focus on affecting the key personal factors that contribute to pro-environmental behaviours. It will also consider how zoo exhibit design can be used to increase the effectiveness of behaviour-change campaigns that focus on these personal factors.
6. Discussion and Conclusions

6.1 Introduction

While science and environmental education in informal learning settings, like zoos, has received a significant amount of attention, research into the impact of zoos on the factors that are thought to lead to meaningful pro-environmental behaviour change remains limited. Further, research into the role of the physical zoo environment in environmental education and behaviour change is largely non-existent. There have been calls for a closer investigation of this relationship for at least a decade (see Fraser et al., 2010). This thesis aims to begin addressing this gap by answering the overarching research question: does zoo exhibit design affect the efficacy of zoo-based behaviour change campaigns? It does this by examining a series of sub-questions aimed at understanding the impact of zoos on the personal factors that contribute to behaviour change. This chapter will work through each of these research sub-questions, before coming to a conclusion on the overarching research question and making recommendations for future work.

This chapter will discuss the impact of a visit to Taronga or Western Plains Zoos’ tiger exhibits on personal factors that may influence behaviour (Section 6.2). It will also look at which of these personal factors apparently contributed most significantly to reported intention to make more sustainable palm oil product choices to help protect tigers (Section 6.3). Relationships between exhibit engagement and these key personal factors, and connection to tigers will be discussed in Sections 6.4 and 6.5 respectively. This chapter will then take the research findings and put them further within a practical context, making recommendations and observations for consideration by zoo professionals (Section 6.6). Finally, the limitations, summary recommendations and conclusions of the research are discussed (Sections 6.7, 6.8 and 6.9 respectively).

6.2 Does visiting tiger exhibits impact visitors’ perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation?

Analysis of the pre-visit and immediate post-visit survey responses for Taronga Zoo visitors showed that the visit to Tiger Trek significantly impacted all of the measured personal factors. There was also an observed change between the pre-visit and three-month delayed post-visit
stage for some of the personal factors. Visiting Western Plains Zoo’s Tiger Forest also appeared to significantly impact visitors’ perceived behavioural control, attitudes, sense of connection and understanding of tiger conservation issues immediately following their visit. Overall, the observed impact on zoo visitors was of a smaller magnitude than was observed at Taronga Zoo, and there was no significant effect of the Western Plains Zoo visit on visitors’ attitudes towards wanting to help protect tigers, or their perceived ability to influence their friends and family to help protect tigers. These results will be further discussed in more detail below, organised by personal factor.

6.2.1 Perceived behavioural control

As discussed earlier, perceived behavioural control is hypothesised to be a direct contributor to behavioural intention, and may directly impact on behaviour, according to the Theory of Planned Behaviour (TPB; Ajzen, 1991; 2002). Overall, the visit to Taronga Zoo’s Tiger Trek appears to have had the largest immediate post-visit effect on visitors’ reported perceived behavioural control regarding behaviours that help protect tigers, compared to the other personal factors. Visiting Western Plains Zoo also had a moderate immediate post-visit effect on the perceived behavioural control measures.

Of the shifts in perceived behavioural control, the largest effect for both sites was on the more generalised perceived behavioural control measure pertaining to the belief that they could help protect tigers in the wild. Visitors left Tiger Trek with a much stronger general feeling that they can help protect tigers in the wild, and this is sustained and in fact increased over the subsequent three month period. This supports and accords with the findings of Clayton et al. (2017) who found that visiting a Paris zoo had a significant effect on visitors’ self-efficacy regarding their ability to help protect biodiversity. This is particularly notable, since both the current study and the Clayton et al. (2017) study examined whether visitors believed that they could help protect tigers and biodiversity respectively. This may point to a significant theme in visitor self-efficacy or perceived behavioural control: the role of the individual as part of the ‘whole’ in biodiversity and species conservation. That is, that zoo visitors recognise that they can actually ‘do something’ that makes a tangible difference to the conservation outcomes of species, even species in other countries.
This perceived behavioural control appears to increase at the three-month post visit stage. This may indicate that visitors are able to reinforce their ability to help tigers by changing their palm-oil purchasing behaviours in that period. It may also, or alternately, be indicative that the zoo visit created a platform for further learning about ways to help protect tigers that compounds over time. This speaks to the idea of zoos as “catalysts for conservation”, the name of a 2004 zoo symposium examining the direction for zoos in the 21st century (see West & Dickie, 2007, p. 4) and the claim that the zoo experience can lay a foundation for further learning, care, concern, and action. Finally, it is important to note that this effect was noted in the small cohort of visitors who completed the 3-month post-visit survey. It is possible that this group were motivated to complete this voluntary online survey by their own personal feelings about tigers, conservation, or palm oil, and this may have biased the results.

6.2.2 Attitudes and cognition

The results of this study align with the outcomes of a large, multi-institution study which found that visitors to zoos reported a significantly increased understanding about biodiversity and knowledge of actions to help protect it (Moss et al., 2014). Tiger Trek had a very large impact on visitors’ reported immediate post-visit understanding of the threats to tigers, which is sustained over time (although not significantly increased) to the delayed post-visit survey. This suggests that visiting Tiger Trek has a measurable and persistent impact on cognitive understanding of the information conveyed about threats to tigers. Visiting Tiger Forest also had a large impact on understanding of the threats to tigers in the wild, which is sustained to the delayed post-visit stage (although does not increase significantly following the zoo visit).

These findings are consistent with several studies that have observed a significant increase in conservation knowledge after visiting a zoo (Adelman et al., 2000; Clayton et al., 2017). It also aligns with much broader studies by Moss et al. (2014; 2015), which established that zoos can affect a change in understanding of biodiversity. Moss et al. (2015) discuss the role of zoos as a contributor to achieving Aichi Biodiversity Target 1: “By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably” (Convention on Biological Diversity, 2013, paragraph 3). At the time of writing this thesis, the Convention on Biological Diversity was developing its post-2020 global biodiversity framework, which will contain targets and actions towards a global 2050 Vision for “Living in Harmony with Nature”. The vision states: “By 2050, biodiversity is
valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people” (Convention on Biological Diversity, 2018 paragraph 3). The results of this study, taken in concert with the other studies mentioned here, are supportive of a role for zoos in contributing to this 2050 Vision, such as enhancing peoples’ understanding of how they can act to conserve nature, and increasing their capacity to do so.

The mechanism for increasing cognitive understanding of the threats to tigers in the wild at the two zoo sites included in this study are likely to be different. Taronga Zoo uses minimal traditional interpretative materials like signs. Those signs that exist are typically more focussed on biological facts about tigers that assist in tracking tigers in the wild (aligning with the sub-theme of the exhibit, which is helping rangers to track down tigers in Way Kambas National Park). Information about threats to tigers in the wild is largely limited to the spoken commentary during the ‘plane flight’, and via a video screen located in the Ranger Station building (with which there was very little visitor engagement). All participants in this study experienced the ‘plane flight’; therefore, it could be concluded that this is the major exhibit factor contributing to increased understanding in Taronga Zoo visitors. An experimental research design (comparing visitors who take the ‘plane flight’ to those who don’t) could test this hypothesis although there would be practical ethical and visitor management challenges to this (see section 4.6).

The Western Plains Zoo exhibit uses traditional interpretation signs (in the Interpretation Hut) which highlight quite clearly the threats to tigers in the wild, using language like “Unsustainable palm oil is the biggest threat to their future” (see photos in Chapter 3). It was observed that most visitors who stopped at the Interpretation Hut appeared to be reading the signs. Existing literature on the role of signs and other sign-like interpretive materials in zoos is mixed, but generally unenthusiastic. Some studies found that visitors either don’t read signs or read only parts of signs (Derwin & Piper, 1988), or that the installation of signage did not have an impact on attitudes or learning (Waller, Peirce, Mitchell & Micheletta, 2012). Conversely, the findings of this study may accord with Moss et al.’s (2017) findings that visitors who reported seeing information panels during their visit to one of 20 zoos around the world demonstrated a higher increase in acquisition of biodiversity understanding compared to those visitors who did not see the signs. Clayton et al. (2018) also found that informational signage could be effective in increasing knowledge about the impact of illegal wildlife trade
where the visitors discussed the content of signage. Most visitors to Western Plains Zoo were in a social group of some kind, and so this effect may also have been playing out in this cohort. The scope of this project did not allow the hypothesis of the effectiveness of signage to be considered more fulsomely. As the Understand Threats personal factor was not identified as a key personal factor contributing to behavioural intention at either zoo, it was subsequently not included in the analysis of the impact of exhibit engagement on the key personal factors. Without further exploration of the relationship between engagement with the Western Plains Zoo Interpretation Hut and this increased reported understanding, it is not possible to confirm the relationship empirically within the limited scope of this study. Future research, perhaps focussing on the role of certain signage content, format or structure, may wish to examine this relationship further. However, given most, if not all, zoos continue to use signs usually combining graphics and words (Serrell, 1988) and noting the potential efficacy of the Tiger Forest signs as an educational device, it would be worthwhile evaluating and potentially enhancing this exhibit element. The role of signage as an exhibit engagement factor will be discussed further in Section 6.6.

Zoos have attempted to understand how visiting a zoo can affect visitor attitudes towards animals, biodiversity and conservation. This study attempted to understand whether attitudes towards tiger conservation could be affected by visiting a tiger exhibit hypothesising, based on existing literature, that an experience of a tiger (as the ‘attitude object’) and persuasive communications in the exhibit may affect the emotional or cognitive components that drive attitudes (McGuire et al., 1985; Manstead, 1990). Visits to both zoos in this study significantly positively affected attitudes towards the importance of tiger protection. This is in contrast to earlier studies that found no impact of a zoo visit on attitudes (e.g. Kellert & Dunlap, 1989). Visitors to Taronga Zoo significantly more strongly agreed with the statement ‘If I could, I would like to help protect tigers in the wild’ immediately after their visit. This accords with Clayton et al. (2009) who found that visitors asked the same question following their zoo visit also agreed that they would like to help protect the relevant species in the wild. Further, this thesis also demonstrates that a zoo visit may contribute to increased positive attitude towards wanting to help protect wild tigers, both immediately and three months after the zoo visit. These results align with Falk et al. (2007a) and Clayton et al. (2014) who found that zoo visitors reported strengthened or fortified attitudes towards conservation. The results of the current study are supportive of claims that zoos can affect attitudes related to conservation. Based on the small cohort that completed the delayed post-visit study, the
results of the current study also suggest that a zoo visit can have at least a short-term lasting impact on these attitudes. Additional investigation is warranted to further support these findings, in particular larger longitudinal studies tracking attitudes over time after the zoo visit.

