

Exploring the Role of Post-Visit Action Resources in Free-Choice Environmental
Learning: Translating Environmental Knowledge into Sustainable Action

by

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A Thesis submitted to the Faculty of Graduate Studies of
The University of Manitoba
in partial fulfilment of the requirements of the degree of

MASTER OF ARTS

Faculty of Kinesiology and Recreation Management
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EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Abstract

The purpose of this research was to explore how post-visit action resources, such as printed handouts and email updates, impact environmental free-choice learning and sustainable behaviour after a visit to an environmental free-choice learning centre. Free-choice learning, which occurs in places like zoos, is an increasingly popular and effective experience to communicate environmental sustainability and climate change issues to the public. This research specifically explored how post-visit resources provided after a visit to the International Polar Bear Conservation Centre in Winnipeg's Assiniboine Park Zoo in Manitoba, Canada affected environmental learning and sustainable behaviour change over a two-month period. Questionnaire and personal meaning mapping interview responses revealed that post-visit resources can be an effective way to improve environmental learning, increase awareness, and encourage some sustainable behaviour change. The implications for environmental free-choice learning experiences are discussed and recommendations for future practices explained.

Key Words: Post-visit action resources, free-choice learning, sustainable behaviour change, personal meaning mapping

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Acknowledgements

I would like to acknowledge my supervisor, Dr. Christine Van Winkle, for her hard work and dedication to my learning and this thesis. Additionally, I must acknowledge her for providing me with learning and research opportunities in her research, which has certainly strengthened this thesis and my skill set. I would also like to acknowledge the other members of my committee: Dr. Amanda Johnson, Dr. Mary Benbow, and Dr. Bonnie Hallman. Thank you to Dr. Johnson for her help and guidance while Dr. Van Winkle was on leave, and to Dr. Hallman for joining my committee in Dr. Benbow's absence. I must also thank the Assiniboine Park Zoo, particularly the Research and Conservation department and Dr. Stephen Peterson. Without their co-operation and support regarding input into the research, guidance for the PVAR content, and generous donation of the survey incentives, this project would not have been possible. I am also thankful for the volunteers that helped with the data collection: Jamie and Melissa. Melissa continued on with the project to act as my additional independent data coder, and I must express my appreciation of her hard work and attention to detail. I must also acknowledge my family for their ongoing support. Finally, thank you to the Social Sciences and Humanities Research Council of Canada, the University of Manitoba, the University Women's Club of Winnipeg, and St. John's College for funding this research.

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Dedication

This thesis is dedicated to my father who always supported me and encouraged me to do my best in all my endeavours. You instilled in me a love of travel, places, family, nature, and storytelling. You will always be missed, remembered, and loved.

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List of Abbreviations

<i>CBSM</i>	<i>Community Based Social Marketing</i>
<i>CML</i>	<i>Contextual Model of Learning</i>
<i>IPBCC</i>	<i>International Polar Bear Conservation Centre</i>
<i>PMM</i>	<i>Personal Meaning Map</i>
<i>PVAR</i>	<i>Post-Visit Action Resource</i>

Chapter 1: Introduction

These visitors did not need to hear that there was a conservation problem; that they already knew. What they did want to learn, but which was not provided, were simple, practical and concrete steps they could take to make a difference. (Falk, 2005, p. 276)

The effects of climate change are far-reaching and will increasingly have dire consequences that have been equated to an ecological holocaust (IPCC, 2013; McKenzie-Mohr, 1994; 2000; McKenzie-Mohr & Oskamp, 1995). Research demonstrates that the cause of climate change is undeniably linked to human activity, as carbon dioxide emissions have increased exponentially since the industrial revolution (IPCC, 2013; McKenzie-Mohr, 1994; 2000; Pang, McKercher, & Prideaux, 2013). We can blame other individuals, corporations, governments or other nations, but taking action to reduce carbon dioxide and the effects of climate change comes down to choices we make as individuals (McKenzie-Mohr, 1994; 2000; Murray, Goodhew, & Murray, 2013). Research demonstrates that technological solutions have been insufficient and that we must include people and their individual knowledge, attitudes, and behaviours in the problem-solving process (McKenzie-Mohr, 1994; 2000; McKenzie-Mohr & Oskamp, 1995). Additionally, recent research demonstrates that the general public is concerned about climate change, but face barriers of uncertainty and lack of knowledge that prevent them from taking action (Clayton, Luebke, Saunders, Matiasek, & Grajal, 2013; Hughes, 2011; 2013; Hughes, Packer & Ballantyne, 2011; Luebke, Clayton, Sauders, Matiasek, Kelly, & Grajal, 2012).

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Climate change issues occur on a global scale, making environmental problems feel overwhelming and insurmountable to individuals (Clayton et al. 2013, Luebke et al., 2012; McKenzie-Mohr, 2000; 2004; Pang et al., 2013). Environmental free-choice learning is an effective experience that can communicate environmental sustainability issues to the public and encourage sustainable behaviour modification (Ballantyne & Packer, 2005; 2011; Ballantyne, Packer, Hughes, & Dierking, 2007; Falk, 2005; Hughes et al., 2011; Tofield, Coll, Vyle, & Bolstad, 2003; Zeppel, 2008). Providing environmental education in localized contexts is important, as environmental sustainability is significantly affected by individuals' behaviour in local environments, where knowledge and awareness of sustainability can impact the future of a region. However, environmental knowledge alone can be insufficient, and even detrimental to sustainable behaviour change (Alessa, Bennett, & Kliskey, 2003; Ballantyne & Packer, 2005; Ballantyne et al., 2007). An important issue to consider is how environmental knowledge can be translated into sustainable behaviour. Recent research acknowledges that environmental education should emphasize "people's connection with nature, building environmental literacy, and encouraging stewardship behaviour" (Ardoin & Heimlich, 2013, p. 98). Environmental education must aspire to not only impart knowledge, but also increase awareness and action (Ardoin & Heimlich, 2013). As described by Ardoin and Heimlich (2013): "learning is the role of the learner and that education is not about imposing facts, beliefs, and values upon others, but rather is an activity of facilitating and shaping experiences to allow learners to challenge, shape, extend, and change their own beliefs and values" (p. 111).

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Research suggests that post-visit action resources (PVARs) provided by a free-choice learning site can have a positive impact on sustainable behaviour change by reinforcing the information learned during the experience and prompting individuals to act (Ballantyne & Packer, 2005; 2011; Ballantyne, Packer, & Falk, 2011; Falk, Ballantyne, Packer, & Benckendorff, 2012; Hughes et al., 2011; Tofield et al., 2003). To date, researchers have not extensively examined post-visit free-choice learning experiences of visitors given PVARs (Ballantyne & Packer, 2011; Hughes, 2011; 2013; Hughes et al., 2011). The role that PVARs play in free-choice learning experiences requires further investigation to determine if the results from initial studies are applicable to various settings and locations (Ballantyne & Packer, 2011; Ballantyne et al., 2011; Hughes, 2011; 2013; Hughes et al., 2011). This avenue of research must be explored to broaden environmental learning and sustainable behaviour by providing post-visit resources to visitors. This research will provide environmental education centres with knowledge about whether or not post-visit resources are effective in multiple settings. This is especially important as environmental education centres are increasingly recognizing the role they play in environmental learning, and visitors are seeking out engaging and meaningful learning experiences. PVARs have the potential to act as this catalyst for change while improving visitor experiences, by offering a deeper level of engagement, and therefore merit further exploration. The purpose of this research is to examine how post-visit action resources contribute to free-choice learning experiences that extend learning beyond the on-site visit to contribute to greater environmental learning and sustainable behaviour over time.

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Definitions of Key Terms

Previous studies regarding PVARs and learning have utilized a broad definition of learning that can include changes in knowledge, attitudes, and behaviours (Ballantyne & Packer, 2011; Hughes et al., 2011). Including behaviours within a definition of learning is problematic, since learning is the acquisition of knowledge and does not necessarily include or affect behaviours (Alessa et al., 2003; Ardoin & Heimlich, 2013; Ballantyne et al., 2011; Hughes, 2013). As the purpose of this study was to explore environmental learning and sustainable behaviour change, these terms must be considered distinct. Free-choice learning was defined as meaningful knowledge gain that was informal, contained an aspect of choice and control, and was influenced by personal motivations (Falk, 2005; Falk & Dierking, 2000; Mayer, 2002).

The term “free-choice learning” was used throughout this study, and is intentionally selected instead of “informal learning” due to support in the literature for this distinction (Falk, 2005; Falk & Dierking, 2000; Falxk, Heimlich, & Foutz, 2009; Heimlich & Falk, 2009). The term informal learning was insufficient to describe the learning that takes place in locations such as museums, zoos, aquariums, and other education centres, since it does not account for the personal autonomy of learning that occurs at these sites (Falk, 2005).

It is important to note that throughout this thesis *meaningful* rather than *rote* learning is explored. Rote learning is described as knowledge retention, whereas, meaningful learning occurs when knowledge is transferred “to solve new problems, answer new questions or facilitate new subject matter” (Mayer, 2002, p. 226). This is an important distinction for this study since meaningful learning is essential for individuals

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to apply environmental knowledge to their everyday behaviour (Van Winkle & Backman, 2011).

For the purpose of this thesis, behaviour was defined as actions relating to environmental sustainability (Ballantyne & Packer, 2005). Research supports this distinction that attitudes and behaviours are potential outcomes of a free-choice learning experience that is “part of a broad range of dimensions involving knowledge, skills, aesthetic responses and emotions” (Hooper-Greenhill, 2004, p. 163; Ballantyne & Packer, 2005). Environmental sustainability relates broadly to environmental, socio-cultural, and economic components of life in terms of “meet[ing] the needs of the present without compromising the ability of the future generation to meet their own needs” (WCED, 1987).

Purpose of the Study

The purpose of this thesis was to examine how PVARs contribute to free-choice learning experiences that extend beyond the on-site visitor experience, to contribute to greater environmental learning and sustainable behaviour over time. Specifically, this research explored how PVARs, such as printed materials, social media, or web-based learning, provided to visitors after their visit to a free-choice learning centre, affected environmental learning and sustainable behaviour over a two-month period (Ballantyne & Packer, 2011; Hughes et al., 2011).

Research questions.

To address the purpose of this study the following research questions were examined: How do PVARs contribute to free-choice learning after the visit, and does this

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affect sustainable behaviour? Specifically, the study will address the following research questions:

1. How do post-visit action resources affect free-choice learning after a visit to an environmental education centre, specifically, the International Polar Bear Conservation Centre at the Assiniboine Park Zoo?
2. How do post-visit action resources affect sustainable behaviour change after a visit to an environmental education centre, specifically, the International Polar Bear Conservation Centre at the Assiniboine Park Zoo?
3. How does post-visit free-choice learning relate to sustainable behaviour change, specifically, the International Polar Bear Conservation Centre at the Assiniboine Park Zoo?

Chapter 2: Literature Review

This chapter will discuss the literature regarding free-choice learning, in terms of theory, models, and practical application, as well as the role of zoos in environmental free-choice learning and the relation between behaviour change. Sustainable behaviour change will be discussed in terms of theory and application, as well as current research in this field of study. Finally, a theoretical framework will be provided and implications of this research will be discussed.

Free-Choice Learning

Free-choice learning is a lifelong process that occurs in many settings, most of which are outside the classroom, such as at museums, parks, zoos, aquariums, or various forms of education centres (Ballantyne & Packer, 2005; Falk, 2005; Falk & Dierking, 2000; Heimlich & Falk, 2009). Free-choice learning is highly idiosyncratic, cumulative, and occurs in different contexts. Individuals have different motivations, expectations, knowledge, beliefs, values, attitudes, and prior experiences, which contributes to a wide array of individual learning experiences (Falk, 2005, Falk & Dierking, 2000; Heimlich & Falk, 2009). According to Falk (2005), variation in learning can be shallow and wide, or deep and narrow. Learning can take place during the experience but it can also take root over time through different experiences in various contexts (Adams, Falk, & Dierking, 2003; Falk, 2003a; Falk & Dierking, 2000). In summary, free-choice learning experiences are shaped by a variety of factors with an assortment of outcomes, which distinguishes this type of learning from more formal learning settings.

The majority of environmental learning takes place outside the classroom in free-choice learning settings (Ballantyne & Packer, 2005; Falk, 2005). Ballantyne and Packer

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(2005) explain that a relatively small proportion of one's life is spent in formal education settings which makes free-choice and other informal learning that much more important for life long learning about the natural environment. If environmental learning is to be a key ingredient for sustainability, more research is required to gain a better understanding of the relationship between these concepts (Ballantyne & Packer, 2005). Desired learning outcomes from free-choice learning programs can include: "encouraging curiosity and exploration, changing attitudes, evoking feelings, developing a sense of personal, cultural and community identity, and making decisions about moral and ethical issues" (Ballantyne & Packer, 2005, p. 282). Furthermore, environmental interpretation is increasingly geared towards engendering positive environmental attitudes and behaviours for environmental sustainability (Ballantyne & Packer, 2005; Heimlich & Falk, 2009). Indeed, it has been found that experience-based environmental learning is more engaging, longer lasting, and more likely to evoke attitudinal and behavioural changes than traditional teacher-directed methods (Ballantyne & Packer, 2009b). Though the length of time spent in free-choice learning centres is often relatively short, these experiences have proven to be effective learning experiences with lasting impacts (Ballantyne & Packer, 2005). Free-choice learning is considered an enjoyable experience, where individuals "learn more when it's fun" (Packer & Ballantyne, 2004, p. 65). According to Ballantyne and Packer (2005) characteristics of educational leisure experiences include aspects of discovery and fascination, appeal to multiple senses, appear effortless, and include elements of choice. These are important variables to consider when designing effective and memorable environmental free-choice learning experiences. Finally, free-choice learning experiences should also be sufficiently

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challenging for a wide array of audiences (Rennie & Williams, 2006). Rennie & Williams (2006) state that in their research regarding adult free-choice learning “both institutions [science learning centres] failed to challenge people to think beyond what they already know” (p. 890) and suggest that learning centers need to be more aggressive and challenging.

Free-choice learning, constructivist learning theory and the contextual model of learning.

Constructivist learning theory served as a guide for this study as it conceptualizes socio-cultural processes as ways in which individuals create meaning, and is widely accepted as the theoretical foundation for free-choice learning (Ballantyne & Packer, 2005). Specifically, the contextual model of learning (CML) provides the framework for understanding the constructivist learning experience that occurs during leisure experiences (Ballantyne & Packer, 2005; Falk & Dierking, 2000). This model describes free-choice learning experiences and includes personal, socio-cultural and physical contexts (Falk & Dierking, 2000). Falk and Dierking (2000) conceptualized the CML as the refurbished version of their earlier interactive experience model. The interactive experience model served in introducing the personal, physical, and socio-cultural contexts of learning (Falk & Dierking, 2000). The CML was developed through theory and lived experiences, and was designed to incorporate the individual nature of learning as something that cannot be isolated in time and should not disregard prior knowledge (Falk & Dierking, 2000). Acknowledging learning as both a process and product is another important aspect of the CML (Falk & Dierking, 2000). The CML informs this study by describing how reinforcing events and experiences contribute to knowledge gain

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as part of the physical context of learning (Falk & Dierking, 2000; Falk & Storksdieck, 2005).

The CML encompasses three contexts of learning over time: personal, socio-cultural, and physical. The personal context of this model includes motivation and expectations, prior knowledge, interests, and beliefs, choice and control. The socio-cultural context entails within-group socio-cultural mediation and facilitated mediation by others. Advance organizers and orientations, design, and reinforcing events and experiences outside the free-choice learning centre experience occur within the physical context (Falk & Dierking, 2000).

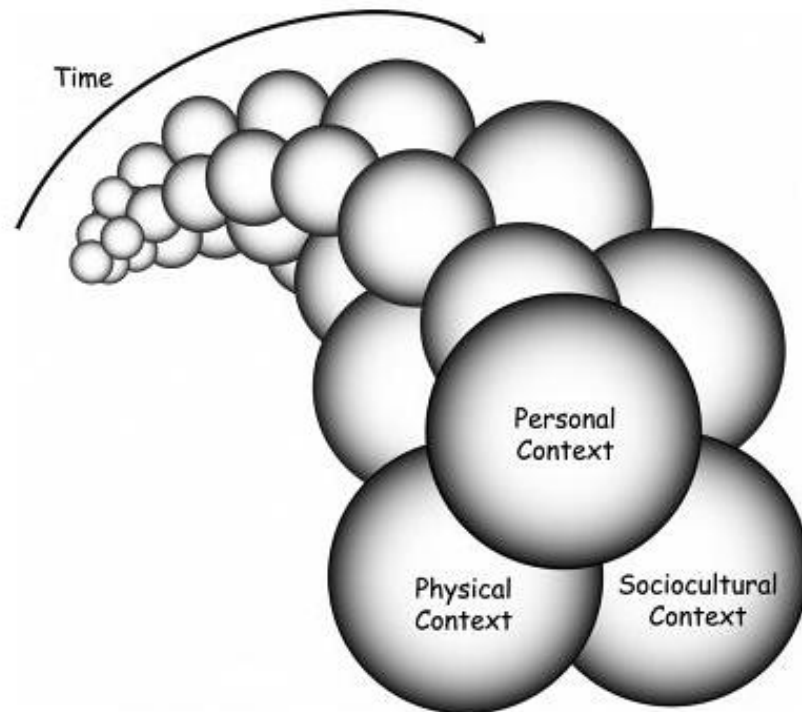


Figure 1. The Contextual Model of Learning (CML) as proposed by Falk and Dierking (2000, p. 12) demonstrates the interaction of personal, physical and socio-cultural

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contexts over time for free-choice learning. © (Falk & Dierking, 2000). Used with permission from Altamira Press.

Free-choice learning and the physical context: Reinforcing events and experiences.

What happens after a free-choice learning experience is important because it provides an opportunity to expand upon what was learned, potentially contributing to meaningful learning by applying new knowledge to various ‘real-life’ settings (Falk & Dierking, 2000). Some free-choice learning centres are already taking note of this and are creating innovative websites and take-home activities to help visitors extend their learning beyond the initial visit (Falk & Dierking, 2000; Hughes et al., 2011). However, despite the intuitive nature of reinforcement for learning, take-home activities, and reinforcing experiences are often overlooked and under-utilized (Falk & Dierking, 2000; Hughes et al., 2011). Despite numerous calls for further research on post-visit learning, research on post-visit action resources (PVARs) is limited (Ballantyne & Packer, 2005; Ballantyne & Packer, 2009a; 2011; Falk & Dierking, 2000; Hughes, 2011; 2013). According to Hughes (2013): “post-visit discussion and activities are likely to be an important part of this [learning] process, yet post-visit reinforcement in a tourism context is generally ad hoc. Visitors are rarely provided with take-home materials or strategies for putting their new knowledge into practice” (p. 68). Interestingly, recent research by Ardoin and Heimlich (2013) reveals that environmental educators and practitioners are aware that environmental education is not just for children and must appeal to a broad range of audiences, but knew little about appropriate environmental education theories

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and only slightly more about age and developmental appropriateness. Environmental education will likely be ineffective if the foundation has not been laid during the planning process.

Learning experiences evolve over time and should aspire to be “transformative” and “deeply engaging and include personal meaning” to positively impact learning, and this is where reinforcing activities have significant potential (Falk et al., 2012, p. 920). If visitors can retain the information they learned, improve upon it, or even apply it, conservation knowledge is more likely to have an impact with localized sustainable actions helping society move towards sustainability.

Free-choice learning and the role of zoos and environmental education.

Versions of zoos, which were typified by displays of animals, originated in the 15th century and became increasingly common by the 18th and 19th centuries (Benbow, 2000). Early zoos were places where animals could be viewed and were considered sources of entertainment. It was as late as the mid 1980s when the mandate of zoos began to be critiqued by researchers, causing zoos to take an introspective look at their purposes and mandates (Smith & Broad, 2008). While historically zoos have been controversial due to captive animal ethics and treatment, modern zoos have evolved from places to merely view animals to places of conservation and environmental education (Benbow, 2000; 2004; Carr & Cohen, 2011). Despite this shift in mandates, zoos continue to be criticized for their weak emphasis on conservation (Carr & Cohen, 2011). Carr and Cohen (2011) call for more balance between conservation, education, research, and entertainment. These goals are mutually beneficial, as enjoyment and fun are considered advantageous for conveying conservation messages (Ballantyne et al., 2007;

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Carr & Cohen, 2011; Packer & Ballantyne, 2004). Indeed, research consistently demonstrated that learning experiences are enjoyable and can be an entertaining aspect of a visit (Ballantyne et al., 2007; Carr & Cohen, 2011; Falk et al., 2012; Packer & Ballantyne, 2004).

As recently as 2011, Carr and Cohen raised their concerns about a lack of evidence for attitude and behaviour changes in relation to zoo education. These concerns are beginning to be addressed, as the end of 2013 saw a flurry of published articles addressing environmental education, particularly in zoo and aquarium contexts (Ardoin & Heimlich, 2013; Clayton et al., 2013; Schultz, & Joordens, 2013; Stern, Powell, & Hill, 2013). Research conducted by Clayton et al. (2013) found that zoos are generally considered trustworthy and politically neutral places where pro-environmental messages can be effectively distributed. Additionally, zoos are considered important locations for people to interact with and learn about the natural environment, which has been found to correlate to pro-environmental behaviours (Benbow, 2004; Clayton et al., 2013). Despite their criticisms of evidence supporting attitude and behaviour changes, Smith and Broad (2008) acknowledge the impact that zoos can have in terms of reinforcing existing environmental knowledge and they call for additional research that examines the role of zoos as a source of educational “reinforcement, enhancement, or inducement agents” (p. 23). In general, it is broadly acknowledged that zoos can play an important role in educating the public in a way that is enjoyable for the visitor (Clayton et al., 2013; Luebke et al., 2012; Smith & Broad, 2008). By engaging visitors in a way that reinforces the original message and encourages action zoos can facilitate meaningful attitudinal and behavioural changes (Clayton et al., 2013; Luebke et al., 2012; Smith & Broad, 2008).

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PVARs as reinforcing events / activities.

‘Post Visit Action Resources’ arose from a need to extend learning beyond the visit to help bridge the gap between learning, intentions, and behaviours (Ballantyne & Packer, 2011). This call for additional research to examine environmental learning experiences after the visit is referred to as “intervening treatments” (Ballantyne & Packer, 2011), “follow-up processes” (Ballantyne & Packer, 2005), and generally as post-evaluation and reflection (Stern et al., 2013). PVAR research has sought to identify aspects from various behaviour theories, learning theories, and community-based social marketing (CBSM) to create a set of tools that can help support learning after the initial visit (Ballantyne & Packer, 2011; Hughes, 2011; 2013; Hughes et al., 2011). CBSM uses psychological theories and social marketing to address issues regarding sustainable behaviour modification. As demonstrated through research, this approach has been useful for informing the development of the PVARs (Hughes et al., 2011).

By using various aspects of CBSM, and multiple mediums to convey the PVARs to visitors, the intention of the research conducted by Hughes et al. (2011) was to understand how learning could be furthered and sustainable behaviours increased by providing visitors with PVARs (Hughes, 2011; 2013). PVARs can include: fact sheets, newsletters, puzzles, quizzes, mazes, colouring sheets (with conservation themes), online resources such as suggestions for conservation activities, craft projects, links to major environmental websites, prompts (in the form of visit related updates), email reminders about environmental topics, articles posted on the environmental education centres’ websites, and environmental events (Hughes, 2013). Respondents to the Hughes et al. (2011) study reported that they felt a stronger connection to the animals (turtles) through

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the email updates (Hughes, 2013). The survey data supports this finding by visitors stating that they were strongly influenced by the turtle data updates (53.5%), email contact by the researcher (35.5%), fact-sheets (35%) and newsletters (22.5%) (Hughes, 2013, p. 75).

Ballantyne and Packer (2005) provide an outline and description of factors that contributed to environmentally sustainable attitudes and practices, which are valuable for informing the creation of PVARs. “Factors that have been most consistently identified include those that arouse learners’ emotions, challenge their beliefs and enhance environmental conceptions” (Ballantyne & Packer, 2005, p. 287). Ballantyne and Packer (2005) also highlight the importance of using a range of strategies to reach a maximum number of visitors due to the individual nature of free-choice learning and visitors’ motivations. Ballantyne et al. (2007) elaborate on this foundation of strategies and state the importance of challenging beliefs, and linking conservation goals to everyday activities to enhance environmental conceptions. This is supported by CBSM, which states that barriers and benefits need to be addressed, social norms need to be established through communication, and outcomes are encouraged by providing incentives and removing external barriers (McKenzie-Mohr & Smith, 1999). Beliefs are challenged when barriers and benefits are identified, and enhancing environmental conceptions includes providing practical steps for everyday life through building norms, communicating, providing incentives and removing external barriers (Ballantyne et al., 2007; McKenzie-Mohr & Smith, 1999). While CBSM does not address emotion directly, it does suggest using communication vividly, which could evoke emotion in visitors (McKenzie-Mohr & Smith, 1999). Emotion and empathy have been found to be

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important in meaningful environmental learning experiences (Clayton et al., 2013; Tofield et al., 2003; Zeppel, 2008). Particularly, emotional experiences were found to improve when the experience includes local settings (Tofield et al., 2003). Additionally, emotional aspects and empathy are important regarding long-term conservation behaviour outcomes (Zeppel, 2008) and connecting with nature (Clayton et al., 2013).

Free-choice learning and behaviour change.

How learning contributes to behaviour remains poorly understood. We know there is a disconnect between knowledge and actions, but we do not know why the gap exists (Alessa et al., 2003; Ballantyne & Packer, 2011; Hughes, 2011; 2013; Hughes et al., 2011; Orams, 1995). Ballantyne and Packer (2011) provide a research-based model to describe this phenomenon (Figure 2).

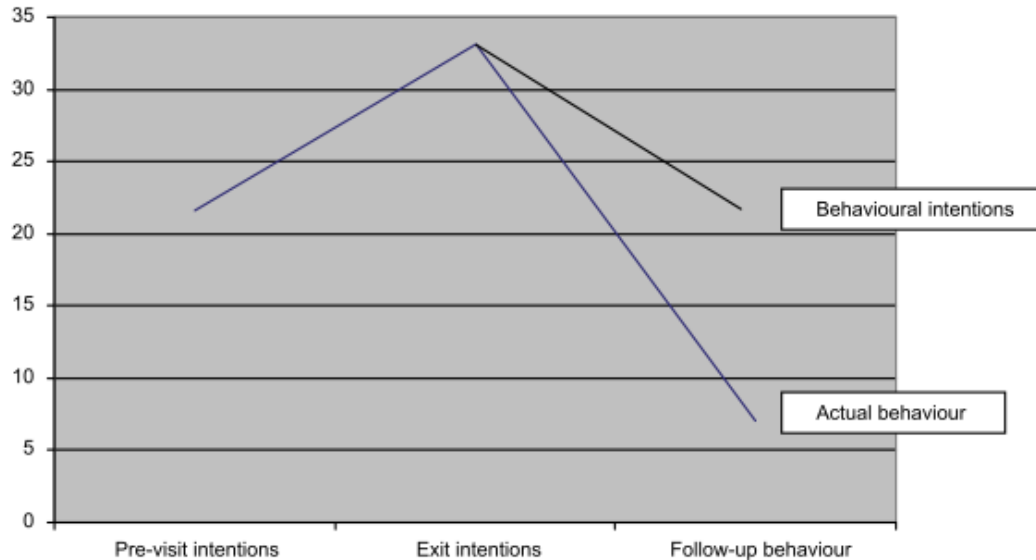


Figure 2. Intentions versus actual behaviour (Ballantyne & Packer, 2011, p. 209) © Used with permission from Taylor & Francis Group (www.tandfonline.com).

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Hughes (2013) elaborated on this discord between visitors' intentions and behaviour over time and suggested that this could be due to a number of factors, such as respondents' over-stating initial intentions, inaccuracy in self-reporting, lack of skills or resources to fulfill behaviours, or time restrictions.

The theoretical model provided by Ballantyne and Packer (2011) describes how visitors' environmental learning may be impacted by PVARs. However, this model and current research does not conclusively demonstrate that meaningful environmental learning results from PVARs.

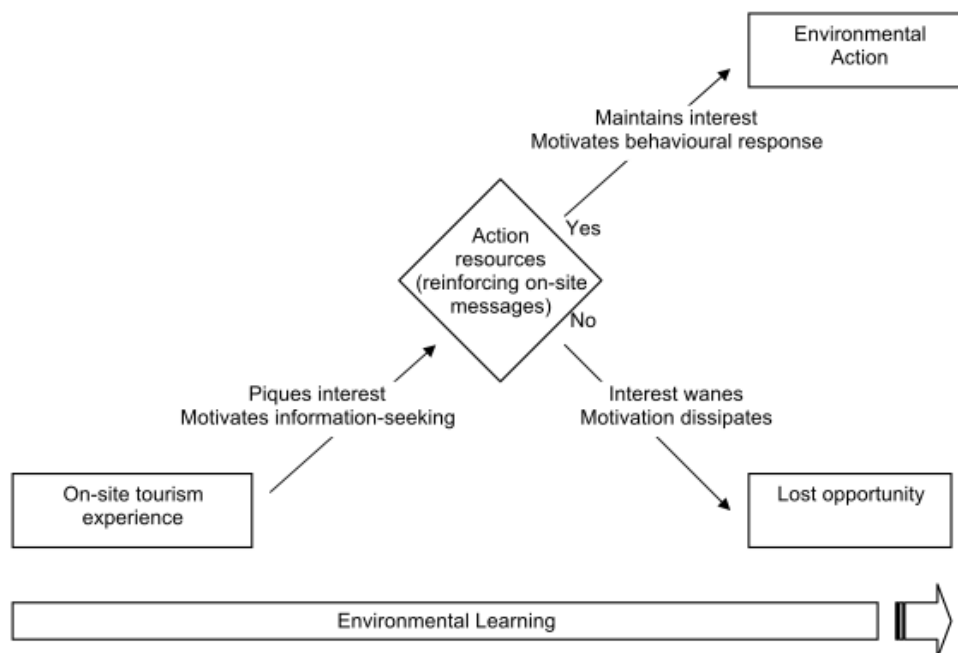


Figure 3. Tourism experiences and the outcomes relating to PVARs (Ballantyne & Packer, 2011, p. 211) © Used with permission from Taylor & Francis Group (www.tandfonline.com).

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This model should be expanded upon to reflect the possible variation in environment learning between PVARs or no PVARs. As the model is currently presented, environmental learning appears to be constant over time, whereas research demonstrates that learning is volatile over time and may either increase or decrease after a visit (Ballantyne et al., 2007; Falk & Dierking, 2000; Falk & Storksdieck, 2005).

As noted earlier, PVARs are believed to act as reinforcing events, giving visitors the necessary tools to extend their learning beyond their visit and translate learning into action (Hughes, 2011; 2013; Hughes et al., 2011). Research has not yet conclusively demonstrated the long-term impact of PVARs on environmental learning and sustainable behaviour (Ballantyne & Packer, 2011; Hughes, 2011; 2013; Hughes et al., 2011). According to the theory of planned behaviour, human thought can be arranged in a hierarchy beginning with values, which are shaped by ways of thinking or meaning making, which sequentially influences value orientations, attitudes and norms, behavioural intentions, and culminates in the influence of behaviours (Ajzen, 1991; Needham & Rollins, 2009). With this conceptual model, one can see that while attitudes and behaviours are intricately linked to knowledge, these concepts are distinct. Learning, therefore cannot be meaningfully measured by using a broad definition. Additionally, previous research on PVARs and environmental free-choice learning has not distinguished between rote and meaningful learning, which requires further investigation (Ballantyne & Packer, 2011; Hughes et al, 2011: Hughes, 2011; 2013). Further research is required to determine the most appropriate time frame for measuring “long-term”

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learning, as current studies range from one month to three years (Ballantyne et al., 2011; Falk et al., 2007; Hughes, 2013; Hughes et al., 2011).

Sustainable Behaviour and Behaviour Change

Research has found that visitors are often aware of environmental problems and have good intentions to alter their behaviour in order to address these issues, but they lack knowledge, specific steps, and tools required for action (Alessa et al., 2003; Ballantyne & Packer, 2005; Ballantyne et al., 2007; Falk, 2005; Hughes, 2011; 2013; Tofield et al., 2003; Van Winkle & MacKay, 2008). Specifically, Van Winkle and MacKay (2008) found that education and communication material needed to be in a local context to improve visitors' conservation actions. Ballantyne and Packer (2009) advocate for "experienced-based modes of learning" in lieu of formal learning experiences, stating that they are integral for "facilitating attitudinal and behavioural changes" (p. 217). Similarly, Ardoin and Heimlich (2013) argue that environmental conservation initiatives should emphasize "people's connection with nature, building environmental literacy, and encouraging stewardship behaviour" (p. 98). They elaborate by explaining that key audiences should be engaged within local contexts and that social-marketing and value-based strategies be employed (Ardoin & Heimlich, 2013). These arguments further support the need for using real-life examples in local environments within the context of free-choice environmental learning.

Rennie and Williams (2006) found that people engage with science when they believe it affects their life. This research by Rennie and Williams (2006) also found that people are often detached from science learning experiences because their learning experience has failed to challenge what they already know and they postulate that

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learning centres need to be more aggressive and challenging. These findings echo Falk's (2005) research, which found that people are insufficiently challenged in free-choice environmental learning contexts. In conjunction with this knowledge one can apply the findings of Gutrich, Donovan, Finucane, Focht, Hitzhusen, Manopimoke,... Sasmitawidjaja (2005), which suggested that people prefer scientists take a more significant role in interpreting research into management decisions. Additionally, the findings by Clayton et al. (2013) revealed that pro-environmental messages were well received by zoo visitors, as the zoo is considered a reputable and non-partisan place. This research demonstrates that researchers, scientists, and places like zoos have the capacity to inform the public in a way that is perceived to be non-partisan and trustworthy in regards to environmental learning, conservation, and sustainability (Clayton et al., 2013; Gutrich et al., 2005).

Community-based social marketing.

Community-based social marketing (CBSM) arose from the recognition that economic-based models of behaviour change were psychologically ineffective, and that by applying social psychological principles success rates of sustainable behaviour change would improve (McKenzie-Mohr, 1995). While Hughes et al. (2011) introduce CBSM as a theory, McKenzie-Mohr (2000) describes CBSM as an approach that utilizes psychology theories and social marketing. Therefore, CBSM is best described as an approach, or conceptual framework, used to address sustainability outcomes, and does not offer an explanatory component as a theory would, CBSM is most appropriately conceptualized as an approach. CBSM consists of several tools to foster sustainability. It is designed to uncover barriers and benefits, use commitment to help transfer intentions

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to actions, engage prompts to help people remember to act sustainably, build community support through social norms, tap into communication to create effective messages, use incentives and remove barriers to promote action, and provides an outline to design and evaluate effective programs (McKenzie-Mohr & Smith, 1999). The approach offers detailed steps and strategies, grounded in psychology, to utilize each of the above concepts to their fullest capacity (McKenzie-Mohr, 1995; McKenzie-Mohr & Smith, 1999). For example, having individuals engage in social commitment for a particular action is based in “cognitive dissonance” (McKenzie-Mohr, 1994, p. 229) where individuals internally seek to have their beliefs align with their actions and will alter one or the other to maintain consistency. This translates into modified behaviours when new beliefs emerge based on new information or commitment (McKenzie-Mohr, 1994). McKenzie-Mohr (1994) has applied social marketing in relation to energy conservation and criticizes the ‘rational-economic model’ as being “naïve” and “ineffective” (p. 224) in relation to behavioural change. Empirical evidence describes the effectiveness of social marketing for a home energy conservation campaign finds this to be a successful strategy (McKenzie-Mohr, 1994; 2000). McKenzie-Mohr has become the authority on CBSM and co-authored *Fostering Sustainable Behaviour: An Introduction to Community-Based Social Marketing* with Smith (1999). Their book has become a key resource for community sustainability and has been applied to a wide array of community-based sustainability projects (Hughes, 2013).

CBSM takes into consideration personal factors, such as time and monetary costs. It is recognized that there are certain barriers that individuals face that prevent them from engaging in a particular behaviour. McKenzie-Mohr (1994; 2000) emphasized the

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importance of assessing communities to determine barriers, utilizing pilot testing, and having clear evaluation methods to ensure that objectives are met. For behaviours it is recognized that there are differences between one-time and recurring behaviours. CBSM posits that recurring activities are important for sustainability, as many issues cannot be fixed with one-time actions, and require sustained behaviour change (McKenzie-Mohr, 2000). In order to address behaviour modification an assessment of barriers for that community must first be conducted. Additionally, CBSM acknowledges that “curtailment (e.g. walking to work) is less effective than investment (e.g. driving a more fuel-efficient car) because it is difficult to maintain such behavioural change in a society that is structured around high and individualistic resource use (e.g. driving to work)” (McKenzie-Mohr, 1994, p. 226). It is also recognized that information needs to be presented in a visual way, such as explaining to homeowners that all the cracks in their home add up to a hole the size of a football in your wall (McKenzie-Mohr, 1994). Furthermore, McKenzie-Mohr (1994) states that people must believe in the credibility of the source of information: “the perceived credibility of the assessor plays a crucial role in determining what, if any, action is taken” (p. 228). The importance of understanding and remembering information is encompassed within CBSM. For example, in terms of home energy conservation many homeowners will make these decisions privately at a later point in time, which means that information needs to be clear, concise and easily recalled or accessed again (McKenzie-Mohr, 1994). To conclude, McKenzie-Mohr (1994) emphasizes that many conservation initiatives have failed in the past because “...we have ignored their human dimensions. We have sought out technological solutions and then have used naive economic theories of human behaviour to promote their adoption” (p.

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232). This is the crux of why sustainability must be examined through a lens that accounts for human dimensions and is able to respond and adapt accordingly to our psychological complexities.

The theory of planned behaviour.

The theory of planned behaviour informs this study by providing distinctions between attitudes, intentions, and behaviours, while supplying insight into visitor behaviour and behaviour change (Ajzen, 1991; Ajzen & Driver, 1992). Literature often uses the theory of planned behaviour to explain that people are expected to act rationally, with knowledge influencing attitudes, which in turn influences intentions, and subsequently can affect behaviour (Ardoin, 2009; Needham & Rollins, 2009). Ajzen (2011) points out that this is a misinterpretation of the theory of planned behaviour, which does not assume rational thought. To clarify, Ajzen (2011) states that control beliefs are based on information that may be inaccurate or incomplete. To further complicate the usefulness of the theory of planned behaviour, research shows that intentions are not consistent predictors of behaviour (Ajzen, 2011; Hughes, 2011; 2013; Hughes et al., 2011; Orams, 1995). Despite these criticisms of the theory of planned behaviour, it is considered a useful theory in ultimately predicting behaviours, as a substantial amount of empirical evidence indicates (Ajzen, 2011). Ajzen (2011) states that many variables can be accommodated within the theory but some, such as “habit formation and various backgrounds” cannot. It is these complex variables that “expand and enrich our understanding of social behaviour” (Ajzen, 2011, p. 1124). To conclude, the framework of the theory of planned behaviour is useful in its capacity to inform this study, as knowledge is the basis for beliefs and ultimately behaviour change regardless of

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the role of intentions. Therefore, it is important to provide people with clear and accurate information or they will otherwise base their behaviour on incorrect or misunderstood information.

Previous research has demonstrated that after an environmental free-choice learning experience intentions often do not result in behaviour change and PVARs are recommended as a means to address this shortfall (Ballantyne & Packer, 2011; Hughes, 2011; 2013; Orams, 1995). Given the complex nature of behaviour change, more research is required to further understand how individuals translate knowledge into behaviours (Ballantyne & Packer, 2005; 2011). This study contributes to furthering our understanding of how PVARs potentially contribute to meaningful learning, sustainable behaviours, and how environmental learning and sustainable behaviour relate to one another.

Current research in free-choice learning and sustainable behaviour change.

As mentioned earlier, Hughes, Packer, and Ballantyne (2011) have begun to address the challenges of addressing sustainable behaviour change through their research at the Mon Repos turtle rookery in Queensland, Australia. This study looked at the impact of post-visit support, and no post-visit support in relation to knowledge, attitudes, and behaviours of visitors pre-visit, post-visit, and post-PVAR (Ballantyne & Packer, 2011; Hughes, 2011; Hughes et al. 2011). Their research was accomplished in two stages: stage one consisted of a questionnaire to identify barriers and benefits for six conservation actions associated with Mon Repos and based on CBSM. This research by Hughes et al. (2011) utilized prompts and identified and addressed barriers and benefits. Stage two of the Hughes et al (2011) study included a pre- and post-visit questionnaire to

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determine overall conservation learning. In total, 100 randomly selected families were given PVARs (treatment group) and 100 families were given no post-visit support (control group) (Hughes et al., 2011).

The hypotheses tested in the Hughes et al. (2011) research were that knowledge, attitudes, and behaviours would remain the same or increase as a result of PVARs. The researchers found no significant difference between knowledge, attitudes, and behaviours immediately after the visit (Hughes, et al., 2011). This is surprising, as numerous studies have found changes between pre- and post-visit measures of knowledge, attitudes or behaviours (Adams et al., 2003; Falk, 2003a; Falk et al., 1998; Falk & Storksdieck, 2005). While these findings might indicate a lack of changes, they could be due to the time of day when this information would have been collected (the turtles are viewed between 7 p.m. and 2 a.m.), and considering that families were being interviewed small children may have caused parents to rush their responses. Alternatively, this could also be an indicator that the methods used to measure knowledge, attitude, or behaviours were unable to detect sometimes subtle and idiosyncratic variations between individuals' knowledge, attitudes, and behaviours.

The dependent variables were measured using five measures of conservation knowledge, three of conservation attitudes, and two of conservation behaviours (Hughes et al., 2011, p. 316). There were no significant changes between the three knowledge measures, but there was a significant change for the two perceived knowledge measures. For the conservation attitude measures there were significant changes. Seven of eight levels of agreement increased significantly for the treatment group and 85% of treatment group families said their attitudes had changed after the visit. Overall, the authors found

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that reflection helps change attitudes (Hughes et al., 2011). There were no significant differences between overall changes in behaviour, except for picking up litter. It is important to note that 80% of participants reported at least some increased involvement in all thirteen conservation behaviours and the authors suggest that this could partially be attributed to a large public conservation campaign which targeted many of the study's conservation behaviours, except picking up litter (Hughes et al., 2011). It was not possible to determine the degree to which this media campaign influenced the results (Hughes et al., 2011).

There was also a significant increase in eight of thirteen conservation behaviours for both groups and a significant difference for the number of conservation actions between groups. In addition, Hughes et al. (2011) noted that the treatment group demonstrated transfer of turtle knowledge to other animals living around their home in terms of their reported conservation actions. Despite these encouraging findings Ballantyne and Packer (2011) acknowledged that still relatively little is known about the impact of a visit once the visitor has left the site, but this research has demonstrated promise in remedying the general failure of environmental knowledge to translate into action (Hughes, 2011; 2013; Hughes et al., 2011).

Current research in zoos regarding attitudes and behaviours relating to climate change.

In 2010 the Climate Change Literacy Zoo Education Network (CliZen) was created in response of a need to create a partnership between “zoo educators, learning science researchers, conservation psychologists, and climate scientists to explore strategies for effectively leveraging the unique opportunities of informal science

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education in zoos and aquariums toward increasing climate change literacy” (Luebke et al., 2012, p. 3). Their goal “is to develop a new approach to climate change education, an approach that encourages people to make personal connections to climate change by activating their sense of caring and concern for charismatic animals whose very existence is threatened due to human behaviour” (Grajal, Goldman, & Marks, 2012, p. i). One of CliZen’s first actions was to conduct a nation wide survey of zoo and aquarium visitors in the United States to learn more about visitors’ knowledge, attitudes, values, beliefs, and actions regarding climate change compared to the general public. This survey took place at fifteen zoos and aquariums in the United States during the summer of 2011. Two surveys were administered: one focused on attitudes (N=3,594), and the other on behaviours (N=3,588). The findings from these surveys were summarized in 5 key points regarding zoo and aquarium visitors: 1) they are receptive to messages about climate change; 2) they want to address climate change, but barriers (particularly ignorance) prevent them from doing so; 3) Zoos and aquariums provide socially supportive contexts to discuss animals and nature; 4) they have access to social media and internet platforms and are experienced with them; 5) their participation in behaviours that address climate change vary in relation to their sense of connection with animals. The CliZen group recommended climate change dialogue emphasize solutions by providing visitors information about what they can do to reduce the effects of climate change along with reasons for the recommended actions. According to Luebke et al. (2012) “Zoos and aquariums can create the context in which audiences can build understandings about what people are already doing to make a difference, what actions are the most feasible and

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effective, and how addressing climate change will not only benefit the global environment but also our local ecosystems” (p. 4).

Further information was recently published from this research, which stated that a primary barrier to understanding climate change is that it can be “remote and abstract, of little personal relevance” (Clayton et al., 2013, p. 1). This research also found that zoos are considered places where people can learn about climate change and sustainability in a non-partisan context. Additionally, researchers explained that a “sense of connectedness to nature is associated with pro-environmental behaviour” (Clayton et al., 2013, p. 2). Furthermore, Clayton et al. (2013) posited that there are three elements that are needed for connecting with nature: “direct experience, emotional arousal, and social interaction” (p. 2), all of which are typically present during a visit to the zoo. This research established that zoos are trusted institutions and that they are key locations in disseminating information that can be sensitive or perceived as political. It was found that there was a correlation between people with a greater belief in climate change and those who practiced pro-environmental behaviours. Also, zoo visitors had greater concern about climate change than the general public and a visit to the zoo had a positive impact on attitudes regarding climate change. Clayton et al. (2013) summarized by stating that zoos are places that have the potential to be highly successful in encouraging pro-environmental attitudes and behaviour and disseminating information that is viewed in a non-biased fashion to many different types of people, and recommended further research in this area.

Theoretical Framework

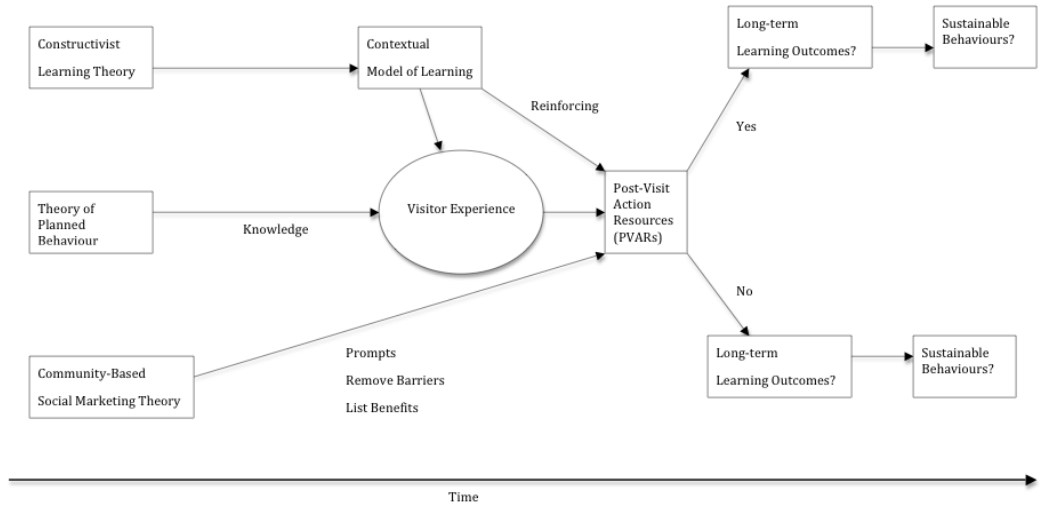


Figure 4. Theoretical framework of the research.

This theoretical framework draws from constructivist learning theory, the theory of planned behaviour, and CBSM to inform how the visitor experience is understood and relates to the PVARs. Specifically, constructivist learning theory provides the groundwork for the CML, which contextualizes learning into three intertwined components: socio-cultural, personal, and physical. The physical context suggests PVARs can act as reinforcing aspects of an individuals’ learning experience. The theory of planned behaviour indicates that knowledge gained during a visitor’s experience, helps to form the foundation for behavioural decisions. CBSM suggests that PVARs can act as prompt instruments, which contain information to reduce barriers and promote the benefits of the targeted behaviours. Ultimately, this framework suggests that receiving

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PVARs or not receiving PVARs after a visit will result in different long term learning outcomes and sustainable behaviours.

Implications of the Research

This research is important as it has the potential to uncover meaningful information regarding learning outcomes after a free-choice learning experience and may reveal how these experiences influence sustainable behaviour. Sustainability is complex and often poorly understood. Socio-cultural, economic, and environmental action is required to contribute to a healthy environment. Environmental sustainability is essential for the future of the earth and its inhabitants and will require a shift in values, where an environmental ethic is instilled within the human population and revealed through our actions (Currie, 2006). As populations are increasingly urban, environmental education centres continue to play an important role in conveying environmental messages to the public and providing support to help translate this information into action (Ardoin & Heimlich, 2013; Ballantyne & Packer, 2011; Ballantyne et al., 2007; Ballantyne et al., 2011; Clayton et al., 2013; Falk et al., 2007).

Environmental learning is found to be most effective in free-choice settings when local environments are included, as this helps people make direct connections between their everyday life and what they have learned (Ballantyne et al., 2007; Ballantyne, Packer, & Hughes, 2009; Falk, 2005; Hughes, 2011; 2013; Moscardo, 1996; Tofield et al., 2003; Van Winkle & Backman, 2011). The importance of environmental free-choice learning is fully recognized when considering that most environmental learning takes place outside of formal school settings, and is usually more effective and longer lasting, than formal learning (Ballantyne & Packer, 2005; 2009b; Falk, 2005; Falk & Dierking,

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2000). For example, globally the World Association of Zoos and Aquariums (WAZA) receives more than 700 million visits to their facilities each year, indicating an enormous opportunity to help people learn about conservation and connect to the natural world (WAZA, 2014).

Providing people with opportunities to gain knowledge at free-choice learning centres creates the foundation for behaviour change, but it is PVARs that have demonstrated potential to help translate knowledge into action. Initial studies on the topic have revealed that PVARs contribute to long-term environmental learning, as is consistent with the CML (Ballantyne & Packer, 2011; Ballantyne et al., 2011; Falk et al., 2012; Hughes, 2011; Hughes et al., 2011). Indeed, the CML posits that reinforcing activities, such as PVARs, contribute to learning after an experience (Ballantyne & Packer, 2005; Falk & Dierking, 2000). Learning how to better combine on-site free-choice learning with PVARs will be essential to helping bridge information and implementation gaps while transferring knowledge from researchers, government organizations, and practitioners to the public.

Chapter 3: Methods

This research consisted of a multi-stage mixed-methods field experiment to examine how post-visit action resources (PVARs) contributed to free-choice learning experiences and sustainable behaviour over time, and how learning and sustainable behaviour may be related. This was achieved by using an embedded mixed-methods design, where quantitative and qualitative data were collected and analyzed concurrently to understand the effect of the PVARs on free-choice environmental learning and sustainable behaviour change (Creswell & Plano Clark, 2007, p. 85).

According to Creswell and Plano Clark (2007) the mixed-methods embedded design is based on the concept that using any one data source is inadequate for answering the research questions. This method is employed when alternative sources of data are required within a study that is primarily quantitative or qualitative (Creswell & Plano Clark, 2007). Specifically, in relation to experimental studies the embedded mixed-method design is typically used by researchers to either “develop a treatment, to examine the process of an intervention or the mechanisms that relate variables, or to follow up on the results of an experiment” (Creswell & Plano Clark, 2007, p. 67). In regards to supporting the application of this design in this study, Stern et al. (2013) found that quantitative measurements for environmental education research are frequently considered insufficient to capture the broad range of outcomes common in this field of study, and recommend using experimental mixed-methods with a temporal component to gain an “understanding not only if EE [environmental education] works, but also by why and how it works” (p. 23). As the purpose of this research is to examine if PVARs affect learning and behaviour change and how these variables relate to one another using an

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embedded mixed-method is most appropriate to gain an understanding of what is happening and why.

This research included conducting pre- and post-visit questionnaires and personal meaning maps (PMMs) with zoo visitors who were assigned to either a treatment or a control group. To answer the research questions, the participants' pre- and post-PVAR responses were analyzed both quantitatively and qualitatively, to gain a more holistic understanding of the findings (Creswell & Plano Clark, 2007). By incorporating complementary qualitative analyses this deepened insights and improved validity, reliability and trustworthiness in the findings (Creswell & Plano Clark, 2007). Furthermore, Creswell and Plano Clark (2007) summarize the purpose of mixed-methods research as “the collection of more comprehensive evidence for study problems, help[ing] answer questions that quantitative or qualitative methods alone cannot answer... and encourages the use of multiple world-views and is a practical and natural approach to research” (p. 18). This purpose aligns with the PMM research method, which incorporates multiple theoretical perspectives and techniques of analysis to address the complex nature of free-choice learning and provides a depth of information relevant to a variety of audiences.

To summarize, the purpose of using both qualitative and quantitative data is that it permits between-method triangulation: “the bias inherent in any particular data source, investigators, and particular method will be cancelled out when used in conjunction with other data sources, investigators, and methods... the result will be a convergence upon the truth about some social phenomenon” (Denzin, 1978, p. 14).

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Study Site

The research took place at a free-choice learning site: specifically, the Assiniboine Park Zoo's International Polar Bear Conservation Centre (IPBCC). The IPBCC is an interpretive centre that is designed to educate visitors "about polar bears, the Arctic ecosystem, climate change, and what you can do to reduce your impact on our environment" (Assiniboine Park Zoo, 2013). The site was selected based on the appropriateness of the IPBCC's conservation mandate, which specifically aims to help people reduce their environmental impact by making connections to Arctic wildlife and ecosystems (Assiniboine Park Zoo, 2013). In addition, the IPBCC provides a wide range of interpretation experiences such as videos, touchable displays, interesting facts, interactive games, and specific information regarding what can be done to reduce one's environmental impact, which is necessary for creating links between the visit and the PVARs (Assiniboine Park Zoo, 2013). This research was believed to be timely, as this exhibit opened within the past year (2012/2013) and the complimentary exhibit (Journey to Churchill) will be opening next year (summer of 2014). The Journey to Churchill exhibit will be the "most comprehensive project ever undertaken in Canada aimed at issues related to climate change, polar bears and other northern species" (Assiniboine Park Zoo, 2013). The Journey to Churchill exhibit will include the IPBCC and act as a place to "bring the north to mainstream Canadians while bridging the gap between field research, the conservation world and the general public" (Assiniboine Park Zoo). The findings from this research will potentially inform the creation of this exhibit's PVARs and ensure the conservation message is most effectively conveyed to maximize learning and sustainable behaviours.

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Finally, the International Polar Bear Conservation Centre was selected based on the appropriateness of the research project's purpose: to understand how local actions can help contribute to environmental sustainability in one's backyard, as well as on a larger scale. Churchill is largely inaccessible to southern Manitobans and other visitors, as a result the IPBCC has the potential to play an important role in creating links between local, provincial, and national environments to help foster environmental responsibility.

Sample Selection

In total, 350 visitors to the IPBCC were sought to participate in this study, (175 in the both the treatment and control groups). Of these participants, 40 per group were needed to complete the PMM aspect of the research. These sample sizes were selected based on previous research and projected attrition rates (Falk, 2003a; Hughes, 2011; 2013; Hughes et al., 2011).

The 'continual ask' technique was employed to minimize bias and maximize the number of participants, and a refusal log was maintained to record response rates (Falk et al., 2007). Every participant approached was asked to complete a PMM and the questionnaire, and if they declined they were asked to complete only the questionnaire. This approach was utilized because pre-testing revealed high variability and potentially low visitor numbers to the IPBCC. Pre-testing also revealed high rejection rates for visitors asked to complete both the questionnaire and PMM, due to the time required to complete both tasks (20 – 30 minutes). Additionally, time was limited for data collection due to seasonality and weather.

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Criteria for participating included being 18 years of age or older, having a valid email address with regular Internet access, and participants were required to reside in Manitoba for the duration of the study. These criterion were necessary because the PVARs needed to be distributed via email and the information in the PVARs was specific to Manitoba. Participants who met the criteria were then informed that their involvement would require participating at two points in time: both immediately on-site and two months later. Replicating the Hughes et al. (2011) study, participants were assigned to either a control or treatment group by randomly pre-determining group assignment on alternating days. This technique was established to prevent groups who may be visiting together from receiving different group assignments and inadvertently “contaminat[ing] the control condition by breaching the ‘no post-visit support or contact’ criterion” (Hughes et al., 2011, p. 315).

When a group of visitors met the criterion the adult with the next birthday was asked to participate. Adult participants were selected as the target population, since they are primarily in charge of a family’s environmental sustainability decisions and are most convenient for the purpose of this study (Hughes, 2011; 2013; Hughes et al., 2011). It is recognized that families are frequently the target population for this type of research; however, previous research demonstrates that it is typically an adult within the family that primarily engages in the research and speaks of behalf of the family (Hughes, 2013). Additionally, to ensure that individual learning is measured, only adults (individuals 18 years of age and older) were selected to participate and it was reiterated throughout the data collection that the responses were intended to reflect their individual opinions.

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Data Collection

Pre-testing was conducted over three days in mid-June. On-site data collection took place over a six week time period from June 21 to July 26 2013 for a total of 28 days, during zoo hours from 9:00 a.m. – 6:00 p.m. Additionally, data collection took place on every day of the week and in all types of weather to reduce sampling bias. July 26, 2013 was considered an appropriate cut-off date for data collection as this meant the last PVAR email would be sent on September 12, and the final follow-up data collection would be finished by the end of September. Since October is a month when Winnipeg's average temperatures can change rapidly, the researcher determined that it was advantageous to complete the data collection at this point in time to avoid seasonal influences. As visitors left the IPBCC they were approached and asked to participate in a voluntary study regarding environmental learning and sustainability (See Appendix A for script and instructions). In total, 653 visitors were approached of whom 372 agreed to participate and 280 did not, resulting in a 57% response rate. This number was above the target of 350 because the number of participants required to complete a PMM (to allow for quantitative analysis) had not been met for both groups when 350 total participants was reached.