6.2.3 Connection

The results of this study are supportive of the fundamental belief that zoos can facilitate emotional connections with animals (as discussed in Barongi et al., 2015). It appears important that this connection is made, as connection with animals influences pro-environmental beliefs and behaviours (Carmi, Arnon & Orion, 2015; Grajal et al., 2017; Howell et al., 2019). Visitors to both zoos in this study reported a large shift in sense of connection to tigers immediately following their visit. This is still observed three months following the zoo visit, and in fact increases between the immediate post-visit and the delayed post-visit survey stage. These visits contributed to an observed, lasting difference in the way visitors reported that they felt about tigers. As discussed earlier, this post-visit increase speaks to the concept of zoos acting as ‘catalysts’ for increased connection to wildlife, that can be built upon after the initial spark of connection is formed or amplified during the zoo visit.

Many studies argue that implicit personal connection to nature, or a feeling of being part of nature, are essential elements in mediating personal beliefs, concern and action regarding the environment (e.g. Schultz, 2002; Schultz et al., 2004; Bruni et al., 2008; Powell & Bullock, 2014). Time in nature has been found to correlate with “nature relatedness” (Nisbet, Zelenski & Murphy, 2009 p. 716) which contributes to environmental concerns and behaviours.

In support of the role of zoos in facilitating a connection to the natural world, visitors to both Taronga Zoo and Western Plains Zoo reported an increased sense of connection to the natural world (Connection Nature) immediately after their visit. This increase is roughly equal across both zoos, suggesting that both zoos have the ability to effect immediate increases in connection to nature regardless, perhaps, of the degree of exhibit naturalism or immersion. This accords with a study that found that visitors leaving the San Diego Wild Animal Park reported a higher connection with nature than those entering (Schultz & Tabanico, 2007). This study, and that of Schultz and Tabanico (2007) are supportive of the notion that zoos can
act as ‘nature proxies’, acting as a potentially effective substitute for a true, wild nature experience.

It could be that simply attending a zoo could in itself be a useful (and possibly convenient, given that many zoos are located in urban areas) proxy for nature. Zoos, as demonstrated in this study, could provide or inspire the increased sense of connection to nature that appears to be important in facilitating environmental concern. This is somewhat in opposition to Bruni et al.’s conclusions (2008), who identified an implicit connection to nature after a zoo visit that was possibly not apparent to visitors at the time. In comparison, this study relied on direct visitor reporting of their sense of connection, constituting an explicit sense of connection, which was not identified in the Bruni et al. (2008) study. These authors noted that it is important to understand whether any changes in connection to nature after a zoo visit have “residual value or are sustained after the visit” (p.149). The current study has (with a small sample size) identified that there is some kind of residual effect of the zoo visit on a sense of ability to ‘help protect’ tigers, and on a sense of connection to tigers. However, the current study did not identify a lingering sense of connection to the natural world in the delayed post-visit survey. While it is encouraging that the zoo visit appears to be related to an immediate increase in reported connection to the natural world, the reported feeling of connection to nature at the three-month post-visit survey stage is not significantly different to the pre-visit stage, suggesting that the nature connection reported post-visit is not maintained. This poses broader challenges for those zoos or other ‘nature experiences’ attempting to use nature connections to facilitate pro-environmental behaviours, as ideally these stronger nature connections would be sustained over time.

6.2.4 Behaviour, Intention and influence

The TPB (Ajzen, 1991; 2002) posits that behavioural intention can directly influence behaviour. While there is an increase in zoos’ use of the TPB to design and implement their conservation programs, there is little research evaluating post-visit behaviours. This study attempts to address this gap, by both evaluating the uptake of the target behaviour in the post-visit phase, and attempting to understand what aspects of the zoo visit may relate to this uptake.
Sixty-five percent of visitors to Taronga Zoo who completed the delayed post-visit survey reported that they had made purchasing choices to favour products that used sustainable palm oil since their zoo visit. Only 29% of Western Plains Zoo reported the same, although the sample size for this cohort is very small which may have affected results. The survey results indicate that those people who more strongly agree (at the immediate post-visit stage) that they intend to make more sustainable palm oil product choices are more likely to report that they have done so, three months after their visit. This reinforces the TPB, specifically the pathway between behavioural intention and actual behaviours, at least in Taronga Zoo visitors. This result indicates that reported behavioural intention to make more sustainable palm oil purchases may indicate likely behavioural outcome (with caution regarding possible confounding effect of completing the surveys on the behavioural outcome, and the possibility of reporting bias). The results of this study do align with existing research in various other fields that support behavioural intention as a predictor of behavioural intention (e.g. Armitage & Conner, 2001; Sheeran, 2002). This has implications for evaluation of the impact of behaviour change interventions. Post-visit follow up, especially temporally distant from the zoo visit, can be complex and using measures of intention as likely predictors may simplify the evaluation process.

Social communication or engagement about conservation issues may be a significant contributor to pro-environmental outcomes. This study found that visitors to both zoos reported a much higher level of intention to speak to their friends and family about tiger conservation immediately after their visit, compared with their pre-visit baseline. Clayton et al. (2018) found that zoo visitors who had experienced an exhibit and discussed it in a social group reported significantly higher conservation concern and knowledge. While this research was based on social discussions at the zoo, this compound impact of post-visit social engagement on issues learned at the zoo may also be a contributor to increased conservation concern and action. Indications that significantly more people intend to speak to their friends and family about helping tigers than had done so prior to their visit (baseline taken in the pre-visit survey) are supportive of the role of a zoo visit as a catalyst for meaningful conservation action (as per Clayton et al., 2018). However, this may also have a broader community impact via influence on social norms, which is posited as the third contributor to behavioural intention in the TPB (Ajzen 1991; 2002).
6.2.5 Summarised answer to research question 1: Does visiting tiger exhibits impact visitors’ perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation?

A visit to a modern Australian zoo (or, at least, these two zoos) does impact a range of personal factors of zoo visitors, including perceived behavioural control, attitudes, connections to nature and tigers, and behavioural intention. Overall, the largest impact visiting the two tiger exhibits analysed in this study was on perceived behavioural control about being able to help protect tigers in the wild.

The impact of these visits is evidenced by the ‘shifts’ between the pre-visit, immediate post-visit, and delayed post-visit stages. A visit to Taronga Zoo’s Tiger Trek affected a significant shift in all measured factors immediately after the visit. Some of these shifts were maintained or even apparently increased over three months. Most of the personal factors showed shifts in Western Plains Zoo visitors, although overall the magnitude of shift was generally smaller than in Taronga Zoo visitors, and fewer of the factors showed an overall difference after three months. As discussed in this section, these findings support the existing body of evidence that zoo visits can impact visitors’ understanding, attitudes, perceived behavioural control, connections and intentions related to conservation. It also supports the theory that modern, immersive exhibits are more effective tools for conservation education than traditional or non-immersive exhibits.

6.3 What personal factors of the zoo visit have the greatest impact on zoo visitors’ behavioural intentions regarding tiger conservation?

Having confirmed that a zoo visit can affect change in the personal factors measures on the surveys, one intention of this study was to identify which of these personal factors have the greatest impact on zoo visitor behavioural intention regarding tiger conservation. In this case, this related to visitor intention to make more sustainable palm oil product purchases after the zoo visit. This analysis was intended to focus the remainder of the study on the factors that contribute to the ultimate outcomes of zoo-based behaviour change campaigns: behavioural intention and actual behaviour change.

As noted in the Results (section 5.2.3), correlation and regression analysis excluded demographic, motivational and basic exhibit engagement factors (e.g. dwell time) and ‘shift’
between the pre-visit and post-visit surveys as direct contributors to reported behavioural intention at both Taronga Zoo and Western Plains Zoo. Only the immediate post-visit survey responses showed significant relationships with behavioural intention. Therefore, this discussion will focus on only these immediate post-visit personal factors.

6.3.1 Perceived behavioural control

The personal factors most significantly and frequently predictive of behavioural intention were perceived behavioural control measures. Perceived ability to make product purchases that help protect tigers in the wild (Purchase) is the only personal factor that contributes to behavioural intention for visitor cohorts from both zoos. This might be expected, given its close relationship with the actual target behaviour. Another measure of perceived behavioural control, perceived ability to help protect tigers more generally (Help Protect), also contributes to behavioural intention in the Taronga Zoo visitor cohort, albeit uniquely explaining only two percent of the variance in behavioural intention. This personal factor is arguably a more generalised version of Purchase, indicating a broader belief of being able to help tigers (but without the specification of a behaviour that could help). These results support the TPB which identifies perceived behavioural control as one of the precursors to behavioural intention (Ajzen, 1991; 2002; Armitage & Conner, 2001). Noting that many researchers use the terms perceived behavioural control and self-efficacy interchangeably (Zimmerman, 2000), these results also accord with studies that found self-efficacy a reliable predictor of pro-environmental behaviour (Hines et al., 1987; Zimmerman, 2000; Bamberg & Möser, 2007; Clayton et al., 2018).

While there was a bias towards perceived behavioural control measures in the survey (five perceived behavioural control statements, but only two each measuring attitudes or emotional connection), this does have implications for zoo-based behaviour change campaigns. It may be that perceived behavioural control is a more straightforward factor to influence in a zoo setting. If this is the case, zoos should capitalise on this and focus their interventions on increasing visitor behavioural control or self-efficacy. This would represent an efficient and effective application of established behaviour change science. It could also help simplify and focus zoo-based behavioural interventions that, at least anecdotally, often take a more broadly-targeted approach to behavioural interventions (e.g. attempting to affect change in
more than one behaviour, or affect norms, attitudes and perceived behavioural control together).

However, in this study, perceived behavioural control does not directly relate to actual behaviour. The sample sizes for the delayed post-visit surveys at both zoos may contribute to this, and this relationship could be further explored with a much larger cohort. On this basis, the results of this study support a cautious approach to using evaluations that fail to measure behavioural intention as an independent factor in predicting behaviour.

This study did not identify a direct relationship between perceived behavioural control and behaviour hypothesised in the TPB (Armitage & Conner, 2001; Ajzen, 2002), although this may be a factor of survey design and caution should be taken making too much of this result. Correlation analyses show that Purchase and Help Protect are quite strongly correlated in the Taronga Zoo cohort (although not enough to have disrupted the multiple regression analysis). This indicates that there is a close relationship between the two personal factors, and therefore that people who feel like they can broadly help protect tigers are also likely to feel that they can specifically make product choices that help protect tigers in the wild. The relationship between these two variables supports cooperative visitor interventions that build both general and specific perceived behavioural control or efficacy. This could include more general motivational messaging e.g. ‘We can all help protect tigers in the wild’ as well as specific messaging such as is conveyed in the Tiger Trek Supermarket (e.g. you should select this brand of chocolate in preference to that brand, because it uses sustainable palm oil).