If participants did not meet the research criterion they were not included in the study or in the approach/refusal counts. The majority of visitors who did not wish to participate cited young children, the weather, another engagement, or simply not wanting to do a survey as the reason for non-participation. All individuals were asked to complete both the questionnaire and a PMM, and if they refused, they were asked if would be willing complete only the questionnaire. As the questionnaire took 5-10 minutes, as

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opposed to 20-30 minutes to do both the questionnaire and PMM, this method encouraged participation for those who would have otherwise been non-participants. In total, of the 372 participants, 79 agreed to do both the PMM and questionnaire.

This research involved an immediate post-IPBCC visit questionnaire with all participants, provision of PVARs for the treatment group, and a two-month follow-up questionnaire for all participants. With 39 control and 40 treatment participants a PMM interview was also conducted immediately after the initial questionnaire and again two months later via email and telephone. The time frame for this study was based on previous research conducted by Hughes, Packer, and Ballantyne (2011) (Hughes, 2011; 2013). However, the research conducted by Hughes, Packer, and Ballantyne (2011) used a three-month time frame, but had approximately 50% attrition for the follow-up aspect of their research. Therefore, two months was selected to potentially reduce attrition for the follow-up PMM and questionnaire. Two months is considered to be sufficient to measure long-term learning outcomes after a visit and was appropriate for the time frame of this research (Hughes, 2013). Additionally, this time frame is consistent with other research that measured long-term learning outcomes: which ranged from one month to three years after the visit (Ballantyne et al., 2011; Falk et al., 2007; Hughes, 2013).

Once participants reviewed and signed the informed consent forms, they completed a self-administered questionnaire, and a PMM interview immediately after their visit to the IPBCC (see Appendix B). Participants assigned to the treatment group were given a printed PVAR package and were emailed weekly internet-based PVARs for two-months following their visit. The participants assigned to the control group had no post-visit contact or support. The PVARs were based on existing literature and

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developed in collaboration with the Assiniboine Park Zoo and the guidance of the researcher's thesis committee (Ballantyne & Packer, 2011; Hughes, 2011; Hughes et al., 2011).

Finally, two months after the visit, an online (encouraged) or telephone (only if online was not an option) follow-up PMM interview and questionnaire was conducted where all participants had an opportunity to make changes to their PMM and respond to a questionnaire (see Appendix C). Participants were emailed their PMM and asked if they would like to change, add, or subtract any of their initial responses and then telephoned within the week to discuss these changes and complete the PMM interview questions. Participants were asked via email to complete a brief follow-up questionnaire online, reporting on their environmentally sustainable activities and intentions. PMM interviews and questionnaires were used to analyze any change in learning and sustainable behaviour.

Treatment.

Participants were randomly assigned by alternating days to the treatment group (given PVARs) or the control group (no PVARs). Community-based social marketing (CBSM) and previous research was used to influence the design of the PVARs. CBSM “states that to promote adoption of particular environmental actions, researchers need to identify barriers and benefits specific to those particular behaviours” (Hughes, 2011, p. 69). In other words, PVARs need to be specific to a particular environment and individual, and should include specific steps and guidelines that help visitors overcome perceived barriers (Hughes, 2011; Hughes et al., 2011). Environmental and free-choice learning research finds that people are aware that there are conservation problems but

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need to learn “simple, practical and concrete steps they could take to make a difference” (Falk, 2005, p. 276; Ballantyne et al., 2007; Rennie & Williams, 2006; Tofield et al., 2003).

For the purpose of this research there were six sustainable behaviours were examined. Since information about these behaviours was included in the PVARs, and it was essential that the PVARs related to the on site IPBCC visit, the centre’s sustainability information was reviewed. The endorsed sustainable behaviours in the IBPCC were compared to the sustainable behaviour measures used by Hughes et al. (2011), and the sustainable behaviours present the IPBCC, and amalgamated into six key behaviours that represented varying. The six sustainable behaviours selected for the study are listed in Table 1.

Table 1

Description of the Six Sustainable Behaviours Used in the Research

Sustainable Behaviour Title	Description of the Sustainable Behaviour
Double Up (Double)	Recycle, reuse, and reduce.
Flick it Off (Flick)	Turn off lights and electronics when you are done.
Slow the Flow (Flow)	Buy low-flow toilets, faucets, or showerheads.
Buy Locally (Local)	Choose locally produced food and other products.
Get Involved (Volunteer)	Volunteer with an environmental organization or participate in planting local vegetation.

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Grow Your Own (Grow)	Chemical free gardening and/or composting.
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Other variables such as costs, and one-time versus repeated behaviours were considered in the selection of the sustainable behaviours with thought given to concerns highlighted in CBSM (McKenzie-Mohr, 1994; 2000). Ultimately, the six behaviours selected were also the most well represented in the literature, and most pertinent to the IPBCC and this research.

The PVARs were based primarily on the research by Hughes (2011; 2013) and Hughes et al. (2011). Additional research on environmental learning and behaviour change was incorporated, such as accommodating different levels of visitor learning, knowledge, motivations, satisfaction, and interests (Ballantyne et al., 2007; Ballantyne et al., 2011). An extensive online review was conducted of North American and well-known international zoos, aquariums, and other environmental education centres and all forms of post-visit resources listed on their websites were examined. This review found that education provided by these free-choice learning centres is typically focused on school aged children and when adult programming is available it is typically geared towards seniors or “keeper for a day” programs. In general, there are few existing take home resources or other ways to connect with the zoo after the visit. Some zoos are beginning to implement apps, live web-cams of popular animals, online puzzles, and colouring activities for small children (Toronto Zoo, San Diego Zoo, Assiniboine Park Zoo, and the Colchester Zoo). Two local nature-based interpretive centres, Fort WhyteAlive and Oak Hammock Marsh, had some online information and resources

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available in the form of fact sheets and links to other relevant websites. Fort WhyteAlive focused on environmental education and provided resources on how to create habitat for local species in your backyard. Oak Hammock Marsh is an interpretive centre that focused on wetlands and provided fact-based information on wetland ecology. However, considering the location specific context and importance of PVARs it was deemed essential to develop the PVAR material specifically for the site and content of the IPBCC at the Assiniboine Park Zoo. Building upon the PVARs discussed by Hughes (2011) and with feedback from the researcher's advisor, thesis committee, and the Assiniboine Park Zoo's Conservation and Research department, it was determined that the most effective strategy for the PVARs would be to include a combination of paper based and electronic information. The paper-based PVARs were distributed at the end of the visit to the IPBCC at the Assiniboine Park Zoo and consisted of: fact sheets for each of the targeted behaviours (see Appendix D), and a pamphlet about climate change to hand out (see Appendix E). The electronic information was included in a weekly email listing the six-targeted sustainable behaviours and emphasized each behaviour once (with an introductory and conclusion email) for a total of eight emails (see Appendix F) with a newsletter about a popular animal (the polar bear) (see Appendix G). See Table 2 for a complementary description of the PVARs and distribution times and locations.

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Table 2

Description of the Post-Visit Action Resource Components and Distribution Schedule

PVAR Components	Description of PVAR Components	PVAR Distribution
Paper-based Brochure	Paper brochure about climate change in Manitoba.	On-site
Paper-based Fact Sheets	Paper-based fact sheets addressing barriers and benefits pertaining to the sustainable behaviours of focus in the study.	On-site
Electronic Fact Sheets	Electronic versions of the paper-based fact sheets.	Weekly via email
Email from the Researcher	Email from the researcher, including brief introduction and bullet points regarding a different sustainable behaviour of focus each week (8 in total, with an introduction and conclusion email).	Weekly via email
Animal Newsletter	A newsletter focusing on a polar bear at the Assiniboine Park Zoo.	Weekly via email
Links to More Information	Links to more information on various topics of interest pertaining to climate change and sustainability.	Weekly via email

The pamphlet donated by Climate Change Connection, a non-governmental organization dedicated to educating Manitobans about climate change, was ideal for the study as it provided detailed scientific proof of climate change in Manitoba (see Appendix E). As previous research reveals that there are people who doubt that climate change exists, this was important to address in relation to becoming more sustainable as an attempt to alleviate the effects of climate change (Clayton et al., 2013; Hughes, 2011; 2013; Hughes et al., 2011). The fact sheets were heavily informed by CBSM and emphasized benefits associated with desired environmental behaviours and identified

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barriers specific to Manitobans. Location specific solutions and suggestions were provided with varying ranges of difficulty in an attempt to be relevant for participants with a wide range of current sustainable behaviours and barriers (Hughes, 2011; 2013).

The PVAR emails included links to websites with more information on a variety of topics related to conservation and research, climate change, polar bears, sustainability in general, and the sustainable behaviour of focus for that week. The email also included an attached newsletter that focused on Hudson, the Assiniboine Park Zoo's sole polar bear at the time. These newsletters were called "Hudson Updates" and were designed to replicate the turtle updates from the Hughes (2011; 2013) and Hughes et al. (2011) research, which found that species-specific updates helped connect visitors to the animals, and positively affected their sustainable behaviours. The "Hudson Updates" also included information about the zoo's research and conservation staff to further help connect people to their local zoo and understand conservation efforts. Based on information regarding the brevity of time that people spend engaging with resources, it was determined that these should be kept as simple and to the point as possible (based on intervening treatment and follow-up environmental education based research). Keeping the "Hudson Updates" as simple as possible was necessary for the feasibility of this research and application for the possible adoption of PVARs. Since most zoos are not publicly funded, they must be self-sustaining, and often lack time and financial resources to accomplish their educational goals, so the PVARs must be low in these costs (Carr & Cohen, 2011). The Assiniboine Park Zoo's conservation and research staff engaged in the research and worked closely with the researcher in developing the "Hudson Updates"

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and editing the content of all of the PVARs, which proved to be invaluable due to their wealth of polar bear, climate change, and environmental sustainability expertise.

Measurement Instruments

Questionnaire.

Sustainable behaviour questions were based on sustainability measures used in research conducted by Hughes et al. (2011) and Luebke et al. (2012), and were customized to reflect the conservation messages in the IPBCC at the Assiniboine Park Zoo. The sustainability questions were measured on a five-point likert-type scale, and inquired how frequently visitors participated in the selected sustainable behaviours – ranging from ‘Never’ = 1, to ‘Always’ = 5, with a ‘Not Applicable’ option, which prompted for an explanation. A measure of post-PVAR perceived learning was adapted from the research conducted by Hughes et al. (2011) and used to measure post-PVAR perceived changes in learning. Additional demographic information, such as age, average income, education, and family size was collected to determine if there was any relationship between these factors and learning or sustainable behaviour. Information about visitor characteristics was collected to determine if there was any relationship between these variables and learning or sustainable behaviour and included items such as interests, perceived knowledge, visit satisfaction, group size and composition, annual frequency of zoo visits, and previous visits to the IPBCC or to other environmental free-choice learning centres. Questions assessing perceived barriers about doing more to reduce climate change and feeling connected to animals at the zoo were based on the research conducted by Luebke et al. (2012) and provided additional insights into the participant characteristics. The questionnaire was completed on-site immediately after

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the IPBCC visit and prior to the PMM interview. The follow-up questionnaire was completed by participants either online or via telephone during the two-month follow-up. Pilot testing with limited variables was conducted prior to the study to ensure the effectiveness of the research instruments.

Personal meaning mapping interviews.

For the second stage of on-site data collection a PMM interview was completed immediately after the IPBCC visit and questionnaire. Personal meaning mapping was designed specifically to assess learning in free-choice contexts and involves asking participants to write words or images that come to mind when presented with a prompt word or image (Falk, Moussouri, & Coulson, 1998). In this case the prompt phrase was “climate change and sustainability”. During pre-testing the prompt phrase was tested for applicability and relevance to the study, as well as coherence for the participants by testing similar words in different combinations. It was determined that the chosen prompt phrase was most appropriate and was easily understood by visitors. Where any confusion was apparent the researcher would provide clarification for the participant. However, depending on the context, the researcher encouraged visitors to respond to the PMM according to what it meant to them in order to reveal visitors’ prior knowledge and beliefs regarding the prompt phrase. Visitors were then interviewed about what they wrote, so that their ideas could be probed deeply by the researcher. Personal meaning mapping allows researchers to measure “differences in the quantity (extent), breadth, depth and quality (mastery) of responses” by grading the change in these dimensions on a scale (Falk & Dierking, 2000, p. 167; Falk et al., 1998). The post-PVAR PMM responses were collected by telephone primarily within one week after the week 8 PVAR email was

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distributed. The week 8 PVAR email included a copy of the participants' original PMM and instructions about the questions that would be asked during the telephone interview. During the telephone interview the participants were asked if they wanted to make any changes, additions, or deletions to their PMM. Most participants were satisfied with their PMM and did not want to make any changes. During pre-testing the researcher surmised that the lack of responses could be due to misunderstanding the purpose of making changes, so it was explained to participants that the PMM was used to measure changes in learning and if they thought their understanding of the prompt phrases had changed they were encouraged to make those changes apparent in the PMM. While this explanation provided clarity for the participants most still declined to make any additional changes. It could certainly have been a drawback to do this over the phone and not in person, which would likely have been more engaging. It is also plausible that many participants simply did not feel that their learning had changed since their visit.

Using PMM provided additional insight into post-visit learning that would not be possible with survey techniques alone, as this method provides a way to measure complex learning (Adams et al., 2003; Adelman, Falk, & James, 2000; Falk, 2003a; Falk, 2005; Falk & Dierking, 2000; Falk, Reinhard, Vernon, Bronnenkant, Heimlich, & Deans, 2007; Falk & Storksdieck, 2005). In addition to complex insights regarding the extent, breadth, depth, and mastery of climate change and sustainability learning, additional information regarding connections between topics and misconceptions are revealed with PMM. Gaining understanding of how participants connect topics or misconstrue an idea is possible because of the open-ended nature of PMMs, and the visual component permits ideas to be clearly linked by the participant (much like a concept map). Additionally, a

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corresponding interview ensures that the researcher understands the visitor's response and interprets it as intended. The interview aspect of personal meaning mapping is a form of validity where the researcher has the opportunity to confirm the interpretation of the data immediately with the participant.

The results in the Mon Repos study (Hughes et al., 2011) indicated that there were no immediate changes in learning (knowledge, attitudes and behaviours), despite overwhelming research indicating that learning typically takes place during a free-choice learning experience (Adelman et al., 2000; Adams et al., 2003; Ballantyne et al., 2007; Bamberger & Tal, 2006; Falk, 2005; Falk & Dierking, 2000; Falk & Storksdieck, 2005; Heimlich & Falk, 2009; Orams, 2002; Rennie & Williams, 2006; Tofield et al., 2003; Zeppel, 2008). While the learning measures in the Hughes et al. (2011) research, which used pre-post treatment differences in responses to survey questions regarding knowledge about turtle conservation, and measured levels of agreement regarding statements of knowledge change, demonstrated no learning changes the perceived measure of post-treatment learning did demonstrate significant learning changes. This discrepancy suggested that additional and more sensitive methods for measuring learning, such as PMMs and measures of perceived learning, could more accurately detect changes in learning and further supports the rationale for utilizing personal meaning mapping and both quantitative and qualitative measures of learning. Free-choice learning research has often employed PMMs to better understand learning in leisure settings. This tool is an effective method to measure change in free-choice learning, as it has the capacity to measure meaningful learning, by accounting for variations of visitor's knowledge, motivations, interests, and actions (Ballantyne et al., 2007; Falk & Dierking, 2000). This

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method provided insight into learning transfer by examining the extent, breadth, depth, and overall mastery of a visitor's knowledge of climate change and environmental sustainability, which in turn provides further information relating to their sustainable behaviours.

Points of measurement.

There were several aspects of learning change and behaviour change measured through the questionnaire, PMMs, and the interview questions. Since learning and behaviour change are complex, using multiple forms of measurement triangulated and complemented the data and added a level of depth to the research that would not otherwise have been possible. The various points of measurement are listed in Table 3.

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Table 3

Points of Measurement

Learning and Behaviour Measures	Pre-PVAR	Post-PVAR
Questionnaire: Learning		
1) Perceived knowledge change since IPBCC visit (Q10)		X
PMM: Learning		
2) PMM learning measures	X	X
3) Perceived learning change (Interview Q1)		X
Questionnaire: Behaviour		
4) Pre- and post-PVAR questionnaire behaviour change (Q6)	X	X
5) Perceived change in environmentally sustainable behaviours (Q10)		X
6) Behaviour change responses relating to the IPBCC (Q11, Q12, & Q13)		X
Treatment Group Only		
7) Behaviour change responses relating to PVARs (Q14, Q15 & Q16)		X
PMM: Behaviour		
8) Perceived behaviour change (Interview Q2)		X
PMM: Learning and Behaviour		
9) Improving post-visit learning and behaviour change (Interview Q3)		X

Data Analysis

The questionnaire data was analyzed primarily quantitatively with some open-ended questions analyzed qualitatively. The PMM interview data was analyzed both

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qualitatively and quantitatively. Mixed methods research permits a “complementary strengths component” that encompasses “all of the major purposes identified by Green et al. (1989); i.e., triangulation, expansion, complementarity, development, and initiation)” (Johnson, Onwuegbuzie, & Turner, 2007, p. 127). Furthermore, mixed methods research emphasizes breadth and corroboration: “(a) validate and explicate findings from another approach and produce more comprehensive, internally consistent, and valid findings; (b) provide more elaborated understanding and greater confidence in conclusions; (c) handle threats the validity and gain a fuller and deeper understanding; and (d) provide richer/more meaningful/more useful answers to research questions” (Johnson et al., 2007, p. 122). By analyzing the data both quantitatively and qualitatively the research questions could be examined from multiple angles to add depth and increase the trustworthiness, reliability, and validity of the research (Creswell & Plano Clark, 2007; Johnson et al., 2007).

Participant description.

Demographic and visit characteristics of research participants were analyzed using descriptive statistics. Variables that were possible confounding variables were included in a correlation analysis with the dependent variables to determine if they should be included in subsequent analysis as covariates. According to Bryman and Cramer (2011) “.70 or above is usually taken as a reliable measure” (p. 259) in correlation analyses; if variables met this criteria they were included as covariates.

Data preparation.

To prepare data for analysis each PMM (post-visit and follow-up) was analyzed quantitatively and qualitatively. Quantitative assessment was undertaken by measuring

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changes in extent, breadth, depth, and overall mastery (Falk et al., 1998; Falk & Storksdieck, 2005). Extent was measured by the “changes in the number of appropriate words the subject used to describe the prompt” (Falk & Storksdieck, 2005, p. 752; Falk et al., 1998). Words, phrases, or images that are irrelevant or inappropriate were not included in the count, but were considered in the qualitative analysis if relevant to or informative for the Assiniboine Park Zoo (Falk et al., 1998; Falk & Storksdieck, 2005). To address issues of reliability in coding and scoring the PMMs a detailed rubric was developed, and the constant comparison coding method employed independently by both the researcher and research assistant until an inter-rater Kappa score of a minimum of .80 was achieved (see Appendix H for coding rubrics) (Falk, 2003a; Falk & Storksdieck, 2005; Wood, 2007). Due to the high volume of responses and subtle nuances in interpretation of specific words, images, and phrases, extent was measured in categories. Extent of learning was initially scored from 1-46+ and these scores were then collapsed into categories ranging from 1-10. Responses that received a score from 1-5 were coded as 1, scores 6-10 were coded as 2, and so on in increments of 5 until the maximum score of 46+ (coded as 10) was accounted for (see Appendix I). Breadth was measured by the “change in the number of conceptual categories an individual uses to describe the prompt” (Falk & Storksdieck, 2005, p. 753). Conceptual categories were determined from the data and were “refined in an iterative process until two independent researchers agree[d]”, to address validity of the categories (see Appendix H) (Falk & Storksdieck, 2005, p. 753). Depth was determined by the “change in degree of understanding within each breadth category” (Falk & Storksdieck, 2005, p. 753) and the “quality of use of each concept” (Bowker & Jasper, p. 144). In general, depth is intended to measure the

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sophistication and detail of the PMM (Falk et al., 1998). To achieve this, depth was measured on a scale of 1-5, ranging from no-elaboration to significant elaboration (see Appendix H) (Falk et al., 1998; Falk & Storksdieck, 2005; Falk et al., 2007; Falk & Storksdieck, 2010). Mastery was measured by the “change in overall understanding” (Falk et al., 1998; p. 112). Designed to be a holistic measurement, mastery was graded on a score of 1-5, ranging from novice to expert (see Appendix I) (Falk et al., 1998).

The PMMs were further analyzed using a content analysis method, which permitted the researcher to “systematically identify, code, and categorize primary patterns or themes within participants’ responses and facilitated recognition of rich and complex patterns across cases” (Falk et al., 2004, p. 176). The content analysis utilized the open-coding constant comparisons technique to ensure that the content analysis coding remained consistent and reliable throughout the analysis and avoided definitional drift (Gibbs, 2010). Coding categories originated as descriptive and were further analyzed to determine unifying themes, patterns, and relationships for both treatment and control group responses (Ritchie and Lewis, 2003). Additionally, the interview immediately following a PMM was extremely important for contextualizing the data and acted as a form of member checking and validity to ensure the PMM was interpreted as the participant intended (Adams et al., 2003; Falk, 2003a). Probing questions followed a format outlined by Falk et al. (2004), which asked participants to “clarify, elaborate, give an example” and explain connections made (p. 194). These probing questions were tailored to suit the individual participants and ensured that the prompt phrase was understood or examined how the prompt phrase was misunderstood to gain insight into perceptions of climate change and sustainability. Drawings on participants’ PMMs were

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analyzed within semiotic themes, were typically explained by the participant and were predominately descriptive in nature (Hunter, 2012).

The interview questions following the post-PVAR analysis followed the same open-coding and constant comparison content analysis method to allow the categories to emerge from the data. To add depth to the analyses, learning and behaviour change were also analyzed qualitatively using an open-coding constant comparison content analysis for both the open-ended responses on the questionnaire and PMM interview questions.

Research question 1.

To understand how post-visit action resources affected free-choice learning after a visit to an environmental education centre a mixed-design repeated measures ANOVA, where the independent variable was group assignment (control or treatment) and the dependent variable was learning, was conducted to determine the significance in the change from post-visit to post-PVAR PMM on each learning measure (extent, depth, breadth, and mastery). A Pearson's chi-square test for independence was conducted to assess significant differences for a perceived measure of learning. Additionally, to enhance understanding of how PVARs relate to learning, a qualitative assessment of the PMM interviews was conducted by the researcher and research assistant by independently reviewing the PMM responses for both the control and treatment groups and derived categorical themes that were distinct and as mutually exclusive as possible (the nature of the research causes some overlap between themes). The categorical themes for the treatment and control group were similar, with some small variations. Wherever variations occurred they were discussed until an appropriate category could be determined (Bowker & Jasper, 2007; Falk, 2003b). A detailed coding rubric, which

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listed all the variations of participant responses, was kept with any new additions discussed until agreed upon (see Appendix H). By using the constant coding method and the detailed coding rubric all of the PMM data was coded independently by both the researcher and the research assistant. A test for inter-rater reliability was conducted, and any variations in coding were reviewed until a Kappa ≥ 0.80 ($p < 0.05$) was achieved. By using multiple measures the data can be triangulated and assessed to be complementary, contradictory, or inconsistent, and the overall understanding and validity of the research question enhanced (Johnson et al., 2007).

Research question 2.

To determine how PVARs affect sustainable behaviour change after a visit to an environmental education centre a mixed-design repeated measures ANOVA was conducted, where the independent variable was the treatment group / control group (PVAR / no PVAR) and the dependent variable was sustainable behaviour change (measured pre- and post-PVAR). Additionally, to assess the validity of the data a Pearson's chi-square test for independence was conducted to determine significant differences for a perceived measure of behaviour change. The PMM interviews were also assessed qualitatively using an open-coding constant comparison content analysis method to gain a more holistic understanding of why behaviour change did or did not occur in relation to the IPBCC visit and the PVARs. Again, by using multiple measures the data can be examined by multiple lenses and assessed comprehensively to improve the overall understanding and validity of the research question (Johnson et al., 2007).

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Research question 3.

Finally, to learn how post-visit free-choice learning relates to sustainable behaviour change a MANOVA was undertaken. The independent variable was the change in learning and was based on various categories of learning: extent, breadth, depth, and mastery. The dependent variable was sustainable behaviour change (measured pre- and post-PVAR) for all of the six targeted behaviours. An additional Pearson's chi-square test for independence was conducted to determine significant differences between perceived measures of learning and behaviour change. The PMM interview follow-up question regarding what would help participants learn more to become more sustainable was assessed qualitatively using an open-coding constant comparison content analysis method. This method was used to gain a more complete understanding of why behaviour change and learning did or did not occur in relation to the IPBCC visit and the PVARs.

Chapter 4: Results

This chapter presents the results of this study by first providing a general description of the participants, followed by each research question addressed in turn. Both quantitative and qualitative analyses of the research questions will be presented. Unless specified, all statistical analyses met the correlating test assumptions required such as normality, equality of variances, and appropriate levels of skewness and kurtosis. When the assumptions were not met it has been outlined how these issues were addressed.

Visitor Characteristics

In total, 372 participants completed questionnaires and 79 also completed personal meaning maps (PMMs). The post- post-visit action resource (PVAR) questionnaire was completed by 236 participants, with the post-PVAR PMM completed by 70 of these participants. Attrition was 37% for all participants, but was notably lower at 11% for the participants who also completed the PMM.

The majority of participants were between the ages of 18 – 54 (86%). The mean age range was 3.09 ($SD = 1.361$), and the mode age range was 3.00 (35-44) (30%). The majority of participants displayed high levels of education, with 2% of the participants had less than a high school diploma, 28% had completed high school 34% of participants had completed college or vocational training, 22% had obtained an undergraduate degree, and 15% had a graduate degree. The majority of participants were visiting with one other adult (52%), or as an individual adult (29%), ($M = 2.00$, $SD = 0.977$), and were with 1 (32%), or 2 (42%) children ($M = 2.05$, $SD = 1.037$). In total, 58% of visitors reported visiting with children and 35% were visiting with a spouse/partner.

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Only 9% of participants reported having a zoo membership, and the majority of visitors reported that they visit the zoo once (37%) or 2-3 times (40%) per year. The mean for the number of zoo visits per year was 2.33 ($SD = 1.683$). Seventy-eight percent of participants indicated this was their first visit to the International Polar Bear Conservation Centre (IPBCC) and to the Penguin Cove exhibit, which also has climate change information. Anecdotally, several participants indicated while completing the survey that they entered the IPBCC by mistake while searching for the Penguin Cove Exhibit, or a bathroom. To account for other environmental education influences, visitors were asked if they had been to local environmental education centres in the past 12 months. Twenty-eight percent of participants indicated that they had visited Fort Whyte, 16% Oak Hammock Marsh, and 6% had been to the Living Prairie Museum. The majority of participants (60%) stated they had not been to any environmental free-choice learning centres. Only 4% of participants selected “other”, and 2 people listed the Manitoba Museum of Man and Nature, another listed the Farm, Food, and Discovery Centre (affiliated with the University of Manitoba), one person listed Narcisse (a place to view garter snakes in Manitoba), and one participant listed Churchill, Manitoba. The remainder of the participants listed centres that were outside the province.

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Income was relatively evenly distributed across income categories: 73% of participants stated that their income was between \$25,000 – \$124,999.

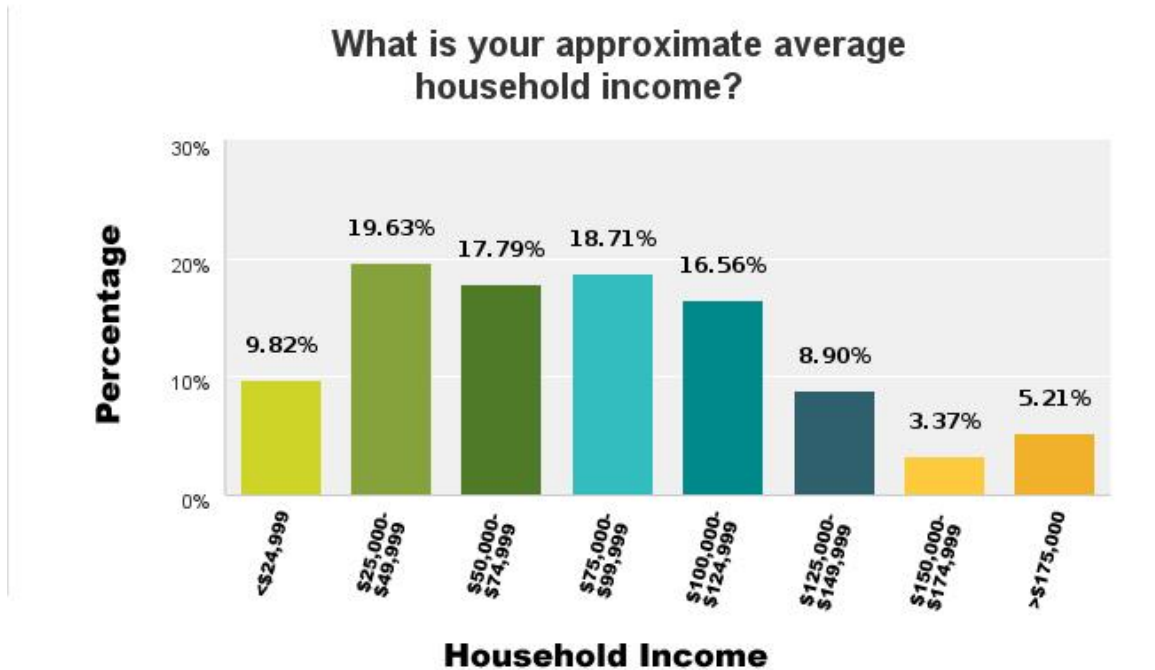


Figure 5. Approximate average household income for all participants.

Visitor Experience Characteristics

Perceived knowledge.

Visitors assessed how knowledgeable they felt about climate change, global warming, species at risk, environmental sustainability, and conservation research by indicating their level of knowledge on a 5-point scale (1 = *not at all* and 5 = *extremely*). The majority of pre-PVAR visitor responses indicated that they felt somewhat or moderately knowledgeable about climate change (84%), global warming (82.2%), species at risk (76.7%), and environmental sustainability (74.0%) (see Table 4). The

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majority of participants felt they were not at all or somewhat knowledgeable regarding conservation research (69.9%) (see Table 4).

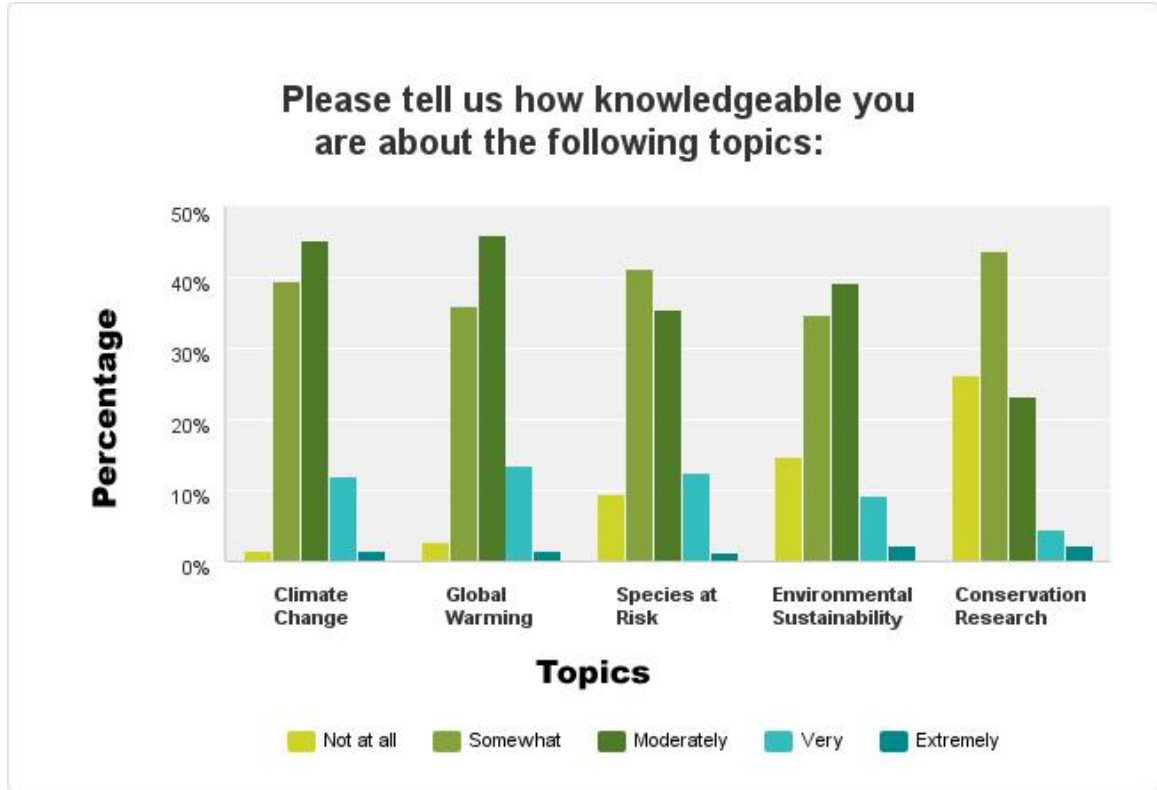


Figure 6. Pre-PVAR perceived knowledge for all participants.

When asked about perceived knowledge post-PVAR the majority of treatment group participants felt that they were moderately or very knowledgeable about climate change (75.5%), global warming (73.6%), and environmental sustainability (69.5%) (see Table 4). For the topics of conservation research (79.3%) and species at risk (75.2%), participants felt they were somewhat or moderately knowledgeable. The majority of control participants felt that they were somewhat or moderately knowledgeable about climate change (82.0%), global warming (82.3%), species at risk (77.4%), and environmental sustainability (71.9%) (see Table 4). Regarding perceived knowledge

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about conservation research the control group participants that also felt they were not at all knowledgeable (70.9%).

Table 4

Differences in Pre- and Post-PVAR Perceptions of Knowledge

Topic		Mean Scores		Standard Deviation	
		Pre	Post	Pre	Post
Climate Change	C	2.70	2.79	.710	.810
	T	2.75	3.37	.800	.766
Global Warming	C	2.73	2.81	.775	.794
	T	2.77	3.02	.787	.793
Species at Risk	C	2.54	2.55	.835	.929
	T	2.56	2.93	.918	.800
Environmental Sustainability	C	2.50	2.62	.962	.965
	T	2.49	3.03	.894	.849
Conservation Research	C	2.09	2.02	.982	.937
	T	2.17	2.70	.873	.818

Interests.

Participants were asked to indicate on a 5-point scale (1 = *not at all* and 5 = *extremely*) how interested they were in climate change, global warming, species at risk, environmental sustainability, and conservation research. The majority of participants expressed that they were moderately or very interested in climate change (71.6%), global

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warming (71.4%), species at risk (71.3%), environmental sustainability (67.6%), and conservation research (64.4%) (see Table 5).

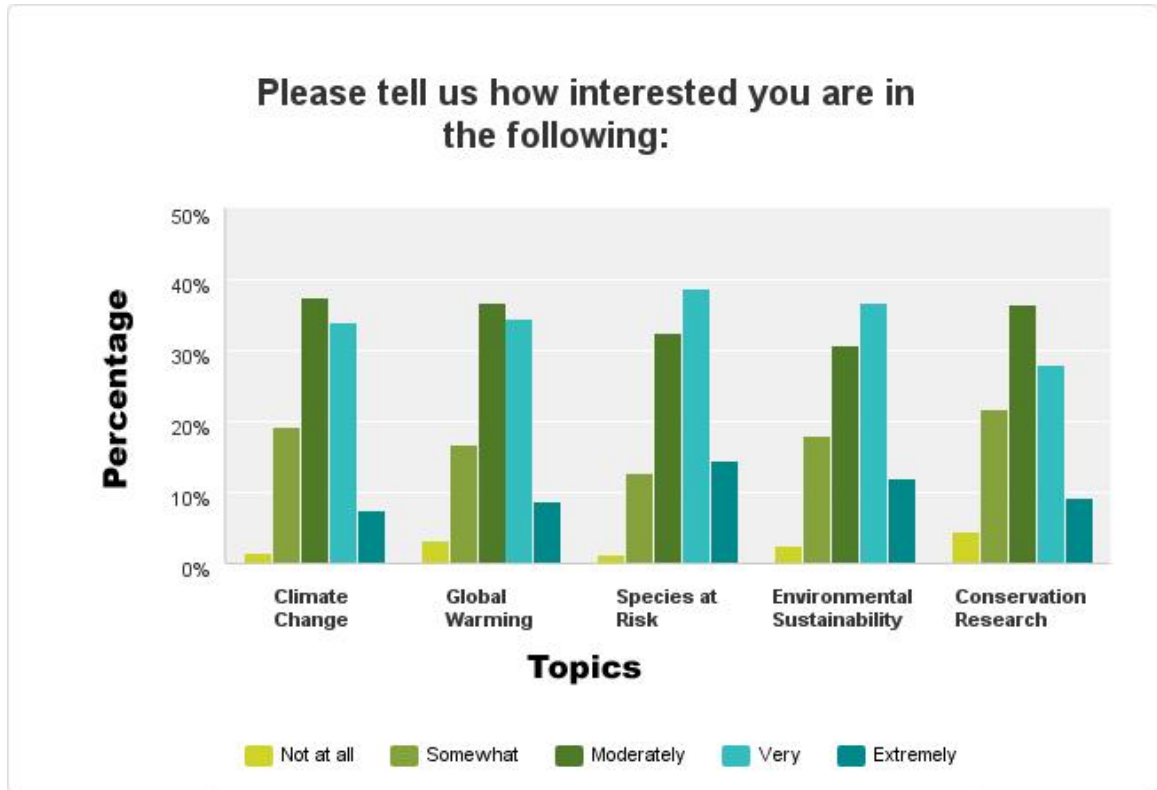


Figure 7. Pre-PVAR perceived interests of all participants.

The majority of post-PVAR treatment group participants expressed that they were moderately or very interested in climate change (80.2%), global warming (73.6%), species at risk (73.3%), environmental sustainability (76.4%), and conservation research (77.4%). The majority of the post-PVAR control group participants expressed that they were moderately or very interested in climate change (70.3%), global warming (66.9%), species at risk (69.5%), environmental sustainability (73.2%), and were somewhat interested in conservation research (67.19%) (see Table 5).

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Table 5

Differences in Pre- and Post-PVAR Interests

Topic	Group	Mean Scores		Standard Deviation	
		Pre	Post	Pre	Post
Climate Change	C	3.32	3.26	.883	.941
	T	3.21	3.33	.937	.836
Global Warming	C	3.31	3.14	.934	.990
	T	3.27	3.21	.974	.923
Species at Risk	C	3.52	3.42	.933	.944
	T	3.53	3.53	.946	.931
Environmental Sustainability	C	3.35	3.39	.998	.900
	T	3.40	3.58	.988	.893
Conservation Research	C	3.09	2.99	1.039	.976
	T	3.21	3.29	.993	.905

Perceived learning outcomes.

Participants were asked to indicate their level of agreement with pre-PVAR learning statement outcomes on a 5-point scale which ranged from 1 = *strongly disagree* and 5 = *strongly agree*. *Seventy-one percent of participants* agreed and 6% strongly agreed that they had learned facts about the topics in the IPBCC. When asked if they learned general information about the topics 79% agreed and 8% strongly agreed. Only 50% of participants agreed or strongly agreed that they would be able to apply what they learned to their everyday lives. Three quarters of participants agreed or strongly agreed

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with the statement that they gained an understanding about the topics. Less than half of participants (43%) neither agreed nor disagreed, and 6% disagreed with the statement that they would be able to apply what they learned (see Table 6).

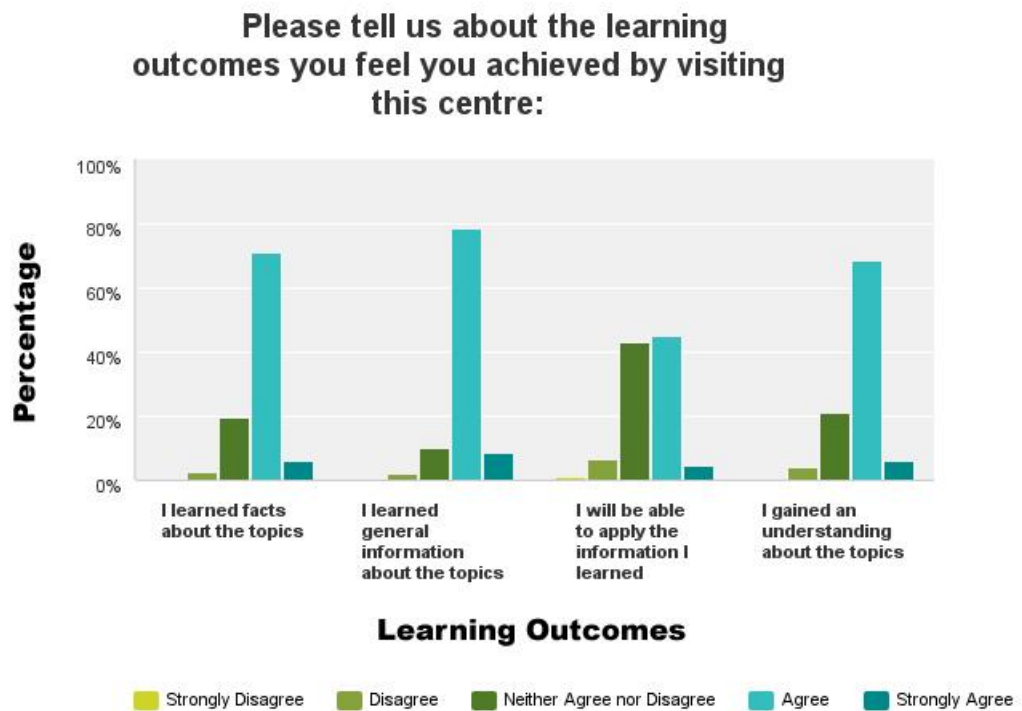


Figure 8. Pre-PVAR perceived learning outcomes of all participants.

Post-PVAR responses indicated that 70% of participants agreed and 6% strongly agreed that they had learned facts about the topics. Seventy-four percent agreed and 4% strongly agreed that they learned general information about the topics in the IPBCC. However, only 46% of participants agreed or strongly agreed that they would be able to apply what they learned to their everyday lives with an additional 46% feeling that they would neither agree nor disagree with this statement. Three quarters of participants

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agreed or strongly agreed with the statement that they gained an understanding about the topics. Learning outcomes after the visit for the control group, 71% to 60% of participants agreed and 6% to 3% strongly agreed that they had learned facts about the topics. In total, 67% agreed and 4% strongly agreed that they learned general information about the topics in the IPBCC. Only 20% of control group participants indicated that they agreed or strongly agreed that they would be able to apply what they learned in their everyday lives. Fifty-six percent of participants now neither agreed nor disagreed, and 20% of post-PVAR control group participants disagreed with 3% strongly disagreed with the statement that they would be able to apply what they learned. Fifty-seven percent of participants agreed or strongly agreed with the statement that they gained an understanding about the topics, while another 32% neither agreed nor disagreed with this statement (see Table 6).

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Table 6

Differences in Pre- and Post-PVAR Perceived Learning Outcomes

Topic		Mean Scores		Standard Deviation	
		Pre	Post	Pre	Post
Facts	C	3.84	3.52	.613	.756
	T	3.88	3.75	.598	.705
General	C	4.00	3.65	.616	.708
	T	4.00	3.75	.504	.677
Apply	C	3.39	2.97	.772	.748
	T	3.50	3.41	.675	.793
Understand	C	3.79	3.50	.687	.725
	T	3.81	3.71	.600	.717

Visitors' sustainable behaviours.

Before receiving the PVARs the participants were asked to indicate on a 5-point scale (1 = *never* and 5 = *always*) how often they do the following: “Slow the Flow” (buy low-flow toilets, faucets, or showerheads); “Flick it Off” (turn off lights and electronics when you are done); “Get Involved” (volunteer with an environmental organization or participate in planting local vegetation); “Double Up” (recycle and reuse); “Buy Locally” (choose locally produced food and other products); “Grow your Own” (chemical free gardening and/or composting); or other (explanation requested). The mean score for “Slow the Flow” was 3.91 ($SD = 1.249$), with the majority of respondents stating that they do this item often (26.4%) or always (33.7%). For “Flick it Off” the mean was 4.52 ($SD = 0.716$), with the majority of respondents stating that they do this item always

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(60.5%). “Get Involved” had a mean score of 2.41 ($SD = 1.238$), where the majority of participants indicated that they do this rarely (30.5%), never (26.9%), or sometimes (26.9%). The majority of participants indicated that they always (59.1%) or often (28.9%) “Double Up” ($M = 4.47$, $SD = 0.826$). For “Buy Local” the mean was 3.72 ($SD = 0.873$), and the majority of responses were often (46.0%) or sometimes (30.9%). “Grow your Own” had a mean score of 3.06 ($SD = 1.539$) (pre- post differences discussed in the results of research question 2).

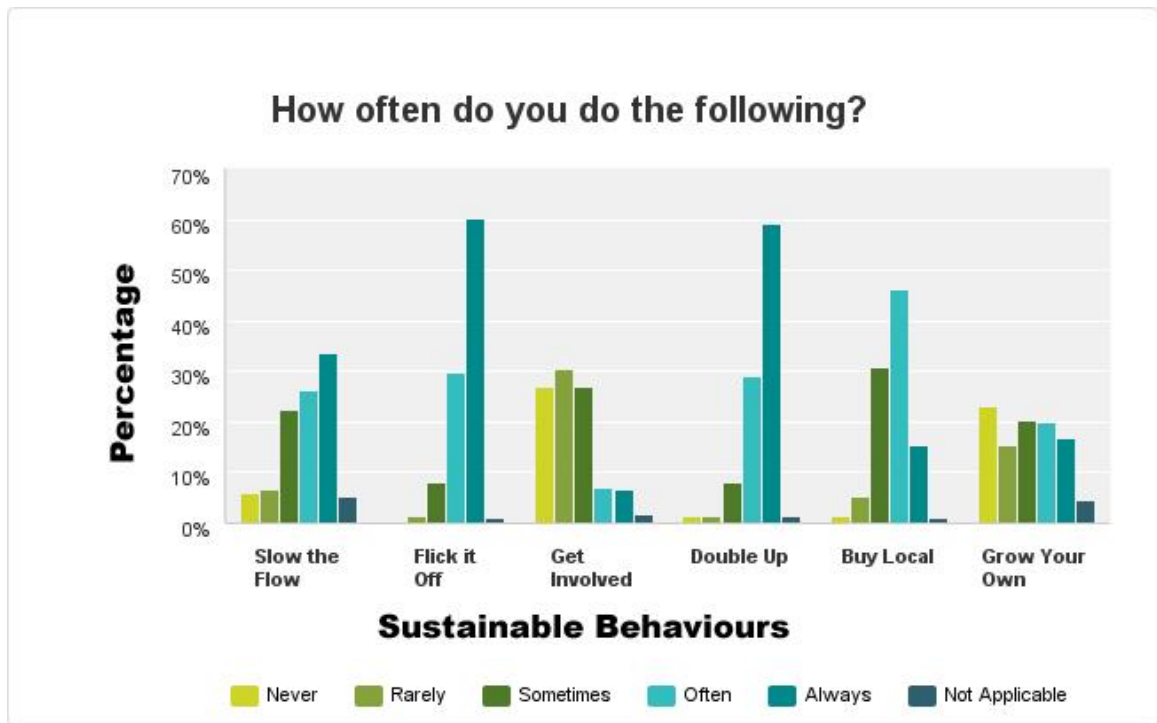


Figure 9. Pre-PVAR sustainable behaviours of all participants.

Visitors’ perceived climate change action barriers.

Based on the research by Luebke et al. (2012), the participants were asked to indicate all of the barriers that affected their ability to do something about climate

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change. The majority of participants stated that they were unsure about which actions would be effective, that the necessary actions would cost too much money, or they reported that they were unsure if their actions would make a difference. Some participants also thought the necessary actions would be too inconvenient or difficult, that the necessary actions would be too time consuming, and a few indicated that the necessary actions would make their life less comfortable (see Table 7). Very few participants felt that their family or friends would not be supportive, or selected the “other” category. The “other” responses prompted participants to specify and these responses ranged from personal to specific barriers such as: “I love to travel (use lots of fossil fuel)” (PMM 300) and “our climate is very cold – not conducive to no idling and biking” (PMM 288), to more socio-cultural comments such as “lack of education” (PMMT 084), “out of my control or influence” (PMMT 101), and “need better enforcement of current regs[regulations]” (PMMT 359). There were positive barriers as well, where one participant indicated that they would quit their job and “volunteer full-time on environmental issues if I could” (PMMT 228). One participant explicitly and unintentionally stated the premise behind the PVARs: “if there was something obvious that we do that directly affects them [polar bears], like simple things that don’t take much time or money... like most of these things go over my head, like multi-million dollar project” (PMM 369).

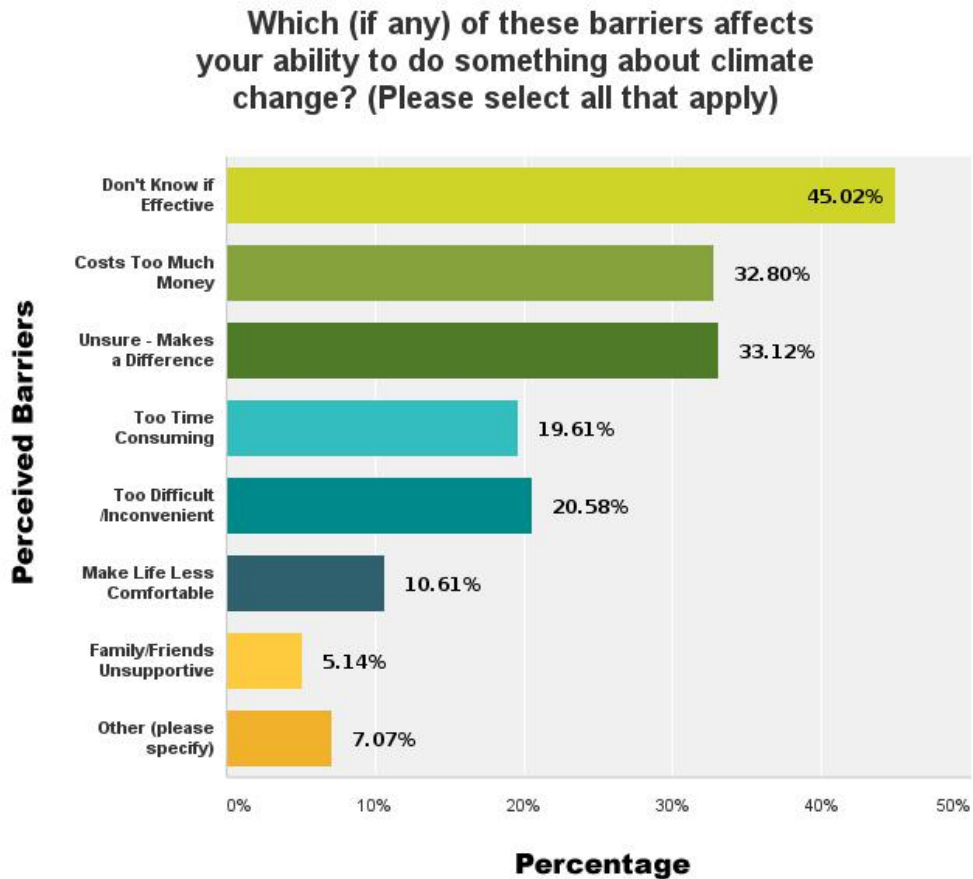


Figure 10. Pre-PVAR perceived barriers for all participants.

There were some changes for post-PVAR responses to this question. Post-PVAR responses indicated that there were less treatment group participants who were unsure about which actions would be effective, whereas, the control group demonstrated little change in their responses. There were small changes for both groups, in regards to the necessary actions costing too much money. The treatment group saw a slight decrease

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for participants who were unsure if their actions would make a difference, with the control group remaining unchanged. Perceived barriers increased for participants who thought the necessary actions would be too inconvenient or difficult for the treatment group and remained the same for the control group. Additionally, both the treatment and control group increased in believing that the necessary actions would be too time consuming. There was also a slight increase for all participants who indicated that the necessary actions would make their life less comfortable. A small percentage of the treatment group participants still felt that their family or friends would not be supportive; interestingly this was reduced for the control group. A few treatment group and control group participants selected “other” with comments emphasizing personal and specific barriers, such as the illness of a family member (see Table 7).

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Table 7

Differences in Pre- and Post-PVAR Perceived Barriers

Topic	Group	Pre- PVAR Percentage*	Post- PVAR Percentage
Don't Know if Effective	C	46%	37%
	T	43%	17%
Costs Too Much Money	C	33%	30%
	T	33%	32%
Unsure if Makes a Difference	C	31%	31%
	T	35%	26%
Too Time Consuming	C	18%	30%
	T	21%	31%
Too Difficult / Inconvenient	C	20%	20%
	T	21%	32%
Makes Life Less Comfortable	C	14%	13%
	T	8%	16%
Family / Friends are Unsupportive	C	3%	3%
	T	7%	8%
Other	C	6%	11%
	T	8%	13%

Note. Participants were asked to select all that apply, therefore, percentages will not total to 100%.

Visitors' satisfaction and connection to animals.

Three hundred and sixteen (85%) visitors agreed or strongly agreed with the statement that they intended to return to the centre ($M = 4.14$, $SD = 0.717$) and would recommend it to friends and family ($M = 4.11$, $SD = 0.701$). Additionally, 330 (89%) of

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participants indicated that they agreed or strongly agreed that they would say positive things about the centre when talking with others ($M = 4.18$, $SD = 0.642$). One hundred and eighty-three (49%) visitors indicated that they agreed or strongly agreed with the statement that the IPBCC was one of the best interpretive centres they could have attended, and an additional 151 (41%) participants neither agreed nor disagreed with this statement ($M = 3.52$, $SD = 0.842$). Comments to the researcher while participants were completing this question indicated that these responses could be influenced by a dislike for the wording of the question, as they saw this as leading. Additionally, many visitors pointed out that when the Journey to Churchill exhibit would be completed they would answer more affirmatively. There were 322 participants (87%) who indicated that they were pleased with their decision to visit the centre ($M = 4.07$, $SD = 0.617$) and 287 (77%) participants indicated that they had a really good time at the centre. Nineteen percent of participants indicated that they neither agreed nor disagreed with the statement that they had a good time at the centre ($M = 3.98$, $SD = 0.708$).



Figure 11. Pre-PVAR satisfaction of visit for all participants.

When asked the pre-PVAR question “do you feel a sense of connection with the animals you saw at the zoo?” 60% of visitors responded that they felt moderately or somewhat connected to the animals. Another 27% indicated that they felt a strong connection to the animals (see Table 8). There was very little change for the post-PVAR treatment and control group responses (see Table 8). Participants reported feeling connected to various animals including, snakes, emus, birds, groundhogs, and the most frequent response was the polar bear, or Hudson (the name of the polar bear).

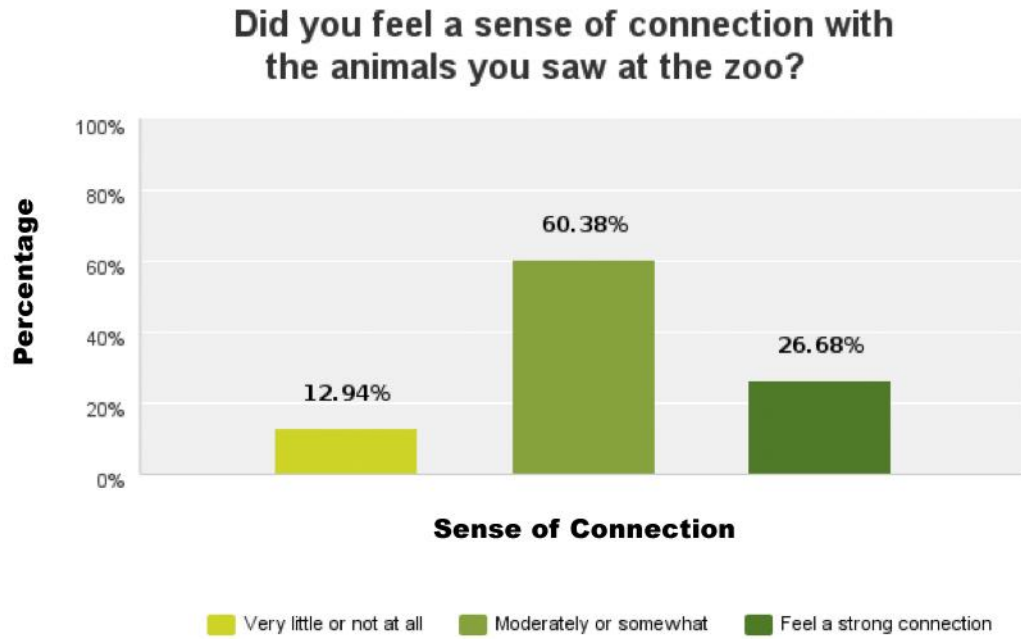


Figure 12. Pre-PVAR sense of connection to animals at the zoo for all participants.

Table 8

Differences in Pre- and Post-PVAR Sense of Connection to Animals

Satisfaction	Group	Mean Scores		Standard Deviation	
		Pre	Post	Pre	Post
Sense of Connection	C	2.13	2.09	.636	.710
	T	2.15	2.09	.595	.683

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Confounding variables.