6.3.2 Attitudes

Attitudes are the other TPB factor posited to contribute to behavioural intention. Certainly, the potential for zoos to affect visitors’ attitudes is widely discussed; the objective of the ‘connect’ phase of the Connect-Understand-Act model used to design Tiger Trek is “to shape attitudes and values that will assist with the uptake and maintenance of conservation-sensitive behaviours” (Squires et al., 2016 p. 98). However, the attitude personal factors measured in this study do not predict behavioural intention in Taronga Zoo visitors (and were not strongly correlated with behavioural intention). Therefore, the results of the Taronga Zoo portion of this study are not supportive of attitudes being a large contributor to the formation of behavioural intention regarding tiger conservation. Further, while attitude towards helping
tigers is a contributor to behavioural intention in Western Plains Zoo visitors, it is a very small independent contributor to this. Perceived behavioural control is a significantly larger contributor. This does not completely accord with the TPB (Ajzen, 1991; 2002) that posits that attitudes contribute directly to behavioural intention, or with other behaviour-change studies that found that attitudes are a primary predictor of behaviour (e.g. Chan, 1998; Tonglet et al., 2004; Fielding et al., 2008). This could be a function of the statements chosen to include on the survey. It could also be a factor of the high means and low standard deviations for the attitude measures (Important Protect and Like to Help) on the surveys, compared to other variables. This low variance would likely have limited the ability of those variables to appear to contribute to behavioural intention. Perhaps a study measuring a wider range of attitudes (e.g. to wildlife conservation more broadly, or to protection of rainforests) may have identified a larger or clearer role for attitudes in predicting behavioural intention related to palm oil product purchases. This is an avenue for further research. Alternately, these findings could simply accord with Ajzen’s (1991; 2002) assertion that the TPB can apply a variable ‘weight’ to the variables relative to their significance in the scenario under consideration. Therefore, it could simply be that perceived behavioural control is a much stronger predictor of intention to make more sustainable palm oil product choices in a scenario where there is a focus on clear communication of ways to do so (as is the case with the Tiger Trek supermarket) than attitudes. As discussed earlier, this has implications for the priority afforded to behaviour change interventions targeting attitudes versus perceived behavioural control.

While post-visit attitude about wanting to help protect tigers is a contributor (albeit a small one) to behavioural intention in Western Plains Zoo visitors, this attitude is not significantly affected by the zoo visit. There was no observed shift in this personal factor between the pre-visit and immediate post-visit stages. The implications for Western Plains Zoo (and other zoos, if this is observed more widely) are that they must capitalise on the implicit desire to help that visitors may arrive at or depart the zoo with and consider novel ways to increase this. As this attitude measure did not contribute to behavioural intention in Taronga Zoo visitors, there was no further investigation into a possible relationship between exhibit engagement and this factor. However, a future study could focus specifically on this relationship. This may shed some light on ways to enhance this attitude in visitors at other sites, including Western Plains Zoo.
6.3.3 Connection to the natural world

Connection to the natural world was found to be a contributing personal factor to behavioural intention in Taronga Zoo visitors. While not a factor of the TPB, emotion is established to be connected to learning and engagement in issues (Damasio, 1994; Boler, 1999). These results are also in line with Kals et al. (1999), who found that emotional affinity to nature is among the predictors of behaviour. Zoos promote their ability to use emotional connections with animals and being places of ‘nature experience’ to impact pro-conservation or pro-environmental belief and actions of their visitors. More broadly, this research accords with existing studies that indicate that nature connections can predict and promote conservation concern (Clayton et al., 2018) and “conservation mindedness” (Howell et al., 2019 p. 5).

While connection was the smallest of the factors contributing to behavioural intention, it does present an interesting matter for consideration: why is connection to nature more significant than connection to tigers? This was certainly not expected. Based on previous studies (e.g. (Bruni et al., 2008; Skibins & Powell, 2013; Lukas & Ross, 2014; Powell & Bullock, 2014), it was assumed that connection to tigers would be a much more significant predictor of intention to perform a behaviour described as specifically protective of tigers. However, unsustainable palm oil plantations are a threat to many more plant and animal species than just tigers. This result then perhaps speaks again to the importance of feeling a part of nature or connected to nature (generally, rather than specific to species) as a mediator of pro-environmental behaviours. Schultz (2002) found that connection to nature was a primary component of a person’s identity as ‘part of nature’, which correlates with general environmental attitudes. Further, a strong emotional experience (evident in the shift in connection to nature during the zoo visits) can encourage engagement with conservation (Powell & Bullock, 2014). It could be that a general connection to nature manifests as an intention to perform a pro-environmental behaviour in making more sustainable palm-oil purchases. If so, this would align with the work of Schultz et al. (2004) who found that implicit connection with nature correlated with explicit environmental concern.

Connection to the natural world, while reportedly significantly higher immediately after visits to both studied exhibits, is not sustained over three months (unlike connection to tigers, which
is sustained). This is interesting, given that the average zoo visitor is likely to have experienced something else that could be considered ‘the natural world’ within the three months after their visit, which might have reinforced this nature connection. It is certainly more likely that they would have experienced ‘the natural world’ than another tiger. As observed in the introduction to this thesis, one of the major challenges facing the pro-environmental movement is people’s diminishing connection to nature. At least in this study, it does not appear that visiting a zoo results in an increased sense of connection to nature three months later. Future research could examine the impact this diminished sense of connection to nature has on behavioural intention to continue to make (or begin to make) sustainable palm-oil product choices at the three month post-visit stage. Results suggest that Taronga Zoo visitors who intend to make sustainable product choices immediately after their visit are more likely to report that they do so. However, this intention may not be maintained to the same degree over time if reported connection to nature is not as strong.

6.3.4 Summarised response to research question two: What personal factors of the zoo visit have the greatest impact on zoo visitors’ behavioural intentions regarding tiger conservation?

This study has demonstrated that perceived behavioural control about being able to make product choices that help protect tigers in the wild was the major predictor of behavioural intention regarding tiger conservation.

However, the group of personal factors that predict behavioural intention are not identical at the two studied zoo sites. A more generalised perceived behavioural control about being able to help protect tigers and reported connection to nature were the other personal factors that predicted behavioural intention in Taronga Zoo visitors. In contrast, in Western Plains Zoo visitors, perceived behavioural control about making purchases that help protect tigers independently predicted more than 60% of behavioural intention, with attitudes towards helping tigers contributing a very small amount independently in the final model.

These results support the application of the TPB in the zoo context, particularly when focussing on the direct relationship between perceived behavioural control and behavioural intention. These findings should be considered in designing, implementing and evaluating behaviour change interventions in a zoo context, and possibly in other informal science and environmental learning contexts. Zoos should primarily focus on influencing perceived
behavioural control, as this personal factor reliably contributes to behavioural intention across both sites, in preference to attitudes and emotional connections. This also indicates that perceived behavioural control can reliably be influenced in different styles of zoo exhibits, which will be further discussed in the next section. However, the results also support inclusion of interventions that look to create connections between zoo visitors and the natural world, and to a lesser extent, influence attitudes towards desiring to help tigers. Further research is needed to understand whether other types of attitudes may be more significant influences on behavioural intention than those studied in this project.

6.4 What exhibit engagement factors relate to the personal factors that contribute to visitors’ behavioural intentions regarding tiger conservation?

The central hypothesis of this study was that engagement with zoo exhibits may impact the way zoo visitors’ attitudes, perceived behavioural control, sense of connection and understanding of threats to tigers are affected by the zoo visit. The supplementary hypothesis was that some types of exhibits or exhibit elements may be better at positively affecting these personal factors. Recalling that Taronga Zoo’s Tiger Trek and Western Plains Zoo’s Tiger Forest are considerably different in their design (modern, immersive and naturalistic compared with traditional and animal visibility-focused), this study intended to compare the relative effectiveness of these two design types. This section will discuss the results of the analysis which sought to understand the relationships between exhibit engagement and the personal factors that contribute to behavioural intention around tiger conservation.

Overall, exhibit engagement at Western Plains Zoo does not broadly relate to the personal factors that contribute to behavioural intention. The suite of analyses looking at correlations between the personal factors and exhibit engagement factors found only a small number of statistically significant relationships, and all significant results suggested only weak positive relationships. Section 6.1 discussed the shift in perceived behavioural control about making product purchases that help protect tigers (Purchase). It does seem that the Interpretation Hut may have some function in contributing to increasing visitors’ perceived behavioural control regarding their ability to make product purchases that help protect tigers in the wild, and their intention to do so. Similarly, engaging with the Woodland Exhibit could be related to increased perceived behavioural control. However, the absence of more, or stronger, relationships between exhibit engagement and these key personal factors indicates that shifts
in the personal factors are in most cases likely not related to the way visitors engage with the exhibit space. The observed shifts in the personal factors at Western Plains Zoo must therefore be related to some other influence, not measured in this study.

Compared to Western Plains Zoo, exhibit engagement at Taronga Zoo’s Tiger Trek does appear to relate to the key personal factors that contribute to behavioural intention. Given this, the focus of the remainder of this section will be on the learnings from the Taronga Zoo analysis, and what this can tell us about how exhibit engagement may contribute to behavioural intention.

The first notable trend in the relationship between exhibit engagement and the personal factors at Taronga Zoo is that exhibit engagement is more closely related to shifts in the key personal factors. While the post-visit survey ‘score’ for the personal factors is the variable that best indicates whether Taronga Zoo’s visitors intend to make product purchases that help protect tigers, exhibit engagement factors relate more closely to the way that visitors’ personal factors change during the zoo visit. While it is clearly important that visitors leave the zoo agreeing as strongly as possible with the statements used to measure the personal factors (because this is what appears to contribute to their post-visit behavioural intentions), it is equally important that the visitors’ time in the exhibit is as affective as possible, to best achieve these high ‘scores’. This affective zoo-visit experience may lead to the largest possible shift in responses between the pre-visit and post-visit stages. Exhibit engagement appears to contribute to this affect.

The second trend observed overall was that dwell time (both overall exhibit complex dwell time and dwell time at the at the focal zones) was not found to be as strongly related to the personal factors as simply stopping at the zones. Where there was a relationship between dwell time and the personal factors, the relationship was very weak, explaining less than five percent of the variation in the post-visit personal factors or shifts in the personal factors (and only up to eight percent at Western Plains Zoo). Overall exhibit dwell time at Taronga Zoo was related only to shifts in personal factors, rather than post-visit personal factors (and does not relate to personal factors at Western Plains Zoo at all). This has been considered a relatively minor finding in this study given the weakness of the relationships. However, given the paucity of equivalent research that attempts to correlate personal and exhibit engagement factors, it may be that an explanation of five percent of variation in personal factors is a
realistic expectation. These findings, particularly that overall exhibit complex dwell time relates exclusively to shifts in personal factors, is an avenue for further research.

In comparison, the six relationships between personal factors and simply stopping (recorded as a yes or no measure) at the Taronga Zoo focal zones were mostly strong relationships (moderate or large effect). This result suggests that longer engagement with the focal zones may not necessarily be more affective; any engagement (measured by simply stopping) may be affective. In particular, stopping at the focal zones mostly correlated with shifts in the two perceived behavioral control personal factors, related to making product purchases that help protect tigers (Purchase) and being able to help protect tigers (Help Protect). These results suggest that shifts in perceived behavioural control may be related to simple engagement with exhibit elements like those represented by one or more of the Tiger Trek focal zones. Getting people to stop may be more important than the length of time they spend in a zone.

There is a lack of literature to which to compare these results, even in the much more researched field of museum exhibit engagement. Existing studies have generally looked at viewing effort and proportional engagement (as examined in a meta-analysis by Serrell, 1998), identities, motivations (e.g. Falk et al. 2008) and social dimensions of learning (e.g. Packer & Ballantyne, 2005) rather than degree of engagement and resultant impact on the kinds of personal factors examined in this study. These results, while isolated in context and really only indicative of a potential deeper relationship, may set the foundation for further research into the comparative value of brief versus deep engagement with exhibits or exhibit elements in informal learning environments.

6.4.1 Interactive elements

Zoos regularly install interactive elements in exhibit complexes. Interactive elements have been observed to be amongst the most attractive elements of an exhibit, even in adults (e.g. Ross & Gillespie, 2009). Interactive elements are a tool that can be used in the ‘Understand’ stage of the Connect-Understand-Act model used by zoos in designing behaviour change campaigns (Lowry, 2009). From an engagement perspective, interactive elements can often be a ‘venue’ along the linear path of an exhibit and are highly attractive to visitors (Borun & Dritsas, 1997; Sandifer, 2003; Dancstep et al., 2015). Therefore, an appreciation of the role
interactive exhibit elements play in affecting behavioural intention in a zoo setting is warranted, both from an exhibit design and a behaviour change campaign design perspective.

Often, interactive elements are primarily designed to engage children. It is therefore interesting to observe that engagement with the interactive elements of the Taronga Zoo exhibit is related to positive outcomes (both post-visit score and shifts) in the personal factors that contribute to behavioural intention regarding tiger conservation in adults. Of the three major interactive elements in the Tiger Trek complex, two were identified as focal zones: the Ranger Vehicle and the Supermarket carts (the third interactive zone, the motorbikes located in the Village, did not score highly on the focal zone score).

The Ranger Vehicle Zone is the focal zone that was overall most related to impact on the key personal factors that contribute to behavioural intention. Stopping at the Ranger Vehicle was significantly positively correlated with all three of the personal factor measures that contributed to behavioural intention in Taronga Zoo visitors: perceived behavioural control about helping tigers, making product choices that help protect tigers, and feeling a connection to the natural world. Seeing a tiger from this zone was also associated with an increased reported ability to help protect tigers and make product choices that help protect them. There are no interpretive elements (e.g. signs, videos) within the Ranger Vehicle zone that relate directly to helping protect tigers, including about palm oil or shopping. The adjacent video screen, which does convey information about these things, could not be seen from the Ranger Vehicle Zone, and the level of noise in the building usually prohibited visitors hearing the video’s audio from the zone.

Given this, it is not immediately obvious why this space is so strongly related to shifts in the personal factors or reported behavioural intention. The vehicle itself represents a physical component of the work of wildlife rangers and tiger protection activities (a means for navigating around the national park), and it might be that this evocative imagery is particularly connective, reminding visitors of the reality of people protecting tigers. It could also be that there is an affective element to observing your own child (or children in general) enjoy an interactive exhibit element or see a tiger in an interactive or highly exciting setting. If adults in this zone saw a tiger, it would generally be the case that the children in the Ranger Vehicle also saw it. Luebke and Matiasek (2013) identified a possible linkage between adult study participants’ own emotions in seeing animals with some sort of vicarious or empathetic
experience in witnessing children’s reactions to animals. They hypothesised that seeing children react to the animals in their study may have formed a component of the adult’s own emotions, and also found that participants’ affective gains were highly impacted by emotional responses (Luebke & Matias, 2013). It is possible that this phenomenon is also occurring in association with the Ranger Vehicle and it is well worth further investigation and focus, particularly in regard to interactive exhibit elements. Further, it may be worthwhile capitalising on the inherent attractiveness and engagement strength of the Ranger Vehicle (and its possible efficacy as an affective device) by specifically installing interpretive elements on or around the vehicle. Further opportunities could be introducing a ‘Ranger’ to act as docent in the space, which would be consistent with the imagery of the vehicle and could provide further information about how people can help protect tigers.

The potential effect of the Supermarket, as the second major interactive element of Tiger Trek, is somewhat easier to appreciate. As with the Ranger Vehicle, stopping at the Supermarket correlated with significant shifts in all three personal factors that contribute to behavioural intention. Engagement with the Supermarket related to increased visitor belief that they can help protect tigers, including by making appropriate product choices. The role of the Supermarket carts is specifically to educate visitors about which common supermarket products (chocolate, biscuits etc.) use sustainable palm oil and which do not. Visitors are also offered the opportunity to email companies whose products are featured, to thank them for helping to protect tigers by using sustainably sourced palm oil, or to encourage them to do so. In doing so, the Supermarket directly and clearly attempts to effect two elements of visitor behaviour that can contribute to protecting tigers: making sustainable palm oil product choices and using their voice as a consumer to influence companies’ decisions about ingredients in their products. Torre argues for “painless learning”, through “longer, more complete immersive experiences allowing saturation of substance, offering hope and prospect: how can I help?” (Torre, 2016, p. 8). The Supermarket is effectively the “delineating” stage spoken of by Torre (2016, p.11), marking the threshold between the immersive, linear story of the exhibit and the ‘how can we help’ message.

These findings indicate that interactive elements in zoo exhibits that, like the Supermarket, use specific messaging related to increasing sense of perceived behavioural control can be effective components of behaviour change campaigns. The relationships between shift in personal factors and engagement with the Ranger Station also accords somewhat with
previous studies. For example, Swanagan (2000) and Anderson, Kelling, Pressley-Keough, Bloomsmith and Maple (2003) found that combining animal viewing experiences with some form of interactive experience can affect visitor understanding and attitudes about species and issues. However, these studies did not look specifically at perceived behavioural control. Future research could build upon the findings of this study to more deeply examine the impact of interactive zoo exhibit elements on perceived behavioural control, comparing elements with varying degrees of specificity about pro-conservation behaviours. Future research could compare the effectiveness of a physically-based interactive element like the Ranger Vehicle with a more intellectually interactive element like the Supermarket carts, to determine what type of element might be most effective in differing spaces or circumstances.

6.4.2 Tiger visibility

Visibility of animals as part of the zoo visitor experience is one of the most discussed and potentially complex considerations in zoo exhibit design. The complexity of designing exhibits for animal visibility largely arises from the multitude of factors and players in the phenomenon of animal display: animals, their individual and species-based welfare needs (and the views of keepers on this), the impact of available space, the desires and safety of visitors, budget, available materials and organisational priorities. All can be factors in the way animal visibility is considered in exhibit design.

Visitor experience has been demonstrated to be linked to animal visibility (Plaatsman, 1996; Nyhuis, 2004; Woods, 2002; Kuhar, Miller, Lehnhardt, Christman, Mellen, & Bettinger, 2010). Visitors dwell longer, stop more frequently, and appear to engage with exhibits more (e.g. pointing at exhibit elements and animals) when animals were visible, regardless of exhibit design (Bitgood et al., 1988; Marguilis et al., 2003; Davey, 2006). If simply seeing an animal is taken as a metric of a ‘good’ zoo visit, then visiting Tiger Forest at Western Plains Zoo should be a guaranteed satisfactory experience, as all visitors to that exhibit saw a tiger with relative ease. However, as discussed earlier, this animal visibility does not translate into an affective element of the zoo visit, as there were no identified relationships between seeing a tiger and the personal factors that contribute to behavioural intention regarding tiger conservation.
Tiger visibility was found to be a contributing factor to the affective zoo experience in Taronga Zoo visitors, although results were patchy and inconsistent across the exhibit, with tiger visibility from the Ranger Vehicle zone seemingly most affective. Most of the personal factor relationships with tiger visibility are perceived behavioural control measures. This highlights a potential role for an experience of what Manstead (1990) calls an ‘attitude object’ in contributing to developing perceived behavioural control related to the ‘object’, rather than simply (or only) an attitude about the object itself.

Seeing a tiger, unlike most other exhibit engagement factors, also relates to post-visit sense of connection to nature. This study is further support for exhibit design that facilitates visibility of animals to maximise engagement and potential subsequent impact on the personal factors that contribute to behavioural intention. There are obvious animal welfare considerations when designing exhibits for animal visibility; the lack of deep discussion of these in this thesis should be taken as a reflection of scope, rather than relative importance of this matter. Zoo exhibit designers should of course keep animal welfare front and centre in design considerations; we cannot justify keeping wild animals in captivity for any purpose if we are not committed to positive welfare outcomes for all animals in zoo collections.

6.4.3 Connection to nature

Two elements of connection were examined in this study: connection with the natural world, and connection with tigers. These elements were designed to help understand the role of emotion in the zoo experience, as emotion and learning have been demonstrated to be interrelated (Damasio, 1994; Boler, 1999). Visitor learning and understanding of conservation issues and positive actions is a key step in achieving meaningful pro-environmental behaviour outcomes in zoo visitors.

Connection to nature is the key personal factor that is apparently least related to exhibit engagement in these two zoo cohorts. For the most part, only moderate and weak relationships were identified between exhibit engagement factors and connection to nature in Taronga Zoo visitors. The exception was people who stopped at the Supermarket who showed a large shift in connection to nature between the pre- and immediate post-visit stages. This was a more unexpected result, considering that most of the reviewed literature (e.g. Schultz, 2002; Bruni et al., 2008) discusses the impact of natural or naturalistic places on nature
connection. The Supermarket is intentionally designed to be a surprising, non-natural contrast to the ‘rainforest’ design of the Tiger Trek exhibit the visitor will have left before they enter the Supermarket.