Some variables were included in the data collection because it was believed that they may act as confounding variables. Specifically, demographic data and certain visitor characteristics, such as interest and knowledge, were examined to see if they varied with the independent variable. Independent *t*-tests indicated that there were no significant differences between the pre-PVAR control and treatment group responses with regards to demographic variables, knowledge, or interest. To determine if any differences existed between participants who did or did not complete the follow-up aspect of the research additional *t*-tests and Pearson's chi-square tests for independence were conducted. There were some visitor characteristic differences for the control group and treatment group (see Table 9). This indicated that the post-PVAR control group was representative of the pre-PVAR control group, with the exception of age, and that the post-PVAR treatment group was representative of the pre-PVAR treatment group, with the exception of age and education.

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Table 9

Differences in Pre-PVAR Visitor Characteristics for Pre-Only and Pre-Post-PVAR Respondents

Topic	Group	Mean Pre-PVAR Scores of Pre and Pre-Post Respondents		Standard Deviation		Independent <i>t</i> -tests Results
		Pre	Pre-Post	Pre	Pre-Post	
Education	C	2.85	3.28	1.16	1.03	$t(180) = -2.39, p = 0.018$
	T	3.00	3.37	1.03	1.05	
Age	C	2.68	2.88	1.75	1.31	NS
	T	2.64	3.26	1.28	1.40	

Note. Significant at $p < 0.05$, two-sided. All assumptions for normality and equal variances met.

To determine if there were any differences in pre-PVAR visitor experience characteristics of participants who did and did not complete the follow-up research, *t*-tests and Pearson's chi-square tests for independence were conducted. There were some visitor characteristic differences for the control group and treatment group (see Table 10).

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Table 10

Differences in Pre-PVAR Visitor Experience Responses for Pre-Only and Pre-Post-PVAR Respondents

Questionnaire Responses	Group	Mean Scores		Mean Scores		Independent <i>t</i> -tests Results
		Pre	Pre-Post	Pre	Pre-Post	
Q2: Knowledge about climate change	C					NS
	T	2.60	2.85	0.811	0.780	$t(185) = -2.13, p = 0.034$
Q2: Knowledge about environmental sustainability	C					NS
	T	2.31	2.62	0.842	0.911	$t(185) = -2.42, p = 0.017$
Q2: Knowledge about conservation research	C					NS
	T	1.99	2.29	0.814	0.895	$t(185) = -2.40, p = 0.018$
Q3: Interest in environmental sustainability	C					NS
	T	3.19	3.55	0.987	0.967	$t(184) = -2.45, p = 0.015$
Q4: Learned general information	C	3.70	3.98	0.548	0.624	$t(182) = -2.70, p = 0.008$
	T	3.83	4.01	0.568	0.441	$t(139) = -2.29, p = 0.024^*$

Note. Significant at $p < 0.05$, two-sided. All assumptions for normality and equal variances met.

*Variances not assumed equal; test is robust, as N is large and responses are approximately normal.

Regarding visitor experience, the results in Table 10 indicate that the post-PVAR control group was representative of the pre-PVAR control group, with the exception of pre-PVAR perceived learning of general information. The post-PVAR treatment group

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was representative of the pre-PVAR treatment group visitor experience responses, with the exception of pre-PVAR perceived knowledge about climate change, environmental sustainability, interest in environmental sustainability, and perceived learning of general information. Additionally, a Pearson's chi-square test of independence revealed that there was also a significant difference between treatment group pre-PVAR responses (between participants who did and did not respond to the follow-up research) regarding one perceived barrier to do something about climate change (the necessary actions are too inconvenient or difficult). The relationship between these variables was significant, $\chi^2(1, N = 185) = 6.93, p = 0.08$. However, correlations were conducted with these variables and the dependent measures, and there were no correlations above .70, which is considered the minimum correlation to use a variable as a covariate (Bryman & Cramer, 2011). Subsequently, these variables were not included as covariates in subsequent analyses.

Research Question 1

How do post-visit action resources affect free-choice learning after a visit to an environmental education centre, specifically, the International Polar Bear Conservation Centre at the Assiniboine Park Zoo?

To examine research question one, the relation between group assignment (control versus treatment) and learning was examined. In total, three measures of learning change were included in the study (see Table 11). Group assignment was the independent variable and the dependent variable was change in learning, which was measured for both groups both pre- and post-PVAR for the PMMs and post-PVAR for the perceived measure of learning change. A mixed-design repeated measures ANOVA

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was conducted to determine quantitative differences between the PMMs. The PMMs were also analyzed qualitatively using an open-coding constant comparison content analysis method. For the measure of perceived learning change a Pearson's chi-square test for independence was conducted to determine if there was a significant difference in the perceived learning change between the treatment and control group. Finally, a qualitative analysis using an open-coding constant comparison content analysis method of a PMM interview question was conducted to gain a depth of understanding about why participants believed their learning did or did not change.

Table 11

Points of Learning Measurement

Learning Measures	Pre-PVAR	Post-PVAR
Questionnaire: Learning		
1) Perceived knowledge change since IPBCC visit (Q10)		X
PMM: Learning		
2) PMM learning	X	X
3) Perceived learning change (Interview Q1)		X

The effect of PVARs on learning change measured with PMM.

The PMMs were analyzed both qualitatively and quantitatively and the subsequent analyses are discussed in turn. The coding of the PMMs will be discussed first, followed by the quantitative analysis of the PMMs, with the qualitative analysis discussed last, to add depth to the results.

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Data preparation.

To analyze the PMM data quantitatively a categorical analysis was first conducted to determine the breadth categories (see Appendix H). There were 5 primary themes that emerged from the pre-PVAR data and resulted in the breadth categories of the PMM analysis: environmental impacts of climate change (Environment), human impacts on the environment and animals (Human), components of environmental sustainability (Sustainability), aspects of education and awareness (Education), and concepts relating broadly to the future (Future).

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Table 12

Descriptions of the Categorical PMM Themes

PMM Themes		
Abbreviated title	Full title	Description
Environment (ENVR)	Environmental Impacts of Climate Change	People contributing to, but not directly causing impacts in regards to climate change and sustainability
Human (HUMAN)	Human Impacts on the Environment and Animals	Direct impacts caused by people in regards to climate change and sustainability
Sustainability (SUST)	Components of Environmental Sustainability	Comments that positively contributes to sustainability
Education (EDUC)	Aspects of Education and Awareness	Aspects and components related to learning about and understanding climate change and sustainability
Future (FUTURE)	Aspects and Components of the Future	Comments directly pertaining to a future point in time.

Within each primary theme there were several sub-themes that were informative both in regards to triangulating data within this study and directly for the Assiniboine Park Zoo's education program planning (see Appendix H for details on each categorical theme). The pre-PVAR coding for both the control and treatment group participants was similar.

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Personal Meaning Mapping quantitative findings.

The quantitative results from this study provide insight into what adult zoo visitors know about climate change and sustainability after a visit to the International Polar Bear Conservation Centre, at the Assiniboine Park Zoo and how that knowledge changes over a two-month time period. Since the post-PMMs build upon the pre-existing PMMs the differences are noteworthy.

Pre- and post-PVAR PMMs were coded for extent, breadth, depth, and mastery. Scores for extent ranged from 1 – 8 (pre-PVAR) and 1-10 (post-PVAR) (see Appendix I). For both pre-and post-PVAR breadth, depth, and mastery scores ranged from 1 – 5 (see Appendix I). Differences in pre- and post-PVAR PMM responses for extent, breadth, depth, and mastery of free-choice learning were analyzed using a mixed-design repeated measures ANOVA. The results indicated that the post-PVAR treatment group demonstrated significantly more learning in terms of depth and mastery (see Table 13). While there were no significant differences at $p = 0.05$ for extent, the treatment group demonstrated some increase in the extent of their learning, as $p = 0.058$ (see Table 13). There were no significant differences for the participants' breadth in learning (see Table 13).

Table 13

Differences Between Groups for PMM Learning Changes

Topic	Group	Mean Score		ANOVA
		Pre	Post	Output

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Extent	C	3.72	4.03	Time ^A	$F(1, 68) = 20.818, p = 0.000$
	T	3.88	4.56	Group ^B	$F(1, 68) = 0.593, p = 0.444, NS$
				Interaction ^C	$F(1, 68) = 2.970, p = 0.089, NS$
Breadth	C	3.42	3.58	Time	$F(1, 68) = 12.632, p = 0.001$
	T	3.65	3.79	Group	$F(1, 68) = 0.705, p = 0.404, NS$
				Interaction	$F(1, 68) = 0.049, p = 0.825, NS$
Depth	C	3.03	3.12	Time	$F(1, 68) = 9.053, p = 0.004^*$
	T	3.12	3.35	Group	$F(1, 68) = 6.12, p = 0.437, NS$
				Interaction	$F(1, 68) = 5.633, p = 0.020^*$
Mastery	C	2.75	2.81	Time	$F(1, 68) = 12.563, p = 0.001^*$
	T	2.91	3.15	Group	$F(1, 68) = 1.305, p = 0.257, NS$
				Interaction	$F(1, 68) = 4.798, p = 0.032^*$

Note. C = Control, T = Treatment, NS = Non-Significant

^AThe within-subjects effect of ‘Time’ represents the differences of participants’ pre- and post-PVAR scores for both groups combined.

^BThe between-subjects effect of ‘Group’ represents the overall differences of participants’ pre- and post-PVAR scores of the treatment and the control group.

^CThe within-subjects effect of ‘Interaction’ represents the differences between the pre- and post-PVAR scores with the effect of the treatment and the control group.

*When variances are unequal Greenhouse-Geisser scores are reported.

Personal Meaning Mapping qualitative findings.

In general, both the control and treatment group emphasized “Sustainability”, particularly socio-cultural components, and “Education” in terms of a lack of awareness and concern. Impacts were also emphasized, and these spanned both the “Human” and

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“Environment” themes. There were no discernable differences between the two groups for pre-PVAR responses.

For the post-PVAR responses an open-coding constant comparison content analysis found that there was an emphasis on education and awareness for the control group participants. Specifically, control group participants expressed confusion and were unsure of whom to believe in relation to facts about climate change and sustainability, as expressed by one participant: “I would have to say I feel a bit more confused now... Seems to be polar opposite schools of thought [regarding climate change], and where does the truth lie? More aware, but not sure where the answer is” (PMM 307). Participants listed specific media sources and mediums where they heard conflicting information, and several took the opportunity to ask the researcher to clarify what was accurate (the researcher was careful not to compromise the control group and made careful note of all conversations. If participants were still interested after the PMM interview had concluded they were presented with the opportunity to ask additional questions). Responses that focused on educational issues underscored the fact that the information regarding climate change and sustainability was either too simple, or too confusing and complicated. For the “Environment” theme weather changes and impacts for animals were primarily discussed, with some mention of regional issues like recent flooding in Calgary, Canada. “Human” themed impacts were addressed in terms of global temporal impacts, which emphasized general observations that did not include the participants themselves, such as “3rd world” impacts. The regional human impacts that were discussed were typically immediate and location specific. For the “Sustainability” theme participants primarily discussed general socio-cultural components such as

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“whatever humans create should always be recyclable” (PMM 006). When personal components were mentioned they tended to be actions that required less time and were easier to do, such as recycling or “use less” (PMM 370). The other types of sustainable actions mentioned by control group participants were actions that participants were already doing, rather than new actions that were begun since their visit to the IPBCC. Also, in relation to “Sustainability”, barriers were emphasized such as the negative impacts that participants knew they contributed to but could not resolve. For example:

However, this summer we have been driving around so much. Like to go camping, seasonal sorts of things. Haven’t been up to our usual standards. I’d like to say we drove around on one tank of gas per month, but we didn’t! We haul our camper with us. It’s something I feel guilty about, but I know it’s normal. (PMM 005)

Additionally, some participants expressed that the issues seemed so insurmountable that they were unsure of how they personally could have a positive impact on climate change and environmental sustainability.

I suppose in some ways it is a little easier to remain ignorant so as not to become overwhelmed thinking how large the concern is and how the things I can do to help are so miniscule - yes, they can help but how do you get the billions of others in the world to do the same? (PMM 298)

For the post-PVAR treatment group the “Sustainability” category was heavily emphasized. As with the control group, socio-cultural components of sustainability were highlighted, with discussion emphasizing personal components of sustainability. Similar

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to the control group, the less time-consuming and low cost personal things to do, such as recycling, were mentioned. However, the treatment group also reflected some of the six targeted behaviours and used the terms from the study (and IPBCC) such as “Flick it Off”, “Slow the Flow”, and “Grow your Own”.

Just like with you're emails and stuff, slow the flow, flick it off, and source you're food locally... and you know I was getting the reminder from you now, so now I know how to be more sustainable in my life. Like buying your food locally, it's not just about eating healthier, like food grown closer, it's also an environmental thing also. I'll probably think. (PMMT 355)

The treatment group also discussed technological advancements and the need for government support and involvement was also a notable part of both personal and socio-cultural sustainability. The treatment group participants discussed the need for the government to play a more significant role in environmental sustainability: “...change the environmental laws about the atmosphere, it's not just political change it's the public, that needs to set goals, and they're out there, but they're very weak, the federal government is guilty of setting them back” (PMMT 359). Indeed, treatment group participants believed that this was a significant barrier to environmental sustainability and that political agendas were to blame for the disregard for the environment. The treatment group participants stated that there needed to be less emphasis on economics, jobs, and politics, and felt that it was the government's responsibility to create laws, and remove financial and other barriers to encourage companies and individuals to become more sustainable. Several participants, who identified as newcomers to Canada, described how they had perceived Canada as a “green” country and felt that Canada's natural

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environment was not appreciated given this international reputation: “Canada is green country; [need to be] aware of our impacts” (PMMT 290). These individuals spoke passionately about how this was very important to them in their new identity as a Canadian, and that we as Canadians need to do something regarding the environment. Other treatment group participants expressed personal barriers with reference to the “Future”. Some participants felt depressed and overwhelmed about some of the environmental issues today because they felt these issues were out of their hands and that the government was not attempting to improve the situation. However, overall treatment group participants focused on benefits regarding the future and particularly stressed the importance of doing something for their children, or grandchildren, and future generations in general: “Can’t help what governments are doing, but can help what I’m doing” (PMMT 261); “ I look at my children and think about – that’s the reason I have to make an investment!” (PMMT 204).

“Education” was discussed by the post-PVAR treatment group participants in terms of what they had learned since their visit to the IPBCC. These participants were providing ideas and examples of how to educate people about the topic and stressed the importance of educating the public and children. The importance of the polar bear connection for Manitobans was stressed and individuals explicitly mentioned that this localized example helped them understand the importance of sustainability. One participant explained this:

I mean, polar bears appeal to us, they are beautiful animals, and it’s a good way to hit the message home quickly, because they’re big lovely animals... The message hits home louder, stronger, clearer because it’s Manitoba. I talk to my kids about

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no longer having oil and alternative energy, and my child thought about composting and running vehicles with this energy. (PMMT 179)

Within this theme, participants were able to discuss several concepts and things that they had learned from the IPBCC, which did not occur with the control group: “That exhibit (the IPBCC) helps people realize what is going on and think about reducing climate change” (PMMT 030). Educational media and mediums were discussed in terms of where people were learning new information and this was then expanded upon regarding suggestions for ways to further educate others.

Definitely learned other things, and being more conscious of things we can do and how to influence other people how to also do these things. The information that you did send, like there is a lot of knowledge in there and information about things I can do better or do more. Just remembering or making it a habit. Like turning off lights and brushing teeth (have the faucet off). (PMMT 093).

For the treatment group, participants were eager to share with the researcher new things they had learned and discussed new sources of information, such as books, film, Facebook, news, TV shows, and other interpretive centres. It should be noted that some treatment group participants maintained some uncertainty about climate change. Lack of awareness occurred primarily in the form of statements that indicated that they had not realized how much they were already doing, rather than wondering what they should be doing, as was found within the control group. For example, as one participant described: “Well I’ve learned about the turning off the lights, not leaving your water running,

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recycling of course, and you know I didn't realize that we were actually doing a lot anyways" (PMMT 357).

The treatment group participants did not focus on environmental impacts and human impacts. When they did discuss environmental impacts, these examples tended to be more general, temporal (long-term), and broad. For "Human" impacts the examples given were also general and tended to focus on population issues, companies that pollute and the issues with instant gratification and immediate needs, rather than long-term benefits.

In summary, the most apparent differences between the control and treatment group was the emphasis of the control group on uncertainty (Education) and future barriers (Future). For the treatment group the emphasis was placed on "Sustainability", where both socio-cultural and personal solutions were stressed. The concepts of uncertainty and lack of awareness and concern were still apparent, but the focus was placed on others' not understanding or being aware of environmental issues. The treatment group emphasized the need for education; whereas the control group emphasized their uncertainty about facts, who to believe, and what to do.

Post-PVAR perceived knowledge change.

Participants' perception of their possible change in learning was examined by comparing post treatment differences in agreement or disagreement with the statement: "Do you feel your knowledge has changed since your visit to the IPBCC?". "No" responses were coded as 1, and "Yes" responses as 2. Analyses for normality, skewness, and kurtosis were completed, and since the number of participants was large, the sample

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was independent, and the distribution was approximately normal, the tests can be considered reliable. A minority (28.23%) of the control group participants indicated that their knowledge had changed (see Figure 13). For the treatment group 58.1% of participants indicated that they felt their knowledge had changed since their visit (see Figure 14). Pearson's chi-squared tests for independence demonstrated that this difference was significant between the treatment and control group (1, N = 229) = 20.834, $p < .000$.

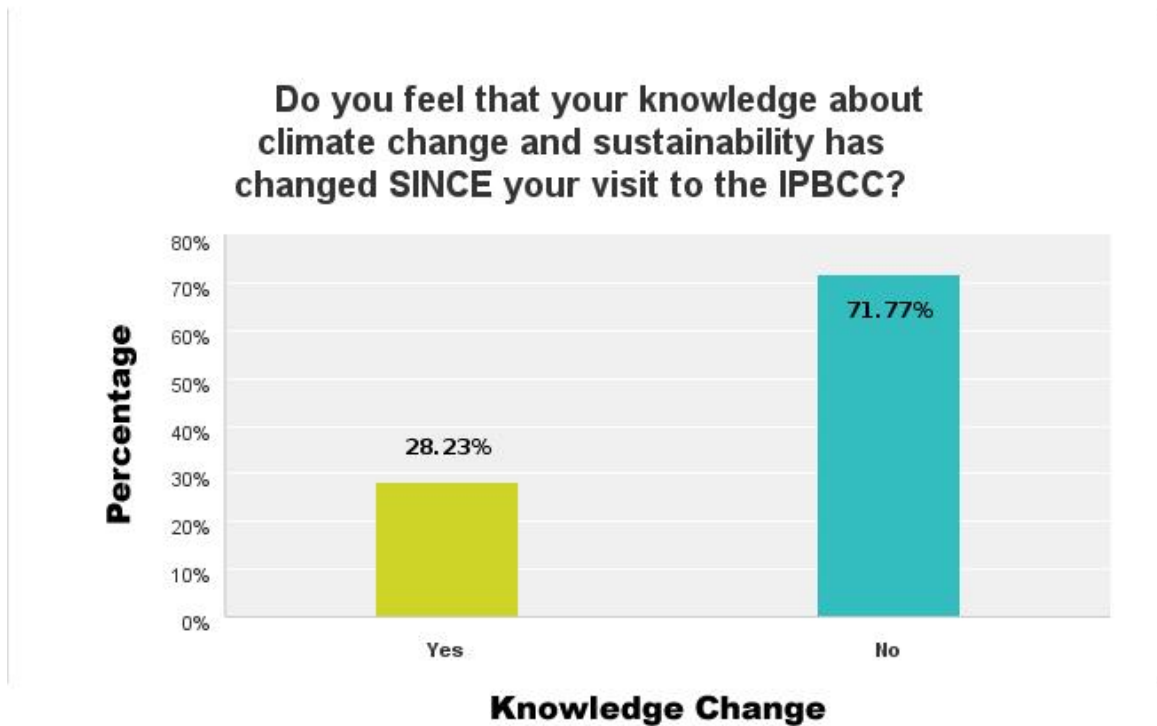


Figure 13. Post-PVAR perceived knowledge change for the control group.

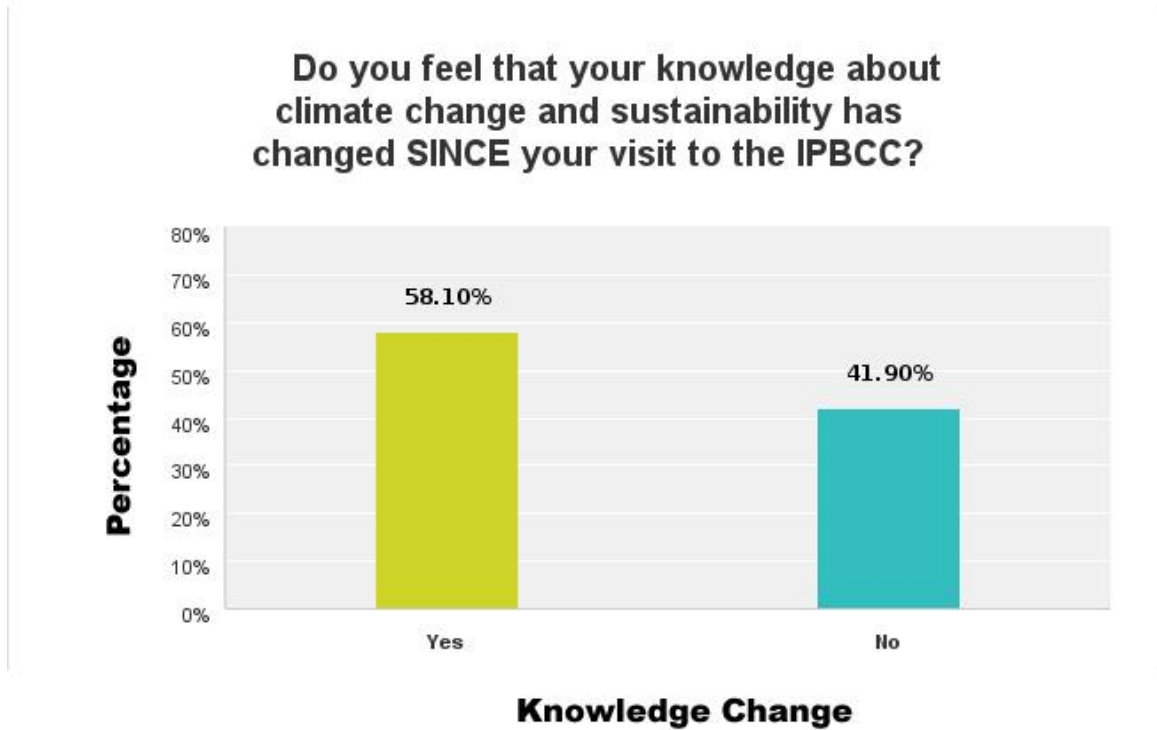


Figure 14. Post-PVAR perceived knowledge change for the treatment group.

Interview responses regarding perceived learning change.

Responses were analyzed qualitatively, as the participants were asked to elaborate and explain why their learning did or did not change. The control group demonstrated little or no change in learning. One participant summarized this finding succinctly: “[My] learning has not changed because I haven’t been in any other situations where I have seen anything about the topics” (PMM 064). In some instances this was coupled with participants describing that they already felt quite knowledgeable about the topic or that they would like to learn more. The control group participants who felt their learning did not change, typically explained this to be due to a barrier, such as being too busy with work or children: “mostly because I’ve been way too busy at work and haven’t had an

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opportunity to do any other research” (PMM 247). Seasonal barriers were also discussed, such as enjoying the summer weather and not spending time researching a topic: “to be quite honest, it’s summer and I’ve been spending time outside instead of educating myself” (PMM 068). Another barrier for several participants was that they felt their strong religious beliefs conflicted with climate change information – or superseded this knowledge in some way: “I have strong [religious] beliefs – they haven’t changed” (PMM 007). There were also some participants in the control group who expressed that they felt “a bit more confused now” (PMM 307), due to conflicting information in the media. Some of these participants identified news sources as being knowingly biased, yet, acknowledged that this still caused them to question the validity of scientific information: “I basically get most of my information from Redit and [I know it’s] not always very academically correct” (PMM 285).

The treatment group respondents reported some increase in learning or a heightened awareness of environmental sustainability. One participant’s responses summarized this finding: “I don’t think it has... there is maybe a more increased awareness, but maybe more of a sensitivity. Like hearing things on the news and making a connection. It’s a sensitivity so now more dots are connecting” (PMMT 204).

Many of the treatment group participants who reported no changes in learning, stated that this was because they already knew a lot about this information and already had a keen interest. There were also participants who expressed that a personal situation impacted their ability to learn more or become more sustainable. Specifically, either their ill health or that of a loved one prevented them from engaging in sustainable behaviours and their zoo visit had been a form of escapism.

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For participants who expressed a change of learning, when prompted about what explicitly caused or encouraged this change, the treatment group participants attributed this to the PVARs. One participant explained this explicitly when asked to expand about their change in learning: “Not after my visit, but yes after your emails. The information in the centre is for all types of people and it’s very big, basic, and general – not that specific” (PMMT 290).

Another participant described the effectiveness of the emails for reminding them of what they already knew: “I found the emails that were sent were a good refresher, like I had the knowledge, maybe got it somewhere else and now remembered a few things. They were [the emails] good reminders for day-to-day activities” (PMMT 172). Several participants stated that just doing the research, particularly the PMMs, was a prompt in itself for encouraging learning and sustainable behaviour change. This was evident predominantly for the treatment group, but was also found in the responses of several of the control group participants (who had remarkably high levels of observed interest in environmental sustainability at the outset of the research, as was noted by the researcher in her research journal). A treatment group participant explained when asked whether their learning had changed:

Yes, because I have thought more about it after going there, as well as if people are asking you questions then its on your radar, then you relate it back to your responses... So I went there and had no real thought process, and just walked through the building, the brainstorming activity piqued my interest, and then thought about the topics after. Most reflection the week after. (PMMT 291)

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Additionally, the responses to the open-ended interview questions allowed participants to make additional comments. Here participants in both the treatment and control group took the opportunity to personally thank the researcher for allowing them to be a part of this study:

I thought it was awesome and thank you for including me in it. I think the zoo and polar bear exhibit were also awesome and think they're doing a really great job. I also loved the Hudson Updates. (PMMT 172)

Yes, I learned that it's happening [climate change] and you're trying to make something happen, and I think it's on the right track... I don't see any negatives. I learned that there is actually someone trying to do something. (PMMT 359)

This demonstrates that learning and engagement can take form through a variety of cumulative experiences, including participant involvement in research.

Research Question 2

How do post-visit action resources affect sustainable behaviour change after a visit to an environmental education centre, specifically, the International Polar Bear Centre at the Assiniboine Park Zoo?

To examine research question two, to determine the impact of PVARs on sustainable behaviour change after a visit to the IPBCC, there were five measures of behaviour change (two quantitative and three qualitative), with one of these measures comparing pre- and post-PVAR responses and two measures applicable only to the treatment group (see Table 14). The independent variable was group assignment and the dependant variable was sustainable behaviour change, which was measured pre- and post

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PVAR change for the six-targeted sustainable behaviours. To measure perceived changes in behaviour a Pearson's chi-square test for independence was conducted to determine if there were significant differences between the treatment and the control group. Finally, post-PVAR questionnaire responses assessed the attribution of behaviour change for either behaviours begun or increased in relation to the IPBCC visit and the PVARs. These qualitative responses were analyzed using an open-coding constant comparison content analysis method, which was also used to analyze a PMM interview question regarding why participants believed that their sustainable behaviour did or did not change. The qualitative responses were used to gain a more complete understanding of why behaviour change did or did not occur in relation to the IPBCC visit and the PVARs.

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Table 14

Points of Behaviour Measurement

Behaviour Measures	Pre-PVAR	Post-PVAR
Questionnaire: Behaviour		
1) Pre- and post-PVAR questionnaire behaviour change (Q6)	X	X
2) Perceived change in environmentally sustainable behaviours (Q10)		X
3) Behaviour change responses relating to the IPBCC (Q11, Q12, Q13)		X
Treatment Group Only		
4) Behaviour change responses relating to PVARs (Q14, Q15, & Q16)		X
PMM: Behaviour		
5) Perceived behaviour change (Interview Q2)		X

Note. *Includes all of the measures in the main group for related treatment or control groups.

The effect of PVARs on behaviour change.

Participants' perception of the frequency of their involvement in the six-targeted environmentally sustainable behaviours was measured on a 5-point likert-type scale, from 1 = *never* to 5 = *always*. The six-targeted behaviours included: "Slow the Flow" (buy low-flow toilets, faucets, or showerheads), "Flick it Off" (turn off lights and electronics when you are done), "Get Involved" (volunteer with an environmental organization or participate in planting local vegetation), "Double Up" (recycle and reuse), "Buy Locally" (choose locally produced food and other products), "Grow your Own" (chemical free gardening and/or composting). A mixed-design repeated measures ANOVA comparing

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the control and treatment group pre- and post-PVAR responses regarding the sustainable behaviour change question were conducted. There were no significant differences for any of the behaviours between the treatment and the control group in relation to their reported sustainable behaviour (see Table 15).