As this study does not identify causality, and only relationships, the explanation for this phenomenon is not completely clear. Overall, it could be that connection to nature is a much more intrinsic matter, and therefore is less impacted by or related to specific engagement factors. Dutcher, Finley, Luloff and Johnson (2007) contend that connection to nature is a spiritual phenomenon, and Vining (2003 p. 88) that interactions with animals can connect people to “a spiritual sense of wonder at being part of a vast interconnected network”. Connecting the fate of animals and the impact of humans on wildlife with visitors’ real life (supermarket shopping) may increase the feeling of connectedness to the natural world. In fact, it may be that exhibit engagement is driven by sense of connection to nature, rather than being a result of it. People whose sense of connection to nature is more affected by their zoo visit may be more likely to engage with the Supermarket, because they are more motivated to understand how they can help protect tigers or the environment more broadly. This could be further investigated by deeper examination of how and why visitors are using the supermarket carts, either by asking them or tracking the activities on the devices themselves.

Visiting Tiger Trek may also be considered an experience of nature more generally, and connection to nature could be influenced by the immersive nature of the exhibit. If this is the case, this would align with a three-year visitor impact study in the USA (Falk et al., 2007a) that also found that a zoo visit strengthened visitors’ connection to nature. Falk and colleagues (2007a, p. 12) found that visitors may perceive their zoo visit as a “nature experience” and suggest that zoos can encourage visitors to “explore and value nature”. This has broad implications for environmental ethics and human health, as well as providing a marketing opportunity for zoos as key tools for nature connection in an increasingly urbanized world (Falk et al., 2007a). This would also support the theoretical and philosophical justification for the use of immersion-style exhibitory, which can, as suggested by Coe, go some way to “making the zoo experience real” (Coe, 1985 p. 206).

What is clear is that some visitors may arrive at the zoo with a strong implicit nature connection, and it is important that this connection is at least maintained, if not enhanced during their visit. Care must be taken not to disconnect people from nature, which could occur
if there are concerns about animal welfare, non-naturalistic design (or any number of other potential triggers). Further, zoos must capitalise on their ability to affect change in nature connection during a visit by understanding what aspects of the zoo experience contribute to this.

Relevantly, Ballantyne et al. (2018) call for a greater focus on values-based design of visitor experiences and interpretive materials, acknowledging that it may be that people who more highly value universalism values (including preservation of nature) may frequent zoos more often. Based on the current study, and taking into account Ballantyne and colleagues’ (2018) recommendation, it will be important to think ‘outside the box’, noting the unexpected relationship between engagement with the strikingly non-natural Tiger Trek Supermarket and shift in reported nature connection. An ability to connect the zoo experience with visitors’ daily lives (in this case, shopping at a supermarket) or their underlying values may be a very useful exhibit element in ‘grounding’ the learnings and shifts in perceived behavioural control and attitudes realised during the zoo visit. There may be opportunities to link the findings of the current study to research that has established positive relationships between some pro-environmental values and pro-environmental behaviours and attitudes (e.g. Schwartz 1992; 2006; Gatersleben, Murtagh & Abrahamse, 2014), noting that changing personal values is likely to be a complex process (Aronson, 1999; Bardi & Goodwin, 2011; Manfredo et al., 2016; Ballantyne et al., 2018).

6.4.4 Summarised answer to research question three: what exhibit engagement factors relate to the personal factors that contribute to visitors’ behavioural intentions regarding tiger conservation?

Engagement with interactive exhibit elements was related to the largest changes in perceived behavioural control about being able to help protect tigers in the wild, which is the strongest predictor of behavioural intention regarding tiger conservation.

Interactive elements like the Taronga Zoo Supermarket, appear to be an effective tool in behaviour change campaigns. Engagement with these interactive elements was related to larger shifts in the key personal factors that contribute to behavioural intention, especially, as noted above, perceived behavioural control. Ensuring that visitors can see tigers can be important, particularly in establishing a strong post-visit sense of connection to nature, although overall, connection to nature was less related to exhibit engagement than the other personal factors.
However, exhibit engagement at Western Plains Zoo does not significantly relate to the personal factors that contribute to behavioural intention to make product choices that will help protect tigers in the wild. This may be indicative that more traditional exhibits like that at Western Plains Zoo are less useful tools in effective behaviour change campaigns.

Overall, the results of this section support the hypothesis that zoo exhibit design, manifested through visitor engagement with the exhibit, does relate to the efficacy of behaviour-change campaigns. The results are simply indicative of a relationship, and cannot ascribe causation. Likewise, exhibit engagement or exhibit design will never be able to claim to be the sole element of success of such campaigns. However, these results do contribute useful material to the discussion of the design and implementation of effective, engaging zoo exhibits.

6.5 What exhibit engagement factors relate to increased sense of connection to tigers?

Tiger visibility is an important factor in connecting visitors with tigers. Shifts in reported sense of connection to tigers were strongly correlated with seeing a tiger at the Ranger Station and Ranger Vehicle at Taronga Zoo. These results support the findings of Powell and Bullock (2014) that viewing tigers can stimulate positive emotional responses in visitors. However, all visitors to Western Plains Zoo saw a tiger, but the observed change in sense of connection to tigers was not found to be related to seeing a tiger from the exhibit focal zones. This suggests that the sense of emotional connection developed in Western Plains Zoo visitors cannot be solely ascribed to tiger visibility.

Collectively, the results of this study suggest that there may be a pathway from designing exhibits that engage visitors and provide opportunities to see tigers, to an increased sense of connection to tigers. Emotional connection to animals in zoos can increase care and concern for wild animals, relate to pro-conservation beliefs, intentions (Myers & Saunders, 2002; Clayton et al., 2009) and contribute to inspiring “conservation-mindedness” (Howell et al., 2019 p. 5).

Tiger Trek as an immersive exhibit appears to be, as Bruni et al. (2008) suggest, creating a literal connection between visitors and tigers. The reported increased sense of connection was found to relate, at least in part, to the way visitors engaged with the exhibit complex. Stopping
at the two largest viewing windows in the exhibit, affording some of the best visibility of
tigers in the exhibit complex, was strongly related to increased sense of connection to tigers. 
Therefore, attracting visitors to stop at these zones appears to be advantageous. In contrast,
relationships between exhibit engagement and post-visit connection to tigers in the Western 
Plains Zoo cohort were almost non-existent.

Stopping at major viewing areas is more strongly related to increased sense of connection
during the zoo visit than dwell time, suggesting that the length of engagement with a viewing 
area is not particularly indicative of the strength of the connection to tigers that can develop. 
The results support the use of immersive exhibits as a tool to create emotional connections 
between people and animals, which is the mission of many major modern zoos and zoo 
associations.

6.6 Recommendations for exhibit design to support behaviour change campaigns

The intention of this thesis was to use research findings to make practical, applied exhibit 
design recommendations to zoos (and possibly to other informal science learning centres) 
about how exhibit design can impact the efficacy of behaviour change campaigns. Ambitions 
were modest; with only two research sites, it was obvious that it would only be possible to 
make general observations that may be applicable to other sites. At least, the findings begin 
the conversation and may encourage further investigations into the impact of the physical zoo 
exhibit experience on the pro-environmental attitudes and behaviours of the people who visit 
zoos.

In answering the research question in previous sections, I have discussed elements of zoo 
design that have been identified as effective tools for affecting the personal factors that 
contribute to behavioural intention regarding tiger conservation. These elements have been 
discussed in some detail and contextualized with recommendations about their use and future 
research. This section will focus on discussing exhibit elements for which the 
recommendations or conclusions are drawn from multiple parts of this research project, rather 
than a single research question. It is hoped that this section can act as a summary of applied, 
practical recommendations for designing zoo exhibits that can actively contribute to achieving 
behavioural intentions, and actual behaviors, that support the conservation of wildlife.
Most of what will be discussed in this section is based on the findings from Taronga Zoo. As noted earlier, there were minimal relationships between exhibit engagement and the personal factors that contribute to behavioural intention in visitors to Western Plains Zoo. Nonetheless, it is very possible that the applied recommendations that follow would be applicable to Western Plains Zoo or another zoo with a similar exhibit.

6.6.1 Discrete viewing areas

The focal zone analysis at Taronga Zoo identified the four more attractive zones in the exhibit. Of these four zones, two were major glass viewing windows, into Tiger Habitats 1 (Covered Bridge) and 2 (Ranger Station). There are other large open viewing areas into Tiger Habitat 1, including another (although smaller) glass window (Zone 3A on the map in section 5.3.2) and direct viewing through the mesh barriers along the walking path (Zones 4A and 4C). Despite the fact that these alternate viewing areas into Tiger Habitat 1 often afforded equal or superior viewing opportunities for tigers, visitors are evidently more attracted to stop and dwell at the window. The focal zone analysis also indicates that the three other large glass viewing windows in the exhibit complex were sixth, seventh and eighth (of 17) most attractive to visitors (although these zones were not investigated further).

Unlike Moss et al. (2008) who found that visitors to an elephant exhibit were more likely to stop and dwell longer at exhibit viewing areas that are larger in floor area, the Covered Bridge and Ranger Station viewing areas are not the largest zones for animal viewing within the exhibit complex. The Ranger Station building itself is large, but visitors were only recorded as having stopped at the Ranger Station Zone if they were within several metres of the viewing window, facing the window. It may be that visitors simply assume that they will get a better view of tigers from obvious windows, or they may be curious about the different view a window may offer (recalling the value of a sense of mystery as per Kaplan (1987)). Additionally, it may be the design of these two windows, with floor to ceiling glass, that encourages people accompanied by children (who may be in prams) to stop in an area where the child would be able to look into the exhibit easily from their vantage point. In this way, the viewing windows in Tiger Trek act as ‘destinations’ or ‘venues’ along the linear path of the exhibit complex (Stenglin, 2009; Wineman & Peponis, 2010). Whatever the motivation
(which could perhaps be better explored through social group analysis) it is evident that large viewing windows are effective exhibit design elements to encourage visitors to stop and dwell at specific points in an exhibit. As discussed earlier, engaging visitors to stop at windows in the exhibit relates to shifts in visitors’ perceived behavioural control relating to helping tigers and making product choices that can help protect tigers.

In an applied zoo context, this suggests that exhibit designers who are intending to design exhibits that attract, and impact, visitors should consider using large windows in their design. Larger windows are more attractive than small ones, but windows are more attractive than viewing areas that are simply fenced off from visitors, seemingly regardless of possible better animal viewing opportunities. The effectiveness of engagement with small windows on the personal factors that contribute to behavioural intention has not been examined in this study but could be an area for further research. The use of windows or other designated viewing areas is also amongst the early principles of immersive design. For example, Woodland Park Zoo (1976 p. 44) recommends that exhibits “provide selected views only into the exhibits”, providing at least one major viewing area into each animal habitat.

Large, framed viewing zones that are not glassed in (i.e. are not actual windows, but perhaps archways, gaps in foliage etc.) but function in a similar way may be similarly attractive and effective. This could be a simpler redesign or modification strategy for larger open-style or moated exhibits like the Tiger Forest at Western Plains Zoo that could not easily or affordably be modified to include viewing windows. The Western Plains Zoo focal analysis highlighted that visitors infrequently visit the areas of the path that are further from the main entrance (Zones 1, 2 and 7 on map in section 5.3.1). These framed viewing zones could further act as ‘destinations’ to draw Western Plains Zoo visitors further along the viewing paths at both Tiger Habitats. Additional vegetation screening (or other simple screening, like bamboo poles) along the barrier between the visitor pathway and the moat could also be employed to focus visitors on these framed viewing areas. The density of visitors to Western Plains Zoo (often only a handful of people at a time) would certainly not inhibit this viewing strategy, and additional screening could even add privacy for the tigers.

Additionally, this screening could be used to house or hang additional interpretive materials like signs, so that visitors who do not engage with the Interpretation Hut are also exposed to educational information. This study has demonstrated that engagement with the Interpretation
Hut relates, if only in small part, to greater understanding of their ability to help protect tigers, including by choosing to purchase products containing sustainable palm oil. Broader exposure to interpretative signs like those in the Interpretation Hut throughout the exhibit may expand this effect. The location of signage is reportedly an important consideration. Signs are best placed in the line of sight of visitors while they are facing into the animal habitat portion of the exhibit, rather than behind or beside the visitors, which can create competing stimuli (Bitgood, 2006). The Interpretation Hut signs require visitors to directly turn their back on the tiger habitat to read them; consideration could be given to reorienting or moving them to evaluate any increased impact. This is supported by existing research which found that for educational elements to have a larger attracting power and potential impact, they should be located away from the animal habitats or viewing areas (Ross & Gillespie, 2009).

6.6.2 Exhibit engagement patterns

Tiger Trek at Taronga Zoo is set up as a linear, immersive experience of travelling to Sumatra, arriving ‘by plane’ in the village adjacent to Way Kambas National Park, and entering the national park to ‘track tigers’. The intention to figuratively transport visitors to Sumatra is clear, although few zoo exhibits are so literal in their design. This is a direct application of the ‘Connect-Understand-Act’ principle.

Patterns of engagement with the exhibit zones demonstrate that engagement with the village (within the ‘Connect’ section of the design layout) is very low; most visitors simply walk through the village, not appearing to pay much attention to the space. From a design perspective, this is unfortunate. Cultural resonance design strategies, like using architecture and imagery evocative of a place or time, are common and almost expected in modern design (see Coe, 1994; Coe & Dykstra, 2010). Aesthetically, the village is charming and is genuinely designed using the colours and shapes of residences and shops in the Way Kambas region. It is possible that engagement with the village is a function of a lack of activation or obvious opportunities for engagement (see section 3.3.1). As noted earlier, while functionally possible, during this study there were no ‘villagers’ appearing to operate the shops, fix the motorbikes, or work in the ranger office. Discussions with Taronga Zoo staff also lamented this lack of activation so it is apparent that, should resources permit, the organisation may attempt to activate the space. It would be valuable to compare the engagement of visitors with an activated Village to the baseline established in this study. This comparison alone would
provide an interesting and useful basis for the use of large cultural resonance installations in zoos.

Possibly more important in broader consideration of zoo design is the time between arriving at the exhibit and seeing a tiger. The layout of the exhibit resulting from the intention to ‘transport’ visitors to Sumatra means that visitors may have to tolerate queuing outside the exhibit (for up to approximately 35 minutes for participants in this study), the ‘plane flight’ (several minutes), a walk through the village, and into the ‘national park’ before seeing a tiger is even a possibility. Considering that visitors are very likely to intend to visit other parts of the zoo and may have had to allocate considerable time (and patience) to even getting into the exhibit, it is not unreasonable that they may prioritise seeing a tiger over a more contemplative experience of immersive, culturally resonant areas of the exhibit.

This does not discount that the village may be latently immersive, and certainly doesn’t disregard its significant aesthetic value. However, it may be that the village is misplaced in the exhibit complex and may be more effectively replaced with or combined with a tiger viewing opportunity. This would disrupt the ‘story’ of the ‘trip to Sumatra’, and there is no suggestion that Taronga Zoo should redesign Tiger Trek (this study has, after all, demonstrated it is an exhibit that has a significant, positive impact on visitors). However, the findings of this study suggest Taronga may wish to consider placing a tiger habitat with reliable animal visibility soon after the entrance to the exhibit complex, to begin the process of engaging visitors and connecting them with tigers as soon as possible. While not disputing the learning or social science applications of the ‘Connect-Understand-Act’ model, this study does question the literal application of the sequence to exhibit design. If the intention of zoos is to best use their (usually limited) space to affect behaviour change in visitors or at least to connect people with animals, results from this study suggest that animal displays should be prioritised.

The variable tiger visibility in Taronga Zoo’s Tiger Trek allowed for examination of visitor behaviour when ‘seeking’ out tigers in their habitats. Seeking behaviour was high at the first opportunity to see tigers (the first, small viewing window into Tiger Habitat 1). More than half of visitors stopped at this window even when a tiger was not visible. Seeking behaviour dropped significantly for the remainder of zones adjacent to Tiger Habitat 1 and remained quite low for viewing windows into Tiger Habitat 2. Seeking behaviour increased
significantly at the zones adjacent to Tiger Habitat 3. This may reflect visitors’ eagerness to see a tiger after queuing, plane flight and walk through the village, which decreases when a tiger is not immediately visible. From the zones adjacent to Tiger Habitat 1, it is obvious that there is quite a number of future opportunities to see tigers, which may be reflected in reduced stopping and seeking behaviour along this zone.

This may also affect seeking behaviour from zones adjacent to Tiger Habitat 2 (although, as demonstrated by the focal zone analysis, these zones are still popular with visitors). Tigers were also most commonly visible in Tiger Habitat 2, so visitors were more likely to see a tiger there. This visibility can partly be put down to exhibit design: the exhibit is all on one level, and the tigers showed a preference to rest on top of large crates located centrally in the exhibit which made them easily visible. Also, during this study, there were routinely two tigers on display in this habitat (a sixteen year old female and her seven year old son). This alone made tiger visibility more likely, and the male in particular was commonly easily visible and showed a high degree of comfort being close and visible to visitors. In contrast, seeking behaviour increased sharply for visitors in zones adjacent to Tiger Habitat 3. This habitat is the most densely planted and shaded, making seeing a tiger difficult unless they were very close to the visitor path. Visitor seeking behaviour may increase as it becomes obvious that this is the last opportunity to see an animal before exiting the exhibit complex; indeed, the two viewing windows into Tiger Habitat 3 saw the largest proportion of visitors stopping when no tigers were visible.

Insight into this pattern of seeking behaviour could have implications for design of future exhibit complexes with multiple animal habitats. If we can accept that seeking behaviour will be higher at the start and towards the end of the exhibit complex, then designers could consider using multiple viewing zones, more off-path venues with viewing opportunities or have more complex animal habitats in these parts of exhibits. Zoos could refer back to the original principles of immersion (see Woodland Park Zoo, 1976) which suggest that there be no continuous views of exhibit areas along major visitor paths. Taronga Zoo could achieve this by creating a stronger visual barrier in the middle of the complex, blocking views between Tiger Habitats 1 and 3, thus increasing mystery about what is to come.

There are also obvious implications in this for designing exhibits for animals with differential preferences for parts of exhibits or levels of comfort in being close to or seen by people.
While this goes beyond the scope of this study, it does pose a broader question for exhibit designers and collection planners: are exhibits designed for species or for individual animals? If animal visibility is a significant contributor to the effect of a zoo visit on people, do you design an exhibit that will maximise visibility, or do you choose animals that are more comfortable with being on display? Or perhaps, do you design exhibits that are easily modified or manipulated to meet the needs of visitors and the preferences of individual animals? This study does not answer any of these questions, but its results may helpfully contribute to further investigation and learnings in this regard.

6.6.3 Summary of recommendations for exhibit design

In addition to those recommendations provided throughout section 6.2 to 6.5 this section has recommended that zoos use select, designated viewing areas (windows or similar) to attract and engage visitors. Windows or select viewing areas also allow for improved enhancement of exhibit immersion principles, namely avoiding continuous viewing and screening off cross-views, increasing anticipation and providing selected, deliberate views of animals.

Secondly, it highlights the complexities of applying the ‘Connect-Understand-Act’ model to exhibit design in a literal sense. The Tiger Trek Village, while aesthetically pleasing, is not an engaging feature of the complex and is potentially a hinderance in connecting visitors to tigers. More research examining how to apply the CUA model in a less literal or linear way to exhibit design would be warranted. Finally, it recommends that zoos consider how visitors might naturally differentially ‘seek’ views of animals as they move through an exhibit complex. It appears that visitor seeking behaviour is highest at the beginning and end of the exhibit experience, or what they consider first and last opportunities to see animals. This pattern of engagement could be exploited by designing exhibit complexes that respond to this potentially common or natural pattern of behaviour.

6.7 Limitations of the study

This project has limitations which fall into two broad categories: methodology limitations, and participant dispositions. The methodology-related limitations are covered in detail in section 4.6; limitations pertaining to participant dispositions are thus discussed here. The limitations are also noted, where relevant, in the other sections of this Discussion.
It is important to recognise the likely bias of zoo-goers to pro-conservation attitudes and behaviours. Zoo attendees are essentially a self-selected sample of people who demonstrate at least a basic interest in animals or nature by the fact that they choose to spend their leisure time at a zoo. These people are likely to bring with them a higher degree of environmental or conservation concern than is present in the general population. Compounding this, those people who agree to participate in zoo-based research are likely to be more pro-environmentally motivated. This is likely to be true of those people who agree to participate at all, but most likely to be true for participants who completed the online, delayed post-visit survey. Participation in this stage, while potentially motivated by the small financial incentive, is much more likely to occur in visitors who are personally committed to helping conservation research or Taronga Conservation Society Australia as an organisation. Therefore, the survey responses at this stage are likely to show a bias towards favourable pro-conservation attitudes and behaviours. As a result, the impact of the zoo visit and reported behavioural outcomes are likely to be much higher than the general population. However, this research project intended to look at the impact of a zoo visit on zoo visitors, not on the general population. This study provides a hopefully valuable insight into this sector of the public.

Further understanding of the complex pathway from exhibit engagement to behavioural intention would have been enhanced by a broader analysis of relationships between all of the personal factors, rather than the narrow focus on the key personal factors that relate to behavioural intention as done here. A broader study could look at how exhibit engagement may lead to increases in these other factors, such as understanding and attitudes. That would complement and expand on the results of this study.