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Table 15

Differences Between Groups for Sustainable Behaviour Changes

Behaviour	Group	Mean Score		ANOVA	
		Pre	Post		Output
Slow the Flow	C	4.56	4.51	Time ^A	$F(1, 227) = 14.833, p = 0.000$
	T	4.48	4.55	Group ^B	$F(1, 227) = 0.064, p = 0.801, NS$
				Interaction ^C	$F(1, 227) = 0.811, p = 0.369, NS$
Flick it Off	C	3.42	3.58	Time	$F(1, 227) = 0.105, p = 0.746, NS$
	T	3.65	3.79	Group	$F(1, 227) = 0.053, p = 0.819, NS$
				Interaction	$F(1, 227) = 2.106, p = 0.148, NS$
Volunteer	C	2.35	2.02	Time	$F(1, 227) = 11.852, p = 0.001$
	T	2.42	2.24	Group	$F(1, 227) = 0.984, p = 0.322, NS$
				Interaction	$F(1, 227) = 1.015, p = 0.315, NS$
Double Up	C	4.48	4.35	Time	$F(1, 225) = 3.597, p = 0.059, NS$
	T	4.51	4.46	Group	$F(1, 225) = 0.534, p = 0.466, NS$
				Interaction	$F(1, 225) = 0.586, p = 0.445, NS$
Buy Local	C	3.69	3.61	Time	$F(1, 225) = 5.901, p = 0.016$
	T	3.80	3.62	Group	$F(1, 225) = 0.380, p = 0.538, NS$
				Interaction	$F(1, 225) = 0.836, p = 0.361, NS$
Grow Your Own	C	3.14	2.87	Time	$F(1, 227) = 6.339, p = 0.013$
	T	3.17	2.92	Group	$F(1, 227) = 0.057, p = 0.811, NS$
				Interaction	$F(1, 227) = 0.013, p = 0.910, NS$

Note. C = Control, T = Treatment, NS = Non-Significant

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^AThe within-subjects effect of ‘Time’ represents the differences of participants’ pre- and post-PVAR scores for both groups combined.

^BThe between-subjects effect of ‘Group’ represents the overall differences of participants’ pre- and post-PVAR scores of the treatment and the control group.

^CThe within-subjects effect of ‘Interaction’ represents the differences between the pre- and post-PVAR scores with the effect of the treatment and the control group.

*When variances are unequal Greenhouse-Geisser scores are reported.

The effect of PVARs on perceived behaviour change.

Participants’ perception of their potential sustainable behaviour change was measured with the questionnaire by comparing post treatment differences in agreement or disagreement with the statement: “Do you feel that your involvement in environmentally sustainable actions has changed since your visit to the IPBCC?”. “Yes” responses were coded as 1, and “No” responses as 2. For the treatment group, 40.8% of participants indicated that they felt their sustainable behaviours had changed since their visit. Only 14.6% of the control group participants indicated that their sustainable behaviours had changed. Pearson chi-squared tests for independence demonstrated that there were significant differences between the treatment and control group ($1, N = 226$) = 19.647, $p < .001$.

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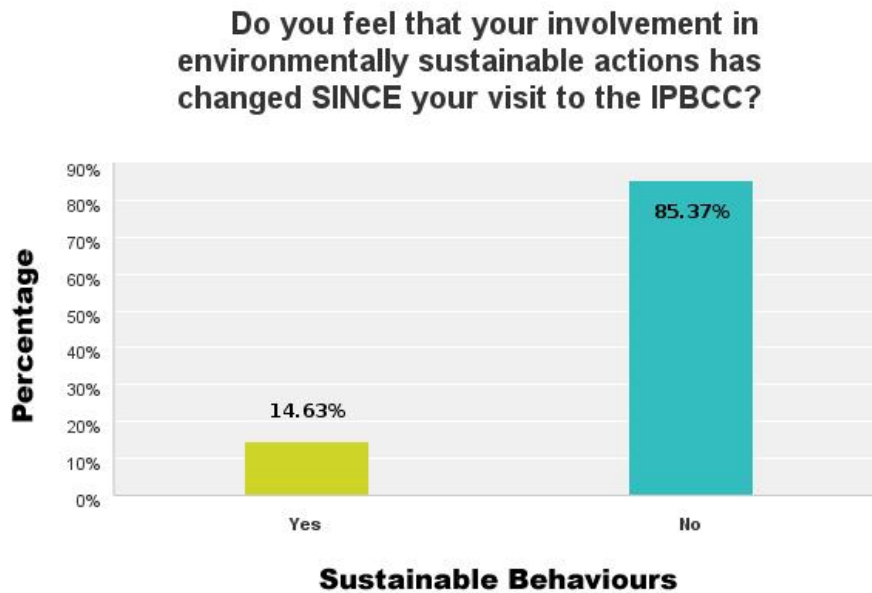


Figure 15. Post-PVAR perceived knowledge change for the control group.

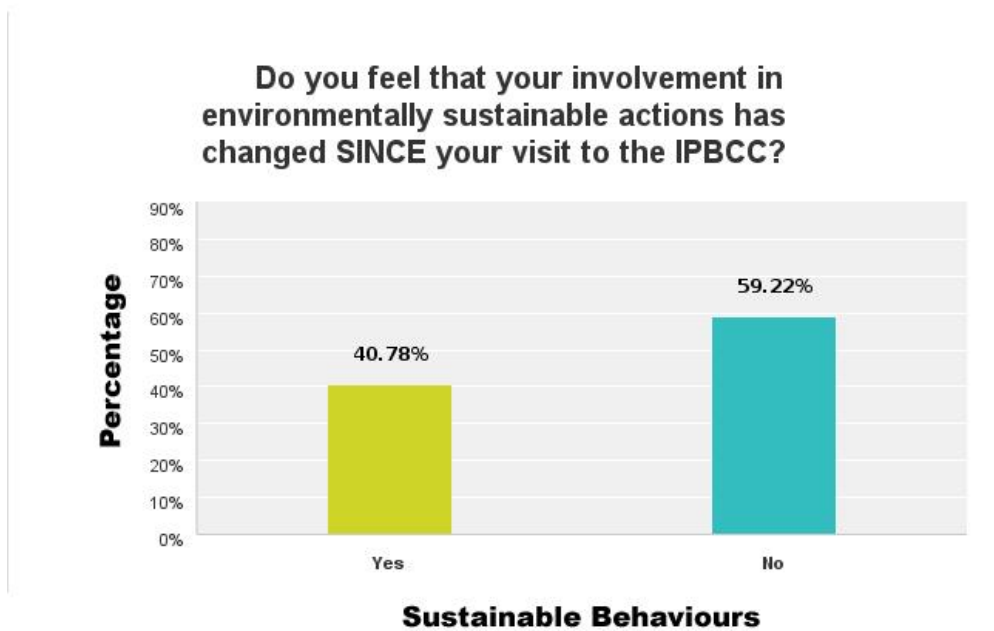


Figure 16. Post-PVAR perceived knowledge change for the treatment group.

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Extent of behaviour increase attributed to specific PVAR components.

The treatment group participants were asked to rate the extent of the impact that each aspect of the PVARs had on influencing, or not influencing, their sustainable behaviour change on a 5-point scale (1 = *Not at all* and 5 = *Extremely*). Based on the research conducted by Hughes (2011) the responses were grouped into categories of responses: *Not at all – Somewhat, Moderately, and Very – Extremely* (see Table 16). The PVAR component that was attributed to the greatest influence on behaviour change was the email from the researcher. The next most influential PVAR components were the other electronic resources: emailed fact sheets, links to more information, and the “Hudson Updates” (polar bear newsletter). The least influential aspects of the PVARs were the paper handouts about climate change and the paper-based facts sheets (see Table 16).

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Table 16

Treatment Group Participants' Perception of the Contribution of the PVARs to the Increase of Their Sustainable Behaviour

PVARs	Perception of contribution to behaviour change (%)				M	SD
	Not at all - Somewhat	Moderately	Very - Extremely			
Paper handout about climate change	34	26	10		2.15	1.070
Paper-based fact sheets	63.4	25.7	10.9		2.17	1.067
Emailed fact sheets	48.1	26	25.97		2.63	1.138
Email from the researcher	44.7	26.2	29.1		2.75	1.204
Hudson Updates	52.9	25.5	21.54		2.45	1.148
Links to more information	53.5	23.2	23.2		2.49	1.224

Note. Adapted from Hughes (2011, p. 75) and based on the scale 1 = *Not at all*; 5 = *Extremely*.

Sustainable behaviour change descriptions related to the IPBCC.

To understand how participants' behaviour changed since the IPBCC visit, all participants were asked questions about both changes to existing sustainable activities and new sustainable activities undertaken. Participants in both the treatment and the control group were asked in the questionnaire if they felt that their "involvement in environmentally sustainable actions has changed" since their visit to the IPBCC. The control group participants emphasized that they felt they were already doing a lot, or that their actions had remained the same. Several reported some small changes such as: "I'm

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more aware of the small things like turning electronics off when finished, and we've purchased a low flow toilet" (PMM 266); "It's made me want to get more involved in educating my children in environmental sustainability" (PMM 295); "Learning more about preserving my own home grown foods so I can be less dependent on store bought produce that is grown less sustainably" (PMM 003); "Trying to reuse and recycle even more...discussion about compost has also taken place in our home" (PMM 253).

The treatment group participants also felt that they were already doing a lot, and others stated that they were becoming more aware and conscientious, which led to a shift in mentality and a desire to teach their children. For example: "We've been driving fuel efficient hybrids for 11 years, upgraded our house, recycle and compost, etc." (PMMT 080); "Because I am more aware, I am trying to implement changes and teach my children" (PMMT 013); "I think twice before doing my daily actions. I think about the environment first" (PMMT 178); "More aware and found I was doing a lot of the right things before, just didn't realize they were the right things" (PMMT 287).

There were several participants who reported substantial changes in behaviour, some of which were specific to the PVAR resources. The following comments relate to the PVARs that focused on "Grow Your Own", "Buying Locally" and "Volunteering": "Going to try and plant a green house garden next year" (PMMT 349); "I am aware of the importance of buying locally and have done more of this. I have used my rain barrel water when available instead of the hose" (PMMT 198); I applied for volunteering in Churchill, at the Research Centre [Churchill Northern Studies Centre]" (PMMT 290); "Learning more about the polar bears allowed me to connect my actions to the lifestyle of the bears and see how my actions affected them" (PMMT 097).

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Participants in both the treatment and the control group were asked to describe any sustainable actions that they had begun since their visit to the IPBCC. Control group participants primarily reported no changes, or small changes like switching off the lights more often, recycling, or riding their bike. Several control group participants reported some broader and more challenging behaviour changes such as: “Being more conscience of my carbon footprint-trying to buy local where possible” (PMM 364); “Encouraging my kids to be aware of sustainability” (PMM 156); “I have brought my family to Fort Whyte Alive and want to participate in some of their fall programs” (PMM 295); “I have started to recycle again myself since I have my own house. Starting to prepare my garden for next year” (PMM 007).

Several treatment group participants stated that they were already doing most of the suggested sustainable actions, but there were still some things they improved upon. Some examples included the following: “Conscious of turning of lights, and not letting water flow as long. Looking to use less plastic, and reuse items when able to” (PMMT 346); “I notice more where I could actually do better” (PMMT 169); “Work harder at recycling at home and work, use more cold water instead of hot and not leaving electronics on” (PMMT 218).

Treatment group participants began some PVAR related behaviours after the treatment. As an example, in relation to “Grow Your Own” one participant: “Bought a rain barrel” (PMMT 026). Another participant “bought low flow shower head” (PMMT 008) in relation to the “Slow the Flow” PVARs. Some participants described an array of PVAR related behaviours: “I recycle more, I turn off all lights when I’m not in the room, I bike more rather than drive my car, I read and watch more educational products to learn

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more about the environment” (PMMT 209); “I'm going to try and buy more locally produced food. I might volunteer as well in the future” (PMMT 011).

Some of the most resource intensive activities that were described by the participants included: “Convert cabin to solar instead of a running a generator” (PMMT 349); “We went to the St Norbert Farmer's market and have found another source for meat other than Frigg's. Another local resource from a link provided in one of the emails” (PMMT 179).

All participants were asked to describe any sustainable actions that they had increased since their visit to the IPBCC. This question was intended to capture any behaviour changes that might not have been reported, as beginning a new behaviour does not encompass improving upon current ones. The control group primarily responded with no changes, or reported an increase in recycling. However, some individuals in the control group reported increases in specific behaviours such as: “Have increased emphasis on recycling as well as avoidance of pesticides and herbicides” (PMM 371); “Reducing the amount of water used for showers, laundry, dishes, etc. around the house” (PMM 364); “Use less water, more aware of energy consumption, talking about getting a clothes line” (PMM 307); “We make sure to compost everything and not waste. We recycle everything we get a chance to” (PMM 087).

The responses by treatment group participants indicated that either their sustainable behaviour did not increase, or they believed they had already described these actions in a previous question. Participants who had not indicated that they began any additional behaviours, here described specific PVAR behaviours that they had increased: “Buying locally grown food. Planting a vegetable garden” (PMMT 348); “Composting

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more, ensuring shutting off electronics when not being used” (PMMT 072); “I am more vigilant about recycling and I try to buy local produce when possible” (PMMT 200); “Larger carpool, more recycling/reusing, collected more rain water and more composting” (PMMT 352).

In response to increased behaviour since the IPBCC visit treatment group participants emphasized a heightened awareness:

“I actually found I turn the lights/electronics off when I leave the room now. Used to be more diligent about it but was slacking off. The exhibit was a nice reminder I should do it always not just sometimes” (PMMT 095).

The treatment group participants were asked to describe any sustainable actions that they had begun as a result of the PVARs. The treatment group participants’ responses emphasized that they felt they had already answered this question previously in regards to the impact of the IPBCC. However, several individuals now listed new behaviours that were not previously reported such as: “Planning to purchase an electric car for the family” (PMMT 178); “We began composting” (PMMT 033); “Composting (and) volunteer initiatives” (PMMT 097); “Turning off lights and electronics more. Farmer’s market shopping for local food” (PMMT 164). Other treatment group participants described an increased interest in a particular behaviour or related subject: “I have not begun new as such but I have put more interest in chemical free gardening” (PMMT 354); “Reading and watching more environmental material that educates me on the environment” (PMMT 209).

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The treatment group participants were also asked to describe any sustainable actions that they had begun as a result of the PVARs. Participants felt they had already answered this question in a prior response, which resulted in limited responses. The responses that were included for this question re-iterated participants' increase in recycling, using less electricity or water, riding their bike more, or buying locally produced food.

Qualitative interview responses for perceived behaviour change.

During the follow-up PMM interview participants were asked: "Do you have any comments about why your sustainable behaviours may or may not have changed since your visit?" The participants in the control group believed that they were already doing most of the sustainable behaviours recommended in the research. The open-ended nature of this question encouraged participants to explain why, or why they did not alter their behaviour. The control group cited a plethora of barriers such as their current setting (house or apartment), the weather, cost of environmentally friendly technology or cars, beliefs, difficulty of changing habits, and liking comforts (such as air-conditioning and SUVs), as the reasons for not changing their sustainable behaviours. Some individuals were very self aware and clearly articulated this finding:

Could I do more? Yes! Absolutely. But have I? Either I'm already doing it, or I'm lying to myself and telling myself that I'm doing enough. Like, people in general would like to think they're good and not the cause – including myself. People like to think that we're not wreaking the earth... A single snow-flake never believes they're part of an avalanche. (PMM 285)

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One control group participant explained how they felt they were already engaged in sustainable behaviours, but that their visit to the IPBCC had increased their awareness and helped them make the “...connection between global warming, animals, and my actions” (PMM 364).

As found in the questionnaire responses, the treatment group reported behaviour changes such as recycling, turning off lights, and other behaviours included in the PVARs. Treatment group participants elaborated on their responses to behaviour change and stated that there were small changes that related to their increased awareness.

I think it has a little bit. I'm not sure there has been a huge change, but more of a conscious effort to do the simple things like turning off lights. Like you become more educated and when you sit in front of a store and see 4 or 5 vehicles idling when its 25 degrees. Why is this happening? Obviously, they're running air conditioning. And now you see these things and it's just an awareness growing. (PMMT 201)

Participants attributed the PVARs to the reason for their behaviour change and described their impact as a tool for ideas of what to do to be more sustainable and reminders for putting these behaviours into practice.

Very slightly [increased behaviour], and probably just because I was getting weekly reminders about my daily behaviour and the things I could do a little bit differently and more of a regular conservation – like the questions posed in the emails and thinking about them. More of an awareness. (PMMT 196)

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It was very nice to get the emails, even if you didn't open them up it was a good reminder. [It was an] eye opener and a good reminder like someone is watching you. Really nice, especially over the summer – let things slide more over the summer. (PMMT 352)

I was actually pretty bad about leaving lights on and after the exhibit I've been better with this. Good reminder, to do things that don't seem important but do make a difference. [Prompted to find out what was a good reminder] Definitely from the emails I was getting from you [the researcher]. (PMMT 095)

In some instances the PVARs became a part of a weekly routine where the participants would read them together with their family: "...I've been trying to teach my kids a lot more. Like my son who wasn't with me on my trip to the IPBCC, and when you send the stuff online I read them to the kids" (PMMT 264).

For some participants they already demonstrated advanced levels of environmentally sustainable behaviour and found that the PVARs did not offer challenging enough suggestions, and for that reason they had not changed their behaviour: "Nothing more challenging in the post-visit activities. Spent last 18 years re-building and installing low-flow, more energy efficient everything. Solar heated and hybrid. Trying to be as good as possible" (PMMT 080).

Other participants related barriers as to why they did not change their behaviour, such as losing a loved one, not having access to a yard or garden, being too busy, seasonal difficulties, and that it is difficult to change your habits. Additionally, some

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participants indicated that while their behaviour did not change, the PVARs affirmed that they were doing the right things:

I wouldn't say I've done anything as a result of this study – some things I've already tried to implement (or have done those things) and were already in place before we talked. It was neat to hear another avenue and that I'm still on the right path. (PMMT 260)

Some participants described substantial changes in behaviour which were not directly suggested in the PVAR material, but which spawned from a piqued interest in relation to the PVARs and/or the visit to the IPBCC. As one participant explained:

Definitely changed my direction – thought pattern. Also got my kids off video games, they're thinking about different things. [Probing question about the impact of the PVARs] It's impossible to say if it was the post-visit questionnaire or activities, or the visit. But something helped me change my direction. (PMMT 349)

Particularly with the treatment group there was a strong theme recognizing that individuals can make a difference:

... I think a research project like this is an opportunity for change. The emails and you on the phone is a nudge, and it does – it makes these small ripples, that you'll never get to see, but it does make a difference! I'm really glad I got to participate, and thank you. (PMMT 204)

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“It was a reminder that even one person can make a change. All the volunteering opportunities that I wasn’t aware of and want to do now” (PMMT 290)

To conclude, while the quantitative analysis demonstrated that the six-targeted behaviours did not change significantly, the perceived measure of behaviour change indicated that the treatment group felt that they had increased their behaviours more than the control group. Additionally, the qualitative interview and questionnaire responses indicated that the treatment group demonstrated some behaviour change, and certainly a heightened awareness. For the control group there were also some behaviour changes, but these were not as common.

Research Question 3

How does post-visit free-choice learning relate to sustainable behaviour change, specifically, the International Polar Bear Conservation Centre at the Assiniboine Park Zoo?

To examine research question three, the relationship between post-visit free-choice learning and sustainable behaviour was examined. Change in learning was the independent variable and was based on the pre - post PVAR change in extent, breadth, depth, and mastery. The dependent variable was sustainable behaviour change and was based on a variable that calculated pre-post PVAR change for the six-targeted sustainable behaviours. A Pearson’s chi-square test for independence was conducted to determine significant differences between perceived measure learning and of behaviour change. Finally, the post-PVAR PMM interview question regarding what would help participants

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learn more to become more sustainable was assessed qualitatively using an open-coding constant comparison content analysis method. This method was employed to gain a more holistic understanding of why behaviour change and learning did, or did not, occur in relation to the IPBCC visit and the PVARs.

Table 17

Measures of Effect of Learning and Treatment on Behaviour Change

Analyses
Questionnaire
1) The effect of PMM learning change and treatment on behaviour change
2) The effect of post-PVAR perceived learning change on perceived behaviour change
PMM Interview
3) Improving post-visit learning and behaviour change (Interview Q3)

The effect of PMM learning change and treatment on behaviour change.

Multivariate ANOVAs were completed using the values for extent, breadth, depth, and mastery of learning as the independent variables in comparison with each possible behaviour change as the dependent variables. No significant differences in behaviours were found in relation to extent, breadth, depth, or mastery (see Table 18, Table 19, Table 20, and Table 21).

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Table 18

Differences Between Groups for Sustainable Behaviour Changes in relation to Extent of Learning

Behaviour	Group	Mean change		ANOVA	
		M	SD		Output
Slow the Flow	C	-0.600	1.826	Interaction ^A	$F(2, 47) = 0.906, p = 0.411, NS$
	T	-0.533	1.224		
Flick it Off	C	-0.120	0.600	Interaction	$F(2, 47) = 0.301, p = 0.735, NS$
	T	-0.100	0.803		
Volunteer	C	-0.600	1.384	Interaction	$F(2, 47) = 1.549, p = 0.223, NS$
	T	-0.100	0.922		
Double Up	C	-0.040	0.455	Interaction	$F(2, 47) = 1.699, p = 0.194, NS$
	T	0.033	0.615		
Buy Local	C	-0.280	0.792	Interaction	$F(2, 47) = 1.048, p = 0.359, NS$
	T	-0.367	1.033		
Grow Your Own	C	-0.880	1.856	Interaction	$F(2, 47) = 2.114, p = 0.132, NS$
	T	-0.467	1.548		

Note. ^AThe ‘Interaction’ effect represents the differences between the change in learning and the change in behaviour with the effect of the treatment and the control group.

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Table 19

Differences Between Groups for Sustainable Behaviour Changes in relation to Breadth of Learning

Behaviour	Group	Mean change		ANOVA	
		M	SD		Output
Slow the Flow	C	-0.600	1.826	Interaction ^A	$F(2, 51) = 1.216, p = 0.275, NS$
	T	-0.533	1.224		
Flick it Off	C	-0.120	0.600	Interaction	$F(2, 51) = 1.189, p = 0.281, NS$
	T	-0.100	0.803		
Volunteer	C	-0.600	1.384	Interaction	$F(2, 51) = 3.974, p = 0.052, NS$
	T	-0.100	0.922		
Double Up	C	-0.040	0.455	Interaction	$F(2, 51) = 0.931, p = 0.339, NS$
	T	0.033	0.615		
Buy Local	C	-0.280	0.792	Interaction	$F(2, 51) = 0.777, p = 0.382, NS$
	T	-0.367	1.033		
Grow Your Own	C	-0.880	1.856	Interaction	$F(2, 51) = 0.305, p = 0.583, NS$
	T	-0.467	1.548		

Note. ^AThe ‘Interaction’ effect represents the differences between the change in learning and the change in behaviour scores with the effect of the treatment and the control group.

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Table 20

Differences Between Groups for Sustainable Behaviour Changes in relation to Depth of Learning

Behaviour	Group	Mean change			ANOVA
		M	SD		Output
Slow the Flow	C	-0.600	1.826	Interaction ^A	$F(2, 50) = 0.065, p = 0.799, NS$
	T	-0.533	1.224		
Flick it Off	C	-0.120	0.600	Interaction	$F(2, 50) = 0.089, p = 0.766, NS$
	T	-0.100	0.803		
Volunteer	C	-0.600	1.384	Interaction	$F(2, 50) = 1.669, p = 0.202, NS$
	T	-0.100	0.922		
Double Up	C	-0.040	0.455	Interaction	$F(2, 50) = 0.846, p = 0.362, NS$
	T	0.033	0.615		
Buy Local	C	-0.280	0.792	Interaction	$F(2, 50) = 0.267, p = 0.608, NS$
	T	-0.367	1.033		
Grow Your Own	C	-0.880	1.856	Interaction	$F(2, 50) = 1.774, p = 0.189, NS$
	T	-0.467	1.548		

Note. ^AThe ‘Interaction’ effect represents the differences between the change in learning and the change in behaviour scores with the effect of the treatment and the control group.

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Table 21

Differences Between Groups for Sustainable Behaviour Changes in relation to Mastery of Learning

Behaviour	Group	Mean change		ANOVA	
		M	SD		Output
Slow the Flow	C	-0.600	1.826	Interaction ^A	$F(2, 51) = 0.092, p = 0.763, NS$
	T	-0.533	1.224		
Flick it Off	C	-0.120	0.600	Interaction	$F(2, 51) = 0.175, p = 0.678, NS$
	T	-0.100	0.803		
Volunteer	C	-0.600	1.384	Interaction	$F(2, 51) = 1.184, p = 0.282, NS$
	T	-0.100	0.922		
Double Up	C	-0.040	0.455	Interaction	$F(2, 51) = 0.985, p = 0.326, NS$
	T	0.033	0.615		
Buy Local	C	-0.280	0.792	Interaction	$F(2, 51) = 0.488, p = 0.488, NS$
	T	-0.367	1.033		
Grow Your Own	C	-0.880	1.856	Interaction	$F(2, 51) = 0.254, p = 0.616, NS$
	T	-0.467	1.548		

Note. ^AThe ‘Interaction’ effect represents the differences between the change in learning and the change in behaviour scores with the effect of the treatment and the control group.

The effect of post-PVAR perceived knowledge change on perceived behaviour change.

Participants' perception of their potential learning and sustainable behaviour change was measured with the questionnaire by comparing post-PVAR differences between the control group and the treatment group agreement or disagreement with the questions: "Do you feel that your involvement in environmentally sustainable actions has changed since your visit to the IPBCC?" and "Do you feel that your knowledge has changed since your visit to the IPBCC?". "Yes" responses were coded as 1, and "No" responses as 2. Pearson's chi-squared tests for independence demonstrated that there were significant differences between the treatment and control group ($\chi^2(1, N = 225) = 53.52, p < .001$).

Improving post-visit learning and behaviour change.

During the follow-up PMM interview both the treatment and control group participants were asked the following question: "Do you have any comments about what would help you learn more after your visit and help you become more sustainable?" The PMM interview questions permitted treatment group participants to express what aspects of the PVARs were effective in improving learning and sustainable behaviour change. Control group participants were able to make suggestions and provide ideas about what the Assiniboine Park Zoo could do to help them improve their learning and sustainable behaviour. Treatment group participants indicated that the most effective aspect of the PVARs for facilitating learning and sustainable behaviour change were the emails from the researcher. The emails were considered to be the most effective because they were considered to be personal, direct, easy to access, and acted as a reminder even if

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unopened. “Something through emails is better, because it’s coming at you and you don’t have to seek it. Website wouldn’t be as good because then you have to seek it” (PMMT 041). “Well I did find them very useful [the PVARs], I thought the emails were awesome and packed with information, and great references. It was a great refresher” (PMMT 172).

The next most effective aspect of the PVARs were the fact sheets, which were considered helpful as they provided evidence of why and how certain sustainable behaviours can make a difference. By having this information on hand it may be applied or contextualized within the participants’ life at a later point in time. “I did find the resources to be valuable and got my husband to read the hand-outs [fact sheets]. Like shutting off water, and lights – and showed him that there is proof that this makes a difference...” (PMMT 291).

I like the weekly stuff and it may not have applied to me, and then this week, ‘oh now I get it’. It just keeps it current. Either I understand something at a later time or the next week’s topic applies. Like: ‘Now I understand why’. (PMMT 260)

The treatment group emphasized a socio-cultural theme that described the importance of interacting and connecting with other people, which helped make climate change and sustainability relevant to the participants. Additionally, as in Hughes’ (2011) research, the PVARs were considered an enjoyable family activity – even something to look forward to. “The resources were good! It’s the power of story, that sure you sense some practical ideas in the resources, but it’s the story of how you can make a difference... that really makes a difference” (PMMT 204).

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Yes, the PVARs were useful and I would announce to kids that we got another email and make it a family thing... And we enjoyed it and we all gathered around the computer... the emails were something to look forward to, something new to learn. 'Look another email!' (PMMT 264).

The concept of PVARs had not been explained to the control group, yet when they were asked for suggestions about how to improve learning and behaviour change they responded with suggestions that emphasized resources that were very similar to the PVAR format, such as emails and other electronic sources. Some control group participants explicitly suggested providing zoo visitors with ideas about simple and easy things they could do to make a difference. For example: "Just easy tips to become more sustainable. Like, five minute ideas, quick, and easy tips... Email would be the best way to get that info" (PMM 312). "So little snippets of info and baby steps for people to get more information and extend on what they learned at the centre" (PMM 364).

In summary, both the control and treatment group participants emphasized that they were looking for additional resources from a single trustworthy source (such as the zoo) that would be electronically distributed. Participants recommended that the Assiniboine Park Zoo should use various electronic and social media platforms to distribute post-visit information in different contexts in order to maximize effectiveness and individual applicability. Additionally, some participants were seeking to interact and connect with others through stories and shared experiences.

Chapter 5: Discussion

The results revealed some significant relations between the treatment and learning and behaviour change, as well as between learning and behaviour change. The mixed methods results were contradictory in some instances and these findings are explored and discussed in relation to previous literature, theory, and practice. Each research question is discussed in turn with a summary of the findings and limitations provided.

Research Question 1

To address research question one, and assess how post-visit action resources (PVARs) affect free-choice learning after a visit to an environmental education centre, the mixed methods analyses included a quantitative and qualitative analysis of the personal meaning maps (PMMs). Additionally, one post-PVAR measure of perceived learning change was utilized to assess the validity of the findings, as well as PMM interview responses to add depth to our understanding of the research question results and context regarding why learning did or did not take place. This research demonstrated that the PVAR treatment improved free-choice learning after a visit to an environmental free-choice learning centre, specifically, the International Polar Bear Conservation Centre (IPBCC) at the Assiniboine Park Zoo.

The quantitative PMM analysis demonstrated significant changes in depth and mastery of learning for treatment group participants. Notably, both groups demonstrated some increase in all measures of learning change at the time of the follow up. The treatment group had significantly higher mean post-PVAR scores for measures of depth and mastery of learning. The lack of significant change in the breadth and extent of learning for the treatment group may be attributed to the relatively high breadth of

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learning demonstrated in the pre-PVAR scores. The lack of breadth change in learning could also be attributed to the fact that from the data there emerged only five breadth categories, and if the average breadth response was 3.7, which is already quite high, this may have resulted in the ceiling effect (where high pre-scores result in indistinguishable changes). The treatment group's lack of increase in breadth of learning may also have been the result of no additional breadth in learning, which would mean that the PVARs were ineffective in increasing visitors learning broadly about climate change and environmental sustainability. For extent of learning, due to the variability and high volume of the data, responses were grouped into ranges and expressed numerically, whereas ungrouped responses may have demonstrated more discernable differences. Unfortunately, analyzing the extent scores as grouped responses was necessary, as it was not logistically possible due to the complex and overlapping nature of responses in regards to analyzing and distinguishing distinct phrases, images, and words. As with the lack of change relating to breadth of learning, the treatment may have been ineffective in increasing the overall extent of learning about climate change and sustainability. This may be due to participants already being quite knowledgeable, or the PVARs not being sufficiently challenging. Interestingly, this could demonstrate the type of learning that is taking place. Rote learning is defined as recalling information (extent and breadth) and meaningful learning is defined as being able to apply what was learned and gain a deeper understanding of a concept (depth and mastery) (Mayer, 2002).

The fact that both groups increased their mean learning in general, and that the treatment group demonstrated significantly more learning, supports the concept of learning being both a process and a product, in that learning changes over time and often

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requires reflection (Falk & Dierking, 2000). In particular, reinforcing experiences after an initial visit will help increase depth and mastery of learning, as supported by the contextual model of learning (CML) (Falk & Dierking, 2000). Additionally, the increase in depth and mastery of learning for the treatment group participants demonstrated that PVARs have a positive affect on meaningful learning after a free-choice learning experience. This supports previous research that has suggested that PVARs are an important component of free-choice learning within the context of reinforcing experiences (Hughes, 2011; 2013; Hughes et al., 2011).

The qualitative analysis of the PMMs revealed that the post-PVAR responses provided by the control group demonstrated uncertainty about what sustainable behaviours are effective and identified barriers they faced for becoming more sustainable. Conversely, the treatment group emphasized solutions for becoming more environmentally sustainable and raised concerns about the lack of awareness and need for educating others about climate change and sustainability. Interestingly, both the treatment and control groups had discussed environmental and human impacts more in the initial PMM. This finding is may be attributed to the participants' recent visit to the IPBCC, as the pre-PVAR data collection took place immediately after the visit, which may have encouraged human and environmental impacts to be at the forefront of their thoughts. While both the treatment and control groups did not emphasize human or environmental impacts in the post-PVAR PMM, these impacts were particularly absent from the treatment group responses. This suggests that the treatment group shifted their focus to sustainable solutions rather than environmental issues. This is interesting, as a primary aspect of community-based social marketing (CBSM) states the need to address

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barriers for people to overcome issues to become more sustainable (McKenzie-Mohr, 1999). Through this qualitative analysis we can see the conceptual focus on barriers by the control group, and solutions (over-coming barriers) by the treatment group. This finding supports the use of CBSM as an effective approach for addressing sustainable behaviour change within the context of environmental free-choice learning. Additionally, the treatment group's emphasis on solutions demonstrates transfer of learning, which also supports the fact that meaningful learning was facilitated by the PVARs.

The nature of the treatment group's post-PVAR responses included environmental impacts that were temporal and large scale in nature, suggesting that there had been a shift to an increased understanding and conceptualization of the long-term environmental impacts of climate change. Here, treatment group participants noted the importance of the connection to polar bears in Manitoba in gaining understanding. This finding is also supported by recent research conducted in zoos which found that having a connection to charismatic species helps individuals understand their role regarding climate change (Clayton et al., 2013; Grajal et al., 2012; Lubeke, 2012). Also, the importance of local connections is consistent with the research by Ardoin and Heimlich (2013) who stated that localized contexts are essential for engaging people in environmental conservation. Indeed, this research supports that free-choice environmental learning is enhanced when people can connect with local wildlife and environments to contextualize their learning within their own lives.

Learning change was examined using participants' post-PVAR perceptions of their changes in learning. These findings demonstrated that the treatment group had significantly more perceived knowledge change than the control group since their initial

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visit to the IPBCC. This finding is consistent with the research conducted by Hughes et al. (2011) and provided supporting evidence of the PMM analyses by demonstrating that PVARs had a positive impact on the treatment group's perceived learning. This is an interesting finding, and it may be argued that perceived learning changes can be just as important as objective measures of learning, as they empower people and give them the confidence to act and put their learning into practice (Rennie & Johnston, 2007). This also suggests that learning can be conceived in different ways: as both a process and a product. As emphasized by Adams, Falk, and Dierking (2003): "attention needs to be given to how visitors integrate the experience with the rest of their life and that requires an interval of weeks, months, and sometimes, years" (p. 20). This finding supports the concept of learning as an ongoing process rather than a product, and suggests that measurement at different intervals in time may result in discernable changes in learning. Perhaps learning needs to be viewed and measured as an ongoing journey rather than a destination.

Post-PMM interview questions regarding learning change revealed more information about why participants believed their learning did or did not change. The control group's responses emphasized that their learning had not changed because they had not been exposed to any additional information on the topic. The qualitative interview data revealed that treatment group participants felt they already had a very high level of knowledge. This interview data further supports that the high level of pre-PVAR knowledge could be why the changes for extent and breadth of learning were not significant. Additionally, research suggests that environmental messages are often insufficiently challenging for some visitors (Falk, 2005; Rennie & Williams, 2006).

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Although the PVAR resources were designed to include some more challenging topics, the PVARs did not seem to be challenging enough for some participants with high levels of prior knowledge.

While treatment group participants did not always feel they had explicitly increased their learning, there was a distinct increase in their awareness of sustainability and climate change. The increase in the participants' awareness was primarily attributed to the PVARs, which were found to act as a reminder or tool for further engagement. This finding supports the concept of using PVARs as prompting tools, as recommended by CBSM (Hughes, 2011; 2013; Hughes et. al., 2011; McKenzie-Mohr, 1999). Furthermore, the qualitative interview data provided interesting insights into barriers for learning, where the control group expressed needing an intervening opportunity to learn more about the topic. Interestingly, some control group participants demonstrated a substantial increase in learning, which could be due to these individuals having high levels of interest in the topic. This supports prior research that claims that interests and motivations play a significant role in free-choice learning, which appeared true for these individuals who demonstrated increases in learning regardless of their group assignment (Falk & Aldeman, 2003; Falk, Scott, Dierking, Rennie & Cohen Jones, 2004).

Some participants added to their PMMs (demonstrating an increase in learning) and yet, reported no changes in their learning. This seemed to be a common theme for some participants who expressed no changes in learning, and yet, they provided more complex responses of their learning about environmental sustainability, which was particularly true of the treatment group. This discrepancy between responses could be attributed to how free-choice learning is conceptualized and acknowledged by

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individuals: as awareness, sensitivity, or explicitly as learning. Free-choice learning is open-ended and acknowledged to be both a process and a product, however, learning could be perceived in the traditional sense by participants as having specific, and tangible points of increase which could result in conceptual variation (Falk & Dierking, 2000).

While research calls for broad definitions in learning (Falk et al., 2004), researchers must ensure that they understand how participants may conceptualize definitions of learning in different ways. The qualitative analysis of the interview questions supported the quantitative findings in that the PVARs have the capacity to facilitate further learning about a specific topic in greater detail. As the participants in this study were found to be quite knowledgeable about the topic, this would seem to be an excellent way to encourage additional learning on a more challenging level for those who are interested.

To summarize, the PMM analyses revealed that the treatment group demonstrated that PVARs encourage deep and meaningful learning as represented in the depth and mastery scores. Through the qualitative analysis the treatment group participants demonstrated their ability to identify and discuss sustainability solutions and large-scale climate change issues, whereas the control group emphasized barriers to becoming more sustainable. This finding provides evidence of the importance of addressing barriers and benefits as recommended by CBSM (Hughes, 2011; 2013; Hughes, et al., 2011).

Additionally, the treatment group included comments directly relating to the PVARs, which demonstrated rote learning in terms of recalling the PVAR specific, and even IPBCC specific, concepts. This demonstrates the potential of PVARs to enhance knowledge retention and build upon learning that took place during a visit. This finding also supports and enforces the CML, as PVARs were found to be important for

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reinforcing experiences within the learning process. The positive effect of PVARs on learning was supported by the measure of perceived learning, which demonstrated that treatment group participants felt their learning had changed more than the control group participants and suggests consistency with other PVAR research (Hughes, 2011; 2013; Hughes et al., 2011). The interview responses also revealed that the control group participants felt that their learning had not changed because they had not been exposed to any additional information, which supports the need for the PVARs. The treatment group responses revealed that they felt they already had a very high level of knowledge, which could have contributed to the lack of change for extent and breadth of learning. Conversely, the lack of change for the extent and breadth of learning may have been due to the participants not learning additional information, which suggests that either rote learning did not occur or that post-visit information needs to have a broad range and breadth of information. Additionally, the treatment group felt that they had gained more of an increased awareness as opposed to increased learning. However, there appears to be some discrepancy with how learning change was perceived by participants, which may be a conceptual issue when measuring free-choice learning. To conclude, from this research PVARs have been found to positively affect free-choice learning after a visit to the International Polar Bear Conservation Centre at the Assiniboine Park Zoo.

Research Question 2

To address research question two, and assess how post-visit action resources affect sustainable behaviour change after a visit to an environmental education centre, the mixed methods analyses included a quantitative analysis of pre- and post-PVAR measures of six-targeted behaviours, a post-PVAR measure of perceived behaviour

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change, qualitative analyses of related questionnaire responses, and a PMM interview question analysis to add depth to the findings and determine changes in behaviour. The findings revealed that the six-targeted sustainable behaviours did not improve with the PVAR treatment, and yet the perceived measure of behaviour change demonstrated that participants felt their behaviour increased significantly, as does the qualitative analysis of the questionnaire and PMM interview data. These contrasting findings are explored and discussed in regards to current literature, theory, and application.

The results of the pre- and post PVAR quantitative analysis of the six-targeted sustainable behaviours indicated that there were no significant differences for any of the behaviours. Interestingly, the perceived measure of behaviour change indicated a significant difference between the treatment and control group. This finding demonstrated that the treatment group participants felt that their environmentally sustainable actions had increased, despite the fact that the six-targeted behaviours showed no significant changes. This is remarkable, because only one of the measures in the Hughes et al. (2011) research was found to have changed significantly. Hughes et al., (2011) hypothesized that there was only one significant difference because of a public campaign that affected the other behaviours targeted and influenced the control group. The quantitative findings of the six-targeted behaviours are consistent with Hughes et al.'s (2011) findings and suggest that either behaviour change did not predominantly focus on the six-targeted behaviours, or did not occur, even though participants felt that it had.

As found by Stern et al. (2013) there are several common concerns of environmental education measurement, such as: issues with the instruments used in

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measurement (unable to detect changes), ceiling effects, as well as “ small sample sizes, vaguely worded survey items, unaccounted-for confounding factors, and social desirability bias (the case in which respondents select the answer they feel the surveyor is seeking, rather than that reflecting their true feelings)” (p.8). However, the sample size was large, survey wording was adapted from previous research, and potentially confounding variables were taken into account. Social desirability bias could be an issue, but should have affected the control and treatment group equally. It may be that the treatment was insufficient, but the face validity from the perceived measures and qualitative questionnaire and interview responses suggested that the treatment was sufficient. This means that either the instrument was insufficient to measure behaviour change effectively due to the ceiling effect, which seems unlikely considering that some of the six-targeted behaviours were reported to be infrequent, or that behaviour change was broader than the six-targeted measures and therefore failed to be detected with the survey instrument. In regards to the validity of the findings, either the perceived measures of behaviour change more accurately portrayed the participants’ behaviours, or inaccurately reflect actual behaviour. It seems probable that the survey instrument may have failed to detect that participants improved their sustainable behaviours in ways that were not targeted in the survey. Recently, Stern et al. (2013) reviewed environmental education research published between 1999 and 2010 and found that many of the studies published during this time period were questioning if environmental education is working, or if we are failing to measure learning and behaviour changes effectively. Stern et al. (2013) further recommended using control groups in future research,

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...and/or using retrospective qualitative interviews to contribute to the overall effort of understanding not only if EE [Environmental Education] works, but also why and how it works. We also urge researchers to broaden the suite of outcomes typically measured and to explore new ways of empirically measuring behavioural change more directly. (p. 23)

This research included a control group and the results still revealed a lack of behaviour change despite perceived behaviour change. If any behaviour change was taking place and the survey instrument was unable to detect it, the qualitative responses become increasingly important for answering this research question, as they are receptive to broader outcomes. However, it may be that sustainable behaviour change is not taking place and that participants instead perceive that there is change when there is not, as self-serving bias would suggest (Van Winkle & MacKay, 2008). As this is a common problem within environmental education research, further research is required to determine if there are differences between perceived and actual changes in behaviour in relation to environmental education.

It is important to note that the perceived measures of behaviour change on the questionnaire and PMM interview responses are supportive of one another. This demonstrates that the smaller sub-sample of PMM participants is reflective of the larger sample of all treatment group participants. The post-PVAR questionnaire data inquired about participants' behaviour changes relating to their visit to the IPBCC. Participants felt that they were already engaging in sustainable behaviour, but that the IPBCC helped them become more aware and conscientious. This finding is consistent with current climate change and sustainable behaviour research in zoos, which found that visiting a

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zoo or aquarium had a positive impact on attitudes regarding climate change (Clayton et al., 2013). In regards to behaviours begun since the IPBCC there were some substantial changes and both groups reported some actions begun as a result of the original visit to the IPBCC, but participants primarily emphasized improving on sustainable behaviours that they were already doing. Even though the majority of behaviours relating to the IPBCC were ones that participants were already doing, confirmation and support of behaviours that people are already doing is an important part of and role for zoos in environmental education and sustainable behaviour change (Luebke et al., 2012). Additionally, recent environmental education research conducted by Ardoin and Heimlich (2013) emphasized the importance of engaging key audiences, in this case the individuals that demonstrated significant changes, as they will play an important role in facilitating behaviour change for others.

The treatment group reported on improving PVAR specific behaviour, which suggests that there was some evidence that PVARs influenced sustainable behaviours. Interestingly, the most difficult or substantial behaviour changes reported by the treatment group were not related to the PVARs, which suggests that learning transfer (meaningful learning) took place and helped the treatment group participants translate this information and apply it in their lives. This finding suggested that, as theorized by Stern et al. (2013), environmental behaviour change might tend to have a very broad range of outcomes that may not be detectable by narrower means of measurement. Additionally, the goal of sustainable behaviour change is often recommended to facilitate meaningful and individualized change related to one's life (Ardoin & Heimlich, 2013; Ballantyne et al., 2007; Falk, 2005; Rennie & Johnston, 2004); yet, the methods often

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utilized in this field of research have often failed to take this recommendation into account when attempting to measure behavioural changes (Stern et al., 2013).

The post-PVAR questionnaire data also assessed any increases in sustainable behaviour, as well as behaviours begun since participants' visit to the IPBCC. There were some changes reported and some increase in behaviours that were not previously reported. These questions were designed to help determine any distinctions between behaviour change related to the IPBCC, the PVARs, and increases in current behaviours versus beginning new behaviours. However, the similarity of these questions was likely confusing for some participants from both the treatment group and control group, as they responded that they felt they had already answered that question in an earlier version. However, participants who had previously reported no changes provided some new answers for this question. These findings suggested that the wording, order, and context of behaviour change questions must be clear, concise and all encompassing with as little room for overlap as possible. This is a common issue in environmental education research, and Stern et al. (2013) identified that vague questions often contribute to measurement concerns.

Finally, the treatment group participants were asked if they had begun any sustainable behaviour because of the PVARs. Here the treatment group demonstrated some substantial changes in behaviour, such as composting and volunteering, and an improved interest in some of the topics in general. However, overall the treatment group participants reported that the PVARs had primarily increased their awareness and piqued their interest rather than generating any specific behaviour changes.

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To summarize, based on these responses it can be concluded that some behaviour change, or increase in current behaviours took place for both treatment and control group participants after their visit to the IPBCC. While it was unclear from participants' responses whether or not this was attributed to the PVARs, the treatment group placed a greater emphasis on sustainable behaviour changes and reported several substantial instances of significant behaviour change – the equivalent of which was not found in the control group. Therefore, it can be concluded that the PVAR treatment had some positive impact on broad sustainable behaviour change outcomes as demonstrated by the qualitative analyses, but the six-targeted behaviours were not affected by the PVARs.

Additionally, interest in the topic was perceived to be an important aspect of behaviour change, as well as the importance of connecting through the animals at the zoo to understand the importance and applicability of the topic. This finding is supported in the research conducted by Clayton et al. (2013), who found a correlation between a connection to animals and improved attitudes and behaviours related to climate change. This finding supports the importance of prior interest and motivation for behaviour change (Falk et al., 2004; Falk, Heimlich, & Bronnenkant, 2008). As supported with the questionnaire responses, treatment group participants emphasized that their awareness had grown, rather than explicit behavioural changes. Treatment group participants also highlighted that the PVARs were good reminders that helped facilitate family interaction about the topic, and generated a routine with the weekly emails. This is an important finding, as it confirms the role PVARs play as reinforcing events within the CML (Falk & Dierking, 2000), prompts within CBSM (McKenzie-Mohr, 1994), and their ability to contribute to routine and habit formation, which are aspects that are acknowledged to be

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important in behaviour change, but unaccounted for in the theory of planned behaviour (Ajzen, 2011).

Some treatment group participants reported that they had not changed because they already felt that they were doing the maximum that they could, or that personal or health issues in their lives prevented them from participating in the suggested behaviours at the moment, but that they would be interested in the future. These findings relate to the importance of interests and motivations, as well as timing, for visiting the zoo (Falk et al., 2004; Falk et al., 2008). One respondent indicated that while they believed they had experienced a change in behaviour they did not feel comfortable stating that it could be specifically attributed to the PVARs, or the IPBCC, but that it was a collective change and that of these experiences may have contributed. While this does not necessarily support the role of PVARs explicitly, it does demonstrate that this participant recognizes that the visit, PVARs, and other experiences may have contributed to their behaviour change and provides further evidence and support that the CML is an effective model for understanding sustainable behaviour change and learning (Falk & Dierking, 2000; Hughes, 2011; 2013; Hughes et al., 2011).

Some behaviour changes, such as installing solar panels at a cabin (PMMT 349), demonstrated learning transfer. PVARs were found to help facilitate learning transfer, as participants explained that their learning and interest had been piqued at the zoo, and through the emails they were reminded of this new information and provided with details for how to apply it in meaningful ways in their lives while gaining an increased awareness. This is an important finding as it demonstrates the PVARs to be effective as post-visit learning experiences in reminding visitors of the initial experience and

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prompting them to act, as per CBSM (Hughes et al., 2011; McKenzie-Mohr & Smith, 1999). Interestingly, while there were more responses from the treatment group that indicated an increase in sustainable behaviour, the control group demonstrated several unique and personalized ideas, such as using a clothesline. This suggests that while PVARs should be specific they should also encourage creativity and individualization to maximize sustainable behaviour change. This is consistent with the CML, which demonstrates that learning occurs in personal, socio-cultural and physical contexts, which are highly idiosyncratic in nature (Falk & Dierking, 2000).

To conclude, while the results are conflicting, the qualitative results suggest that PVARs have some positive effect on sustainable behaviour change after a visit to an environmental education centre, specifically, the International Polar Bear Centre at the Assiniboine Park Zoo. However, the PVARs did not have an affect on the six-targeted behaviours in the quantitative analysis. As suggested in recent literature, this may be a problem with measuring a broad concept narrowly, which cannot detect small changes or increases in sustainable behaviour (Stern et al., 2013). More research will be required to determine if this is the case. Interestingly, while the PVARs did not significantly alter the quantitative measurements of the six targeted sustainable behaviours and learning, qualitative results revealed that there was a change in understanding and *awareness* in regards to climate change and sustainable behaviours. It may be argued that while the PVARs may not have altered learning and behaviour in the way that was expected, increasing awareness and changing behaviours (even untargeted ones) are just as important outcomes. The ability to apply this information and translate it to one's life in a tangible way is ultimately the goal of environmental and conservation free-choice

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learning regarding sustainability. This is consistent with research that suggests that environmental free-choice learning should focus on helping visitors achieve their expected learning goals, rather than the centre's pre-determined goals (Falk & Storksdieck, 2010; Heimlich & Horr, 2010; Heimlich & Meyer, 1999; Murray, 1995).

Visitors' individual identities need to be addressed, as this research demonstrates. The participants were interested and engaged in sustainable behaviour changes, but in many personalized and individual ways, which did not always align with the six-targeted behaviours. Environmental learning centres should focus on their role as facilitators for individuals to participate in learning and behaviour change and must address individual learners in regards to prior knowledge, interests, and motivations (Falk & Aldeman, 2003; Falk et al., 2004; Schultz & Joordens, 2013; Storksdieck et al., 2005). To conclude, from this research PVARs were found to have no significant impact on the six-targeted sustainable behaviours, but did have an impact on perceived behaviour change, as well as some impact on awareness and sustainable behaviours not focused on in the research.

Research Question 3

In examining how learning relates to behaviour change, the extent, breadth, depth, and mastery of learning were analyzed for any possible impact on the six-targeted behaviours. None of the four measures of learning were found to relate to any of the six-targeted behaviours in a significant way. This is not surprising since the six-targeted sustainable behaviours failed to show any significant interaction effect with the treatment over time. Therefore, it was improbable that any particular aspect of learning would be related to this measure of behaviour change.

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The effect of perceived learning on perceived behaviour change was examined and it was found that there was a significant difference between the treatment and the control group. Greater perceived learning was related to greater perceived behaviour change. This poses the question as to differences between actual and perceived measures of learning and behaviour change. Perceived measures can be important, as research has demonstrated the importance of personal affirmation and individuals' locus of control for encouraging learning and behaviour change (Ardoin, 2009; Ballantyne et al., 2011; Heimlich & Ardoin, 2008; Storskdieck et al., 2005).

The post-PVAR PMM interview question asked all participants what could be done to help them improve their learning and behaviour change. This open-ended question was designed to gain an understanding of what participants felt was effective for improving their learning and sustainable behaviour and to capture a wide array of responses in order to better understand why learning is, or is not, related to behaviour change and what can be done to move forward. Treatment group participants felt that the emails were most effective, and that complementing this with various forms of social media would be beneficial since these methods act as quick and easy reminders in various formats. This supports the research that suggests using various forms of communication and prompts are effective ways to improve sustainable behaviour change (Hughes, 2011; 2013; Hughes et al., 2011; McKenzie-Mohr, 1999). Additionally, this finding also supports the effectiveness of PVARs as reinforcing experiences within the physical context of the CML (Falk & Dierking, 2000). The treatment group also described how the PVARs helped them to contextualize the topic in their own lives and suggested that stories can be a powerful way to connect people to a topic. The PVARs were also

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described as a means to facilitate family interaction and routine, where participants would gather with their families to read the weekly email. This suggested that PVARs can be a way to enhance and extend the initial on-site experience as well as help contribute to meaningful learning and behaviour change over time, as supported by the CML in relation to reinforcing experiences (Falk & Dierking, 2000). The control group was also asked this question, and notably, participants stated that they needed simple and easy ideas of things they could do. This further supports the intuitive need for reinforcing resources, such as the PVARs. Some participants also suggested that the zoo could act as a physical (in the form of an events board) or electronic hub of information and events – a centralized and neutral space to disseminate information.

The participants described how they often applied or understood the IPBCC and PVAR information at a later point in time. This is an important finding as it supports the need for PVARs to contribute to learning as a reinforcing event. As posited by the CML, learning changes over time and often requires real-life situations to occur before it can be contextualized within one's life (Falk & Dierking, 2000; Rennie & Johnston, 2004). Additionally, as in Hughes' (2011) research, the PVARs were considered an enjoyable family activity and something to look forward to which suggests that PVARs can *enhance* and *extend* the initial on-site experience for some visitors.

In summary, the quantitative measures of free-choice learning did not relate to behaviour change. However, perceived free-choice learning did relate to perceived sustainable behaviour change and both control and treatment group responses indicated that ways to help them improve their learning and behaviour change appeared to be interrelated. It is indeterminate if these results are indicative of the differences in

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measurement or differences in participants' actual and perceived responses. As methods for measuring free-choice learning are considered most effective when they “emphasize validity over reliability” (Adams et al., 2003, p. 18), it can be argued that by measuring learning and behaviour change both qualitatively and quantitatively, with a variety of questions and approaches, that validity is enhanced. Questions of reliability are most important when attempting to apply the results from this study to other contexts.

However, individualization and location specific advice for sustainability research is necessary. Therefore the results of this study may not be generalizable to other contexts. To conclude, these findings demonstrate that PVARs, as reinforcing experiences, can be advantageous for learning and some sustainable behaviour change. However, since there was no relation between measures of learning and the six-targeted behaviours, how environmental learning and sustainable behaviour relate to one another at an individual level could be highly dependent on individual motivation and perceptions, which may vary (Falk et al., 2004; Falk et al., 2008).

Summary

As demonstrated through the research findings, by encouraging learning across all components of the CML, particularly through reinforcing experiences such as PVARs, learning could be improved upon after a visit and meaningful change in terms of increased sustainable behaviours was possible. Learning must not be considered an experience that takes place only on-site, but must be recognized as both a product and a process that continues even after passing through the gates of the zoo. Visitors are increasingly looking for experiential learning opportunities and post-visit engagement is one way to improve free-choice learning, behaviour change, and the overall visitor

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experience (Ballantyne & Packer, 2011; Carr & Cohen, 2011; Hughes et al., 2011; Hughes, 2013.) Additionally, as this research supports, learning is considered enjoyable and PVARs can add to this aspect of the experience by increasing social and personal engagement and challenges after the initial visit (Packer & Ballantyne, 2004).

PVARs were found to be important for reinforcing information and addressing barriers and benefits, and supported CBSM as an effective approach for environmental education learning and some behaviour change. This research also demonstrated that PVARs were not effective in improving the six-targeted sustainable behaviours, but they were effective in positively increasing awareness and perceived behaviour change of treatment group participants and impacting broader sustainable behaviours. This has important implications for recommendations regarding measurement of sustainable behaviours in environmental free-choice learning contexts, as outcomes must be broad without becoming vague and immeasurable (Stern et al., 2013). Additionally, while there was no relation between the extent, breadth, depth, and mastery of learning and the six-targeted sustainable behaviours, there was a relation between perceived learning and behaviour change. Interview responses support that there was some relation between learning and behaviour change and that awareness and individuality impact how these variables interact. These findings support the understanding that how individuals learn and engage meaningfully in environmental sustainability is highly idiosyncratic, and supports the need for research and practice that addresses individual awareness, interests, prior knowledge, and motivations (Falk & Dierking, 2000; Falk et al., 2004; Storksdieck et al., 2005). To demonstrate the effect of PVARs on learning and behaviour change, with the added component of awareness, the theoretical model developed by Ballantyne

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and Packer (2011, p. 211), which described the role of PVARs and visitors' environmental learning and sustainable behaviour, has been adapted (see Figure 17). The original model by Ballantyne and Packer (2011) did not overtly address learning change. This adapted model presented here demonstrates the research findings, which indicate that PVARs contribute to increased learning and possible increases in sustainable behaviour change.

As demonstrated by this model, this research has added knowledge about the role of awareness in relation to learning, and demonstrates that further research is needed to determine the role of awareness on learning and behaviour change when PVARs are not distributed. Additionally, this model addresses the fact that some individuals demonstrated learning or behaviour change (or lack thereof) regardless of their group assignment (see Figure 17). This indicates that future research needs to address the role of prior interest, motivation, knowledge, awareness, and other individualized characteristics in relation to PVARs and the effects of learning and behaviour change.