The decision to exclude an analysis of norms in this study also represents a limitation. While the rationale for this is robust (see section 4.2.2), this study would be a better assessment of the applicability of the TPB if it was able to understand the interactions between norms and the other TPB variables. As noted, it was understood some research on the impact of norms and values in zoo settings was being conducted by other researchers, and a recent metanalysis has identified significant relationships between subjective norms and behavioural intention across a range of conservation behaviours (Niemic, Champine, Vaske & Mertens, 2020). A larger scale study using a similar methodology to the current research project could incorporate analysis of norms, and address some of the other limitations, recommendations and conclusions of this study.
6.8 Summary of thesis recommendations

The primary intention of this thesis was to provide practical, applied recommendations relevant to the operations of zoos that have a specific, conservation-focused mission. This section will summarise the recommendations of this study. While the presentation of this thesis is the first step in making these recommendations available to the zoo industry, the researcher intends to produce targeted, accessible industry-specific written materials, publications and presentations (in addition to academic literature). While the principles outlined in this section and the previous section would logically be the basis of these future publications, it is acknowledged that the background knowledge (e.g. familiarity with social science theories) and interests of those target audiences would need to be taken into account.

Firstly, visitors to the ‘Tiger Trek’ tiger exhibit at Taronga Zoo were more strongly affected (in terms of perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation) by the conservation and behaviour change messages of the exhibit than visitors to a more traditional tiger exhibit at Western Plains Zoo. This exhibit complex uses modern design principles, including some principles of immersion. This conclusion supports the more widespread use of immersive exhibit design, but will also contribute to the body of work examining how zoos can most effectively meet their social role as environmental advocates and educators in their communities.

A strong sense of behavioural control is the most significant contributor to zoo visitor intentions to undertake behaviours that can contribute to the conservation of tigers in the wild. This is true for visitors to both styles of exhibits studied in this thesis, which usefully suggests that behaviour-change campaigns employed at any style of zoo exhibit would benefit from a focus on increasing perceived behavioural control. These results also support the use of the Theory of Planned Behaviour in designing, refining and evaluating zoo-based behaviour campaigns, and the concept of applying a variable weight to the each of the variables in the model, relative to its significance in the scenario (Ajzen, 2002). However, zoos may wish to reconsider or better understand the value of a literal, linear application of the ‘Connect-Understand-Act’ model to exhibit design.

Relationships between engagement with zoo exhibits and visitor perceived behavioural control and attitudes related to tiger conservation, and sense of connection to the natural
world, were largely limited to the Taronga Zoo cohort. Research at Western Plains Zoo did not establish strong links between exhibit engagement and changes in these personal factors. This alone evidences that more traditional zoo exhibits like the Tiger Forest at Western Plains Zoo are not functioning as part of the ‘behaviour-change toolkit’ available to modern zoos in the pursuit of meaningful pro-environmental behaviour outcomes in the zoo-going public. Based on these conclusions, modern zoos should take opportunities to renovate, redesign or replace existing ‘traditional’ exhibits where possible, and in particular focus on those exhibits associated with behaviour-change campaigns.

The interactive elements that were most strongly related to shifts in the key personal factors, particularly perceived behavioural control factors, were those that provide specific information about how to implement pro-conservation behaviours, or that provide strong emotional or exciting experiences. While the methodology of the project (using correlations, rather than experimental procedures, and the focus on just two exhibits with the same conservation message and display species) limits the generalisability of the results, they do establish that engagement with exhibits, and therefore exhibit design, can be an important consideration as part of the design and implementation of a behaviour change campaign in a zoo setting. Further, these results set a baseline for further research into how zoo design can affect the various elements of a zoo’s mission, including motivating behaviour change, but possibly also the elements of education, engagement and entertainment that contribute to this outcome.

The findings related to tiger visibility have practical implications for exhibit design, suggesting that enhancing the engagement level of a reliable viewing area (or increasing the likelihood of animal visibility from an otherwise engaging area of an exhibit) may contribute to an increased sense of connection to tigers. This is another area of research for which this study establishes a baseline which could be meaningfully built upon by further observational or experimental research.

As noted in the introduction to this thesis, Reading and Miller (2007) recommend that future studies comparing attitude changes in visitors to different types of exhibit should include both quantitative and qualitative approaches. This study is a quantitative analysis; future studies could consider a qualitative approach to both assessing attitudes as well as the other key personal factors identified in this study. While the opportunities for further analysis are
limitless, qualitative analyses that would be complementary to the current study could involve interviews with zoo visitors to more deeply understand their motivations and feelings about wildlife conservation in the context of their experience of the zoo exhibit, or a deeper exhibit content analysis looking at visual, auditory and textual content.

6.9 Conclusions

This study set out to understand whether zoo exhibit design can impact the efficacy of zoo-based behaviour change campaigns. Based on the results of this study, it can be concluded that zoo exhibit design does impact the efficacy of a zoo-based campaign aimed to encourage visitors to two tiger exhibits in Australia to purchase products containing sustainably-sourced palm oil to help protect tigers in the wild.

This study concludes that:

- Visitors’ perceived behavioural control, attitudes, connections and behavioural intention regarding tiger conservation can be impacted by visiting a tiger exhibit. Taronga Zoo’s tiger exhibit was more impactful than Western Plains Zoo’s exhibit.
- A strong sense of behavioural control about being able to make product purchases that help protect tigers is the most significant personal factor that contributes to zoo visitor intentions to make more sustainable palm oil product purchases.
- There is some relationship between engagement with zoo exhibits and visitor perceived behavioural control and attitudes related to tiger conservation, and sense of connection to the natural world. However, these relationships were largely limited to the Taronga Zoo cohort; research at Western Plains Zoo did not establish strong links between exhibit engagement and changes in these personal factors.
- Engagement with interactive exhibit elements at Taronga Zoo proved to relate strongly to shifts in the personal factors that contribute to behavioural intention.
- Finally, tiger visibility is the most significant exhibit engagement factor in contributing to increasing a sense of connection to tigers.
Zoos remain controversial places and organisations. The debate over the ethics of keeping wild animals in captivity continues, and it should. Modern, conservation-focussed zoos should be committed to frequent and diligent self-analysis, asking whether the lives of the animals they keep within their walls are making a difference to conservation outcomes for their wild cousins. If these zoos continue to reason that they exist in large part to educate the public about conservation, then their effectiveness in this regard should be routinely evaluated, and every part of the zoo operation should be dedicated to it. If zoos can successfully facilitate more pro-conservation behaviours in the ‘outside world’, then the rationale for the existence of zoos in communities is reinforced.

To date, physical design of zoo exhibits and how visitors engage with them has been an overlooked tool in the zoo communication toolkit for achieving behaviour change. The design of exhibits has been largely based on anecdotal or informal, practice-based knowledge, and the effectiveness of exhibits is generally under-evaluated. This thesis is a deliberate response to calls from zoo scholars for further research into what specific aspects of a zoo visit can contribute to improved behaviour change outcomes in support of biodiversity conservation (e.g. Clayton et al., 2017) and a deeper examination of the “learning components of exhibit stagecraft” (Grajal et al., 2018 p. 199) and “how the context itself serves to teach” (Fraser et al., 2010 p. 22). The results presented in this thesis illustrate the richness of knowledge that can be obtained through examination of the nexus between zoo-based informal science education, social science and zoo design. This thesis provides a basis for further multi-disciplinary research in zoos, and for the subsequent improved outcomes for the essential conservation initiatives undertaken by zoo-based conservation organisations around the world.
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## Appendix A – Codebook

### Codebook – Survey and Observations

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<thead>
<tr>
<th>SURVEY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Assigned to each participant - manual</td>
</tr>
<tr>
<td>Date</td>
<td>Date format</td>
</tr>
<tr>
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<td>Survey 1 Q1</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 1 Q2</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 1 Q3</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 1 Q4</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
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<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 1 Q6</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 1 Q7</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 1 Q8</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 1 Q9</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 1 Q10</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 2 Q1</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 2 Q2</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 2 Q3</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 2 Q4</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 2 Q5</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Survey 2 Q6</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 2 Q7</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 2 Q8</td>
<td>Likert result (1-7)</td>
</tr>
<tr>
<td>Survey 2 Q9</td>
<td>Likert result (1-7)</td>
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<tr>
<td>Survey 2 Q10</td>
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<td>Survey 2 Q11</td>
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</tr>
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</tr>
<tr>
<td>Survey 3 Q3</td>
<td>Likert result (1-7)</td>
</tr>
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<td>Survey 3 Q8</td>
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<tr>
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<thead>
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<th>3 = 36-45</th>
<th>4 = 46-55</th>
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<td>Residence</td>
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<td>2 = Overseas</td>
<td></td>
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<td></td>
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<tr>
<td>Reason</td>
<td>1 = Entertainment/Recreation</td>
<td>2 = Education or learning</td>
<td>3 = Social</td>
<td>4 = Other</td>
<td></td>
</tr>
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<td>--------</td>
<td>------------------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>1 = Family group w children</td>
<td>2 = Family group no children</td>
<td>3 = Friends/Other</td>
<td>4 = Alone</td>
<td></td>
</tr>
<tr>
<td>See Tiger</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relaxed</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tense</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happy</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sad</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interested</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bored</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather</td>
<td>Text</td>
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<td></td>
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<td>Day Type</td>
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<td>Wend=Weekend</td>
<td>Shols=School Hols</td>
<td>WendShols= Weekend in school hols</td>
<td>PubHol= Public Holiday</td>
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<tr>
<td>Docent Present</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Docent Interact</td>
<td>1 = No</td>
<td>2 = Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OBSERVATIONS**

| Stop | 1 = No | 2 = Yes |
| Dwell time | Minutes/seconds (numerical) | |
Page intentionally left blank for printing purposes
Appendix B – Pre-visit survey instrument

For each question, circle the response that best matches how you feel about the statement

1. I understand the threats to tigers in the wild

2. It is very important that tigers are protected in the wild

3. I can help protect tigers in the wild

4. I feel a sense of connection to the natural world

5. I feel a sense of connection to tigers

6. If I could, I would like to do something to protect tigers in the wild
7. I speak to my friends/family about what they can do to help protect tigers in the wild

1 2 3 4 5 6 7
Strongly Disagree Most Somewhat Neither Somewhat Mostly Strongly Agree
Disagree Disagree Agree Agree Disagree Agree Agree

8. I can influence my friends/family about what they can do to help protect tigers in the wild

1 2 3 4 5 6 7
Strongly Disagree Most Somewhat Neither Somewhat Mostly Strongly Agree
Disagree Disagree Agree Agree Disagree Agree Agree

10. I can make product purchases that help protect tigers in the wild

1 2 3 4 5 6 7
Strongly Disagree Most Somewhat Neither Somewhat Mostly Strongly Agree
Disagree Disagree Agree Agree Disagree Agree Agree

Why did you visit the zoo today? Select all that apply:

☐ Entertainment/recreation  ☐ Education or learning
☐ Social occasion  ☐ Other ______________

Who are you with at the zoo with today?

☐ Family group including children  ☐ Friends/Other
☐ Family group not including children  ☐ Alone

Where do you live most of the time?

☐ In Australia  ☐ Overseas

What is your age?

☐ 18-25  ☐ 26-35  ☐ 36-45  ☐ 46-55  ☐ 55+

What is your gender?

☐ Female  ☐ Male  ☐ Other
Appendix C – Immediate post-visit survey instrument

For each question, circle the response that best matches how you feel about the statement.

1. I understand the threats to tigers in the wild

2. It is very important that tigers are protected in the wild

3. I can help protect tigers in the wild

4. I feel a sense of connection to the natural world

5. I feel a sense of connection to tigers

6. If I could, I would like to do something to protect tigers in the wild
7. I intend to speak to my friends/family about what they can do to help protect tigers in the wild

[7 point Likert scale]

Strongly Disagree  Mostly Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Mostly Agree  Strongly Agree

8. I can influence my friends/family about what they can do to help protect tigers in the wild

[7 point Likert scale]

Strongly Disagree  Mostly Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Mostly Agree  Strongly Agree

9. I can speak directly with companies about the impact their products have on wildlife

[7 point Likert scale]

Strongly Disagree  Mostly Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Mostly Agree  Strongly Agree

10. I can make product purchases that help protect tigers in the wild

[7 point Likert scale]

Strongly Disagree  Mostly Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Mostly Agree  Strongly Agree

11. I intend to make more sustainable palm oil product choices in the future

[7 point Likert scale]

Strongly Disagree  Mostly Disagree  Somewhat Disagree  Neither Agree nor Disagree  Somewhat Agree  Mostly Agree  Strongly Agree

The tiger exhibit made me feel (select all that apply)

- [ ] Relaxed
- [ ] Tense
- [ ] Happy
- [ ] Sad
- [ ] Interested
- [ ] Bored

Did you see a tiger in the exhibit today?

- [ ] Yes
- [ ] No

For a chance to win a $100 VISA Gift Card and to keep contributing to this project, please include your email address below – you’ll hear from us in around 3 months with a follow-up online survey.

______________________________
## Appendix D – Delayed post-visit survey instrument

(text only – sent via Survey Monkey Platform)

<table>
<thead>
<tr>
<th>Survey Statement</th>
<th>Response format</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I can help protect tigers in the wild</td>
<td>7-point Likert Scale Strongly Disagree to Strongly Agree</td>
</tr>
<tr>
<td>2. I understand the threats to tigers in the wild</td>
<td>7-point Likert Scale Strongly Disagree to Strongly Agree</td>
</tr>
<tr>
<td>3. I feel a sense of connection to the natural world</td>
<td>7-point Likert Scale Strongly Disagree to Strongly Agree</td>
</tr>
<tr>
<td>4. I feel a sense of connection to tigers</td>
<td>7-point Likert Scale Strongly Disagree to Strongly Agree</td>
</tr>
<tr>
<td>5. If I could, I would like to do something to protect tigers in the wild</td>
<td>7-point Likert Scale Strongly Disagree to Strongly Agree</td>
</tr>
<tr>
<td>6. Have you spoken to friends/family about what they can do to help tigers in the wild since your visit to [zoo]*?</td>
<td>Yes/No Non-mandatory comment field</td>
</tr>
<tr>
<td>7. I can influence my friends/family about what they can do to help protect tigers in the wild</td>
<td>7-point Likert Scale Strongly Disagree to Strongly Agree</td>
</tr>
<tr>
<td>8. Have you spoken directly to companies about the impact their products have on tigers in the wild since your visit to [zoo]*?</td>
<td>Yes/No Non-mandatory comment field</td>
</tr>
<tr>
<td>9. Have you made more sustainable palm oil-containing product choices since your visit to [zoo]*?</td>
<td>Yes/No Non-mandatory comment field</td>
</tr>
<tr>
<td>10. Please enter the unique participant code included in your invitation email</td>
<td>Unique code</td>
</tr>
</tbody>
</table>
Appendix E – Participant information sheet

Participant Information Sheet
Researcher:
Ms Rhedyn Ollerenshaw, PhD Researcher (Primary Investigator)
Australian National Centre for the Public Awareness of Science
Australian National University (ANU)

Project Title: Does the design of zoo exhibits impact the efficacy of zoo-based visitor behaviour change campaigns?

General Outline of the Project

Description and Methodology:
The research project will investigate how visiting different types of zoo exhibits affects the way that zoo visitors are impacted by conservation-related behaviour change campaigns. It will involve surveying visitors before, directly after and several months after they visit specific exhibits located at Taronga Zoo and Taronga Western Plains Zoo to examine their attitudes and perceived abilities regarding behaviours that can help protect animals in the wild. The survey will aim to examine any change in these variables after they visit the exhibits.

Participants:
The target survey participant group is adult zoo visitors attending tiger exhibits at Taronga Zoo and Taronga Western Plains Zoo. Potential survey participants will be identified randomly; a number (=n) between 1 and 6 will be selected each day by roll of a dice. Each nth visitor will be approached to ask to participate in the survey; if visitor n refuses, the survey deliverers will approach each successive visitor thereafter.
There is no maximum number of participants. Minimum samples sizes are 200 on-site surveys at Taronga Zoo and 100 at Taronga Western Plains Zoo.
Use of Data and Feedback:
The results of this research will be reported in a PhD thesis by the primary investigator, and in publications by the primary investigator and collaborators. The results will also likely be presented in conference presentations/posters at Australian and international conferences. Data may be shared with Taronga Conservation Society Australia through an agreement with the primary investigator. No contact details will be shared.
A summary report will be made available via a website or online data storage site with no login restrictions. Those participants who provide an email contact on the survey form (voluntary, discussed below) will be emailed a link to the summary report when available.

Participant Involvement:

Voluntary Participation & Withdrawal:
Your participation in the project is voluntary.
You can refuse to answer any questions at any time.
You may, without negative consequences, decline to take part or withdraw from the research without providing an explanation at any time data are submitted to the researcher.
If you withdraw, you can allow the researcher to (a) use data obtained to that point or (b) decline to supply any data. In the case of (b), data will be destroyed and not used in the project.

What does participation in the research entail?
You will be asked to complete several short surveys (approx. 10 questions, approx. 3 minutes duration). Most survey responses will be delivered via selecting a value on a scale (where 1 = strongly disagree, and 7 = strongly agree).
Some questions will be asked in multiple surveys.
A short survey will be delivered to you up to 3 times:
Once before you enter a target exhibit on-site at Taronga Zoo or Taronga Western Plains Zoo, and
Once upon your departure from that same exhibit.
You will be given the option to provide an email contact address at the end of the second survey; if you do so, you will receive an email requesting they complete a final short survey online via Survey Monkey (or similar).
Data from the on-site surveys will be transposed by the primary researcher into an electronic database.

**Remuneration:**
A small incentive will be offered for survey participants who provide their email address to allow the investigator to administer a delayed post-visit online survey approximately 3 months after the initial survey, or complete and submit the online survey. The incentive is valued at AUD$100 and is a VISA gift card. One incentive will be offered in each case and will be randomly drawn by the primary researcher. You will be contacted via email if you are the randomly selected recipient of the incentive.

**Risks:**
Participation in the survey is expected to be minimally disruptive to you. Questions are not expected to be sensitive. You will not be asked to provide any identifying details apart from voluntarily supplying a contact email for the 3-month delayed post-visit online survey. Your email address will be stored securely on the ANU-licensed OneDrive cloud server, in a password protected environment, in accordance with ANU policies and will never be made public or shared with anyone.

**Benefits:**
It is unlikely that you will personally benefit from participating in this project, but it is expected that the project will benefit the zoo industry and more broadly to the informal science learning community by enhancing their understanding of effective zoo design and assisting with efficient expenditure of resources in building new exhibits. If the research outcomes are applied, the benefits will flow to zoo visitors by enhancing their recreation and educational experiences, and potentially to wildlife and ecosystems as the research contributes to making zoos more effective conservation educators.
**Exclusion criteria:**
People with obvious physical disabilities that would inhibit them safely completing a paper-based survey (e.g. crutches, using walking frame, significantly vision-impaired) will not be approached to participate in the surveys.
To minimise disruption to carers, groups that appear to have more children than adults will be excluded, as will adults holding/restraining children or physically assisting an adult with their mobility.

**Confidentiality:**
You will not be asked to provide any identifying details apart from voluntarily supplying a contact email for the 3-month delayed post-visit online survey.
These details will be stored securely and confidentially on the ANU-licensed OneDrive cloud server, in a password protected environment, in accordance with ANU policies and will never be made public or shared with anyone.

**Privacy Notice:**
In collecting your personal information (in this case, limited to email addresses) within this research, the ANU must comply with the Privacy Act 1988. The ANU Privacy Policy is available at [https://policies.anu.edu.au/ppl/document/ANUP_010007](https://policies.anu.edu.au/ppl/document/ANUP_010007) and it contains information about how a person can:
Access or seek correction to their personal information;
Complain about a breach of an Australian Privacy Principle by ANU, and how ANU will handle the complaint.

**Data Storage:**
Data will be stored securely and confidentially on the ANU-licensed OneDrive cloud server, in a password protected environment, in accordance with ANU policies.
Only the primary investigator and supervisor will have access to these files.
All data will be stored for a minimum of 5 years from the data of publication of the resulting PhD thesis, in accordance with ANU policies. There are no plans to destroy the research; it will not be destroyed without carefully considering if it has future use and value, such as if it could inform further research in this space or could be used for other analyses.
Queries and Concerns:
Queries or requests for further information should be directed to
Ms Rhedyn Ollerenshaw, Primary Investigator, via email at u2560353@anu.edu.au in the first instance, or
Dr Merryn McKinnon (Supervisor), Australian National Centre for the Public Awareness of Science Australian National University at merryn.mckinnon@anu.edu.au or via phone +61 2 6125 4951

Ethics Committee Clearance:
The ethical aspects of this research have been approved by the ANU Human Research Ethics Committee (Protocol 2017/925). If you have any concerns or complaints about how this research has been conducted, please contact:

Ethics Manager
The ANU Human Research Ethics Committee
The Australian National University
Telephone: +61 2 6125 3427
Email: Human.Ethics.Offer@anu.edu.au
### Appendix F – Observation data collection sheets

<table>
<thead>
<tr>
<th>Taronga Zoo</th>
<th>Stop?</th>
<th>Time</th>
<th>Interact?</th>
<th>Tiger?</th>
<th>Notes</th>
<th>Zone description</th>
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<tbody>
<tr>
<td>1 Plane</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cockpit door (video)</td>
</tr>
<tr>
<td></td>
<td>1A</td>
<td></td>
<td></td>
<td></td>
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