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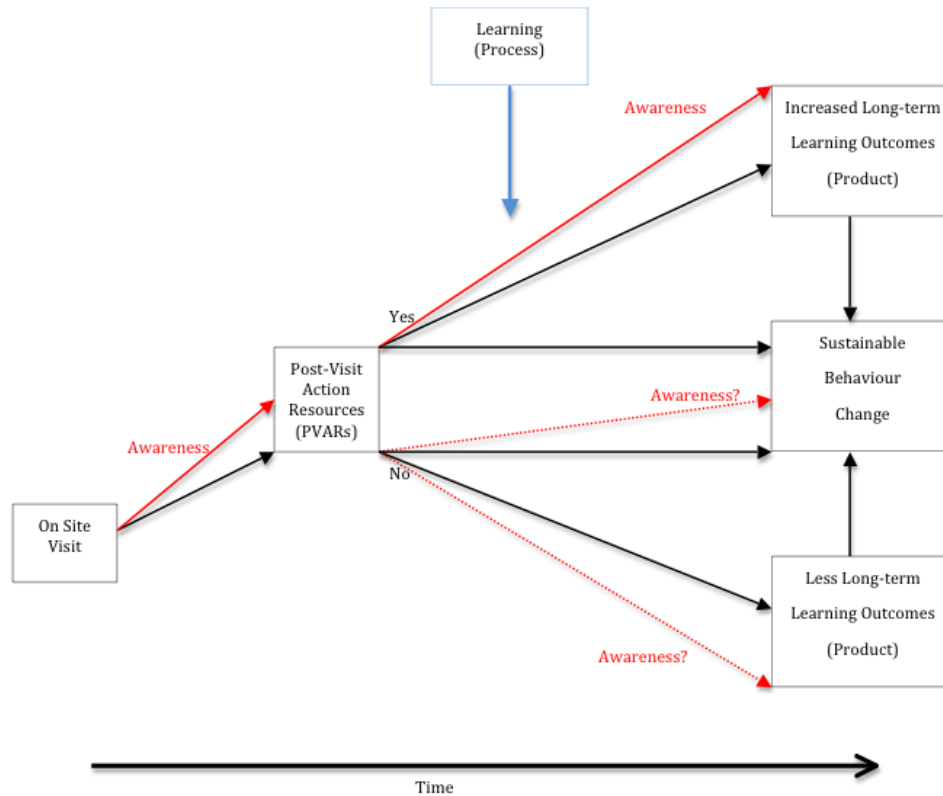


Figure 17. The affect of PVARs on learning and behaviour change. Model adapted from Ballantyne and Packer (2011, p. 211).

Limitations

This study involved measuring learning and behaviour change using PMM interviews and pre-post questionnaire responses. While these tools have often been used in free-choice learning contexts, learning and behaviour can be measured with a myriad of methods and depending on the measures and methods used, the results of the study may vary. Due to time and resource constraints, additional measures of learning and behaviour change to improve reliability were not possible. By using PMMs ceiling

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effects for knowledge were addressed, but this could still have been an issue as high levels of prior knowledge or sustainable behaviour could result in little change in learning or behaviour. Another limitation of the study was that it only included adult participants. Children can play an important role in family learning and the uptake of behaviours (Hughes, 2011; 2013; Hughes et al., 2011). However, the purpose of this study was to examine adult learning and behaviour change and therefore children were not included in the sample. Behaviour change and learning are both extremely complex and difficult to measure and even the best estimates of reality may fail to capture all the subtle nuances of life that can play a role in learning and behaviour change. Additionally, self-reporting measures for behaviour change can be controversial, yet self-reporting was the only viable option for the study and would affect both groups equally. While social desirability bias may have been a factor, this was minimized by using participant facilitated questionnaires, ensuring maximum privacy during the data collection, providing online follow-up questionnaires, and re-iterating the purpose of the research was to seek honest responses, rather than a particular response (Stern et al., 2013).

There is also the possibility of response bias in terms of participants who agreed to be in the research study and those who completed the follow-up research. The large sample size and experimental design attempted to mitigate these effects as much as possible, however, it should be noted that there were fewer treatment group participants who completed the post-PVAR research than control group participants. Statistical analyses demonstrated that this resulted in some response bias for age and education, where treatment group participants who completed the post-PVAR component of the research were older and more educated than the control group, and had more perceived

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knowledge and interest about some of the topics. However, while these response biases must be acknowledged they were not significantly correlated to the variables examined to address the research questions and therefore should not have significantly influenced the treatment group responses.

Due to the scope of this research, and funding and personnel constraints, it was not possible to collect pre-IPBCC visit data. It would have been informative to learn what people know before, as well as after a visit to the IPBCC. However, previous research suggests that visitors typically increase their learning by visiting interpretive centres, and the purpose of this research was not to examine learning from interpretive centres. Additionally, due to the proximity and immediacy of the data collection participants often specifically referenced knowledge they learned from the centre that they did not know before. If a topic was included on a PMM and was suspected to be specific to the centre, this information was obtained during probing questions. For example, there is a video in the IPBCC which shows the changes in Arctic ice from the past until 2040 and if these specific facts were referenced, probing questions addressed whether this came from the IPBCC or not. This was not considered problematic to the data collection, but an aspect that needed to be addressed to further understand learning change. There could also have been other intervening treatments, such as an increase in recycling advertising, or other personal experiences that may have influenced behaviour and learning. Arguably, these variations impacted both the treatment and control groups and did not alter the findings.

The PVARs could also have been a limitation, as they were created with a minimal budget and would have benefitted from professional production. There were

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some issues with formatting between Macintosh and PC computers, and sending the documents as a PDF was not an option due to file size restrictions. Time in developing the PVARs was also a significant investment for the researcher. However, once a template was developed it could easily be adapted and revised. This would likely apply to practical settings as well, if implemented in free-choice learning centres. It was expected that not all participants would be proficient with computers and have personal email accounts, however, this proved not to be a factor. For example, very few participants were ineligible for participation because they did not have an email, and only one individual refused to participate because of the PVARs.

Another limitation of the study was the non-responses from some participants. It was notable that more control group participants responded to the follow-up online questionnaire, and while this was not further examined this could be for a number of reasons which can at best be speculated about. It is possible that these non-responding participants were either uninterested in the research, or did not respond if they did not feel their behaviour was favourable, or they could simply have been busy. Indeed, this is a common problem in survey-based research and it should be noted that the retention rates for the participants who also completed PMMs was notably higher than that of the participants overall. Additionally, it could be argued that the type of people going to the zoo, and particularly the IPBCC, were more inclined to environmental messaging (Clayton et al., 2013; Luebke et al., 2012). However, even if this is “preaching to the choir” this is not necessarily a poor strategy, as Storskdieck, Ellenbogen, and Heimlich (2005) argue that this form of “preaching to the choir” (p. 365) is “a necessary part of identity building and the overall learning experience” and that it “stabiliz[es] attitudes,

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beliefs, and understanding” (p. 365). Enforcing and re-affirming knowledge, attitudes, and beliefs are important components for establishing individual identity, learning and encouraging sustainable behaviour change (Storckdieck et al., 2005). Additionally, interested and willing groups of people are effective resources for facilitating supportive social frameworks to engage other groups of people (Haq, Whitelegg, Cinderby, & Owen, 2008; Storckdieck, Ellenbogen, & Heimlich, 2005).

While seasonality was minimized through planning the time frame of the research, it may have been a factor, as summer in Manitoba often means a change in schedule, vacation, and more time off. This may have resulted in responses that would vary from the rest of the year. However, it is possible that this could be an annual pattern especially for teachers who are off from work during July and August. Also, as some participants expressed, September is a very busy month for most people as regular schedules and school resumes. To minimize attrition two reminder emails were sent to complete the follow-up questionnaire and where delayed responses took place it was noted in the data collection. While this required more time to collect the follow-up responses, it did not appear to affect the responses and added only a minor delay in data collection.

Finally, while it was difficult to identify specific causes of learning and behaviour change by using multiple methods of data collection and analysis this variation was minimized. Another factor that complicated this study was the definition of long term; more research on this topic is needed to determine if these results over the course of two months are consistent with other definitions of long-term learning and behaviour change.

Chapter 6: Conclusions

The results of this research demonstrated that post-visit action resources (PVARs) had a positive affect on environmental free-choice learning, and may also have a positive affect on sustainable behaviour change. However, the PVARs did not have an affect on the six-targeted sustainable behaviours, but rather influenced a broader range of behaviours and an increase in awareness of sustainability issues in general. Additionally, free-choice environmental learning did not relate to the six-targeted measures of behaviour change. However, the perceived measures of learning and behaviour change were related, which was supported by the personal meaning map (PMM) interview data. These apparently contradictory findings raise questions regarding appropriate and sufficiently sensitive measures for behaviour change and the differences between measures of actual and perceived learning and behaviour change. In regards to prior research, this study supports the use of community-based social marketing (CBSM) in environmental education for improving sustainable behaviour change, as well as the contextual model of learning (CML) as a model for understanding the physical context, specifically reinforcing experiences as a means of improving free-choice learning over time. Additionally, this research builds on and supports other current research in the field of environmental education and PVARs, as findings reveal the importance of measurement and conceptualization of learning and behaviour change (Ardoin & Heimlich, 2013; Ballantyne & Packer, 2011; Clayton et al., 2013; Hughes, 2011; 2013; Hughes et al., 2011; Stern et al., 2013). Implications are discussed and recommendations

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are provided that have both theoretical and practical implications along with suggestions for future research.

Implications

This research contributes to the body of knowledge regarding learning outcomes after a free-choice learning experience and provides new insights as to how these experiences influence sustainable behaviour. This research supports the need to examine sustainability within socio-cultural, economic, and environmental contexts across all spectrums of the CML. Since a shift in values, increasing awareness and instilling an environmental ethic within the public is an imperative goal of environmental sustainability (Currie, 2006), this research is important in demonstrating the capacity of PVARs to increase awareness and build an environmental ethic, as was demonstrated by the treatment group responses. It is important to note that increasing awareness was not a goal of the research, nor was it mentioned in the PVARs; therefore, this unsolicited response, which was emphasized by the treatment group, demonstrates the interconnectedness of awareness in post-visit learning and behaviour change.

As populations become increasingly urban, and visits to environmental education centres and free-choice learning experiences continue to increase, these places will play an important role in conveying environmental messages to the public and providing support for sustainable behaviour and conservation efforts (Ardoin & Heimlich, 2013; Ballantyne & Packer, 2011; Ballantyne et al., 2007; Ballantyne, Packer, & Sutherland, 2011; Clayton et al., 2013; Falk et al., 2007). Through this research the capacity of PVARs has been demonstrated in extending the learning experience beyond the on-site visit, in a meaningful and enjoyable way. Additionally, by using localized contexts and

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addressing barriers and benefits of particular behaviours through CBSM, PVARs were found to help people make direct connections between their behaviours and animals affected by climate change, understand what actions would be effective, and how to take action. PVARs were also found to help families and visitors engage through social contexts, which is important for facilitating long-term learning and behaviour change commitment (Falk & Dierking, 2000; McKenzie-Mohr & Smith, 1999).

This research demonstrates that free-choice learning experiences at the zoo can act as an anchor point for facilitating additional learning about climate change and sustainability through PVARs. As stated by Falk (2005), many visitors already know there are conservation problems, and what they need are "...simple, practical and concrete steps they could take to make a difference" (p. 276). PVARs have demonstrated the capacity to act as stepping-stones between conservation learning and sustainable behaviour change, as PVARs provide visitors with a wide array of practical ideas of actions they can take to make a difference. By demonstrating that PVARs improve depth and mastery of environmental free-choice learning experiences, this research adds to the body of knowledge regarding environmental learning and supports that PVARs contribute to long-term learning change, as supported by the CML (Ballantyne & Packer, 2011; Ballantyne et al. 2011; Falk et al., 2012; Hughes, 2011; Hughes et al., 2011). This research contributes to our understanding of free-choice learning experiences and demonstrates that learning does not end as visitors pass through the gates of a zoo, but continues in individualized ways that can be improved upon and meaningfully applied through possible sustainable behaviour change with the use of PVARs.

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Through the content analysis of the treatment group responses we see the importance of awareness in increased learning and behaviour change. This is an important distinction made by the participants as it demonstrates that learning and behaviour change can be conceived in various ways, and may not be identified the same way as by the researcher. In this context, awareness was found to relate to behaviour change as bringing a concept to the forefront of thought, which may or may not result in a specific behaviour change now or in the future. For example, one participant described how the weekly PVARs helped keep sustainability at the top of their mind and recognized that while they had not yet acted they might in the future:

Either [I] understand something at a later time or the next week's topic applies.

'Now I understand why', like switching light bulbs, now that I've had three burn out. I might just get the email to buy light bulbs the day I get the email. (PMMT 260)

Considering when participants may engage in a particular behaviour is important, as the range of sustainable behaviours included in research can be broad and may not apply to individuals within certain time frames. For example, buying low flow appliances may not apply to participants if they do not have appliances that need replacing in the duration of the study, but they might purchase them in the future. This demonstrates that having a broad range of individualized sustainable behaviour goals will be important for environmental free-choice learning centres (and future research) in terms of goal setting and measurement of change.

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Future Research

It is recommended that future research examine the use of social media applications of PVARs. Based on the findings of this research using multiple social media platforms with slightly different contexts and content will likely appeal to a wide range of audiences in their preferred medium. Additionally, isolating particular aspects of PVARs and further research to investigate universal versus localized applications would be informative for both researchers and practitioners.

Visitor identity must also be explored in relation to PVARs, as prior knowledge, interests, satisfaction and motivations will likely provide knowledge about learning and behaviour change outcomes as well as improve visitor experiences and help engage audiences. Indeed, individuals who are highly motivated and interested in the topic could be key audiences that zoos and environmental learning centres need to engage (Storksdieck et al., 2005). Further research that examines the role of these individuals is required (Storksdieck et al., 2005).

The role of awareness in learning and behaviour change in relation to PVARs requires further investigation, as it was distinguished by the participants as related to these concepts, but different in terms of outcomes. The positive findings regarding perceived learning and behaviour change suggest that further examining the role of perceptions of self-efficacy and locus of control would be fruitful. Additional research within the personal and socio-cultural contexts of the CML should be pursued as all three contexts overlap and support one-another. Based on the findings that PVARs were enjoyable because they further facilitated family and social interactions, further PVAR research is required that explores social support and contexts. As recommended by

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Zeppel (2008), environmental education experiences are impacted by the intensity and frequency of the experience, and future research should also address these variables in relation to PVARs.

Due to the continued success of CBSM in sustainability research, it is recommended that additional aspects of this approach should be applied to the PVARs, such as commitment, social norms, and incentives. While generalizability is useful for applying overarching principles, additional research is required that will address localized factors relating to PVARs such as place and experience authenticity, sense of place, and the emotional empathy and appeal of various species included in PVAR resources. Traditional mega-fauna and charismatic species and interactive experiences may have different effects on responses to PVAR learning and behaviour change.

As suggested by Stern et al. (2013) there may be an issue with measuring a broad concept like environmental sustainability narrowly, and more research is required to determine the effectiveness and validity of using traditional likert-type scales in questionnaires for assessing changes in environmentally sustainable behaviours. Additionally, as research calls for broad ranging definitions of learning and behaviour change researchers must exercise caution to ensure that breadth of outcomes does not result in ambiguity. Rather, broad ranging outcomes must be defined and appropriate methods for measurement must be firmly based in a pragmatic epistemology and easily understood and utilized by practitioners (Meyers, 2005; Stern et al., 2013; Weiler & Ham, 2010). This will be especially important for practitioners as numerical evidence of learning and behaviour change is often required, and yet difficult to obtain. Research on the subject of environmental free-choice learning and sustainability will need to be

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creative and use adaptive methods to gain a depth of understanding about how these complex processes unfold. Finally, it is recommended that “long-term” learning and behaviour change in relation to PVARs and choice of sustainable behaviours measured be examined within various time frames, as learning and behaviour change does not end at the zoo gate, nor when the research is complete.

Recommendations

The purpose of this research was to determine if PVARs distributed by a free-choice learning centre, such as the Assiniboine Park Zoo, could positively impact learning and behaviour change. Through this research it can be concluded that PVARs have a positive impact on improving depth and mastery of free-choice learning and can impart some sustainable behaviour change, particularly in regards to *awareness* and how people *perceive* their learning and sustainable behaviour change. Arguably, perceived learning and behaviour change may be just as, or more informative than traditional scales of measurement of behaviour and learning change (Rennie & Johnston, 2007). Since perceived behavioural control is considered more important for behavioural change than intentions, this is arguably an important predictor for behaviour change outcomes (Ajzen & Driver, 1992). Perceptions are important, and much like perceived barriers and benefits, addressed within CBSM, they must be considered when designing PVARs. Perceptions are known to relate to empowerment, social support, awareness, pro-environmental attitudes, and self-efficacy, which are influential in facilitating learning and behaviour change and must be considered when designing free-choice learning experiences (Haq et al., 2008; Heimlich & Ardoin, 2008; Murray, 1995; Stern et al., 2013; Storksdieck et al., 2005). While this requires further research, from this study it

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can be concluded that perceived increases in learning relate to perceived increases in sustainable behaviour change. If perceived measures do predict and represent actual measures, including perceived measures of learning and behaviour change in future research will be essential. While more research is needed on this topic, this current information suggests that facilitating additional post-visit learning after an environmental free-choice experience will encourage positive outcomes regarding increased learning, awareness, and ultimately some behaviour change.

Additionally, as emphasized by the participant responses, the PVARs were effective in terms of acting as reminders and prompting visitors to act. This finding is supportive of the research conducted by Hughes et al. (2011) and CBSM (McKenzie-Mohr, 1999). PVAR development should focus on more components of CBSM, paying particular attention to include an aspect that reminds and prompts people to act in a more sustainable way. This relatively simple concept of PVARs has proven to be effective, via email in particular, and requires further investigation that utilizes more engaging methods, such as various forms of social media. There was also a practical aspect of providing post-visit reminders in the form of PVARs, as many participants explained that they were interested in the content of the International Polar Bear Conservation Centre (IPBCC) but simply could not spend time reading in the centre due to their companions (such as young children or uninterested family or friends). PVARs offer visitors the option to learn more on a topic they are interested in after their visit, in a medium they are comfortable with, when they have time to focus on the information.

Through this research, and past research, PVARs have demonstrated significant potential to help translate environmental learning into sustainable behaviour change

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(Ballantyne & Packer, 2011; Hughes et al., 2011; 2013). The particular components of the PVARs that are most effective will vary depending on the context, the location specific information, and individuals. However, there are overarching principles that can be applied to future research and PVAR development, in that electronic communication that is engaging and offers variety in topics, and various levels of difficulty will likely appeal to the largest number of visitors. Indeed, this research demonstrates the power of PVARs to act as simple reminders and resources to extend learning beyond the on-site experience and facilitate meaningful learning, awareness, and behaviour change. Within the context of travel and learning, experiences that are described to be deeply engaging and include personal meaning are believed to have the greatest impact (Falk et al., 2012). Therefore, when designing and implementing reinforcing activities within environmental learning contexts this information should be applied to extend the free-choice learning experience beyond the gate. Post-visit experiences and resources should be engaging, meaningful, and enjoyable in order to have the greatest impact on environmental knowledge, awareness of issues, and to facilitate long-term sustainable behaviour change. There are practical implications for the Assiniboine Park Zoo, other environmental free-choice learning centres, and for nature-based or sustainable tourism. Interpretation and experiences that are geared towards changing behaviours and raising awareness of a topic need to address learning within the CML and include components of CBSM, by including PVARs in some capacity to help extend the learning experience by providing a reminder that includes practical ideas of how to put this information into practice.

The researcher created the PVARs for the purposes of this study with relatively simple and limited resources. This demonstrates the feasibility for organizations that

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have time and fiscal restrictions. Certainly, PVARs are part of a practical solution for helping people engage with their environments after a free-choice learning experience, to help foster positive environmental knowledge, awareness, and behaviours.

Free-choice environmental learning is a key ingredient for sustainability and capacity building (Ballantyne & Packer, 2005). As the majority of environmental learning takes place outside classrooms, it will be increasingly important to emphasize positive environmental messages in education centres, such as zoos and aquariums, as well as nature-based and sustainable tourism (Esson & Moss, 2013; Falk, 2005; Ballantyne & Packer, 2005). Environmental learning must focus on engendering positive environmental attitudes and behaviours for sustainability (Ballantyne & Packer, 2005; Ballantyne et al., 2011; Heimlich & Falk, 2009). Zoos and aquariums act as places to connect with wildlife and the natural environment and are places to make connections between everyday actions and conservation messages direct and clear (Ballantyne et al., 2007). Free-choice environmental education centres have unique opportunities to reach a wide variety of visitors who may not otherwise be exposed to positive environmental messages. To conclude, PVARs are an effective way to extend original learning experiences and simultaneously improve environmental learning, awareness, and can improve sustainable behaviour change. It is highly recommended that environmental free-choice learning experiences and centres utilize PVARs to extend learning beyond the on-site visit and contribute to learning change and individualized behaviour change over time.

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Appendices

Appendix A

Script for Recruiting Control Group Participants (with option of questionnaire only)

Hello,

I am a graduate student from the University of Manitoba and I am doing a study to better understand learning and sustainable behaviours of adult zoo visitors to fulfill the requirements for my degree and further understand how zoo visitors learn and apply their learning. The study involves approximately 20-30-minute of your time today and 20-30 minutes of your time in 2 months. Your participation will involve an interview and personal meaning map activity (which is a brainstorming activity that involves writing and drawing) and a short questionnaire at the end of your visit to the International Polar Bear Conservation Centre and a follow- interview and a short questionnaire by telephone 2 months after your visit. The research will ask you questions about yourself, your visit to the zoo, your learning about climate change and sustainability, as well as your current sustainable behaviour. The research will involve speaking, reading and writing in English. As a thank-you for participating in this research you will receive a small gift from the Assiniboine Park Zoo (in the form of a zoo coupon worth no more than \$2) upon completion of the consent form. Are you interested in learning more about this research and / or participating? If so, are you at least 18 years old?

No

Would you be interested in participating in just the 5-10 minute questionnaire and 5-10 minute follow-up questionnaire by email in 2 months?

No

Thank you and enjoy your visit to the zoo.

Yes

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Great! You will be asked complete a short questionnaire to help us learn more about your zoo visit and sustainable behaviour. The results from this study will be used directly by the zoo to improve their programming and will be presented in conferences and publications to further inform and improve visitor learning and behaviour change strategies. The first questionnaire will happen now; the second one will happen two months from now and will be done by email. The interview now will take place in a public location where others may hear your responses and confidentiality cannot be guaranteed. You are not required to provide a response to any question if you are uncomfortable responding and you can choose to respond to any question in writing rather than verbally. Your responses will stored safely to enhance confidentiality and you can stop participating at any time by telling the research that you want to stop participating. If you ask to stop participating all data collected to that point will be deleted or shredded upon your request. You can also choose to have the data collected up to that point included but cease further participation and/or contact. Are you still interested in participating?

No

Thank you for your time.

Yes

Great!

Go to nearby table.

Please review this form and ask any clarifying questions you may have.

If you want a copy of the results please check yes and fill in your information here. If not please check no.

After interview: Thank you for your time and participating in this research study!

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Script for Recruiting Treatment Group Participants (with option of questionnaire only)

Hello,

I am a graduate student from the University of Manitoba and I am doing a study to better understand learning and sustainable behaviours of adult zoo visitors to fulfill the requirements for my degree and further understand how zoo visitors learn and apply their learning. The study involves approximately 20-30-minute of your time today and 20-30 minutes of your time in 2 months. Your participation will involve an interview and personal meaning map activity (which is a brainstorming activity that involves writing and drawing) and a short questionnaire at the end of your visit to the International Polar Bear Conservation Centre and a follow- interview and a short questionnaire by telephone 2 months after your visit. The research will ask you questions about yourself, your visit to the zoo, your learning about climate change and sustainability, as well as your current sustainable behaviour. The research will involve speaking, reading and writing in English. As a thank-you for participating in this research you will receive a small gift from the Assiniboine Park Zoo (in the form of a zoo coupon worth no more than \$2) upon completion of the consent form. Are you interested in learning more about this research and / or participating? If so, are you at least 18 years old?

No

Would you be interested in participating in just the 5-10 minute questionnaire and 5-10 minute follow-up questionnaire by email in 2 months?

No

Thank you and enjoy your visit to the zoo.

Yes

Great! You will be asked complete a short questionnaire to help us learn more about your zoo visit and sustainable behaviour. The results from this study will be used directly by the zoo to improve their programming and will be presented in conferences and

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publications to further inform and improve visitor learning and behaviour change strategies. The first questionnaire will happen now; the second one will happen two months from now and will be done by email. Part of this research includes giving you “post-visit action resources”, which consist of information and ideas for additional things you can do and learn in relation to your visit at the International Polar Bear Conservation Centre. You will receive a package now with paper-based “post-visit action resources” (that includes fact-sheets about sustainable behaviours and more information on climate change) and during the next two months you will be sent a weekly email from the researcher with more information relating to your learning experiences about climate change and sustainability at the International Polar Bear Conservation Centre and sustainable behaviour. These resources are designed to help you learn more and give you ideas about how to translate your learning into sustainable behaviour. If you are uncomfortable responding to any question you are not required to provide a response and you can choose to respond to any in writing rather than verbally. Your responses to all part of the study and your email will remain confidential. You can stop participating at any time by telling the researcher that you want to stop participating. If you ask to stop participating all data collected to that point will be deleted or shredded upon your request. You can also choose to have the data collected up to that point included but cease further participation and/or contact. Are you still interested in participating?

No

Thank you for your time.

Yes

Great!

Go to nearby table.

Please review this form and ask any clarifying questions you may have.

If you want a copy of the results please check yes and fill in your information here. If not please check no.

After interview: Thank you for your time and participating in this research study!

Data Collection Instructions (Control Group):

1. Introduce Yourself

- i. Zoo Volunteer – University student assisting with research
- ii. University of Manitoba Graduate Student Research Project for Master's Degree
- iii. About learning at the International Polar Bear Conservation Centre and sustainable behaviours
- iv. 20-30 min interview and activity to share thoughts and experience (now and again 2 months later)
- v. Adults 18+ ONLY, person in group who is willing to participate or next birthday
- vi. Toys and games for family/friends while waiting
- vii. Small \$2 thank you gift for zoo concessions (after consent form)
- viii. Opportunity to help with this research project which will be presented at conferences and publications and contribute to future programming at the zoo!

2. Info for Research

- i. 5-10 min for survey and 15-20 for brainstorming activity now
- ii. Questions about you, your visit and learning about climate change and sustainability and your sustainable behaviours
- iii. Would like to audio record during the brainstorming activity to ensure accuracy (but do not have to)
- iv. Confidentiality cannot be guaranteed because of public location
- v. This research requires a follow-up part that will happen 2 months from now (over the phone and by email) – This part will take approx. 20-30 minutes also.

3. Informed Consent

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- i. Go-over consent form, and ensure that they understand that they are free to leave the study at any point in time and if they have any questions/comments/concerns they can contact me anytime
- ii. Don't need to respond to any questions they don't feel comfortable responding to
- iii. Ensure them that their information will be kept confidentially and locked up
- iv. 1 sheet for participant, and one for us to keep
- v. Follow-up participation form: ensure email and phone number are legible. If not willing to do follow-up – not eligible to participate. Thank them for their time.
- vi. Give zoo coupon when consent form is completed

4. Questionnaire

- i. Do questionnaire on computer with participant. Fill in PMM ### and then have them start. Sit nearby, but do not be looking over their shoulder. Be available to help with computer related or other questions. (If they are not comfortable with computers or cannot read the text you can fill it out for them and read it to them)

5. Brainstorming activity (Personal Meaning Map)

- i. Begin audio-recording and ensure that participant is comfortable, if not, do not record
- ii. Write PMM ### on the top of the page
- iii. Write down any words, ideas, images, or phrases that relate to your understanding of “climate change and sustainability”

6. Interview (probing) Questions

- i. USE A DIFFERENT COLOURED PEN and indicate what is what on the PMM after

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- ii. Ask why the participant wrote/drew what they did and why any connections were made, or if they would connect any concepts if they did not (participant does not need to respond verbally if uncomfortable – can do this just over writing)

7. Thank Participant!

- i. Remind participant that they will be contacted in 2 months for the follow-up part of the research

8. Ensure all data and recordings are coded and organized properly before starting next one

- i. Ensure the PMM number is on everything – and paperclip or staple all forms together

Data Collection Instructions (Treatment Group):

1. Introduce Yourself

- i. Zoo Volunteer – University student assisting with research
- ii. University of Manitoba Graduate Student Research Project for Master's Degree
- iii. About learning at the International Polar Bear Conservation Centre and sustainable behaviours
- iv. 20-30 min interview and activity to share thoughts and experience (now and again 2 months later)
- v. Adults 18+ ONLY, person in group who is willing to participate or next birthday
- vi. Toys and games for family/friends while waiting
- vii. Small \$2 thank you gift for zoo concessions (after consent form)
- viii. Opportunity to help with this research project which will be presented at conferences and publications and contribute to future programming at the zoo!

2. Info for Research

- i. 5-10 min for survey and 15-20 for brainstorming activity now
- ii. Questions about you, your visit and learning about climate change and sustainability and your sustainable behaviours
- iii. Would like to audio record during the brainstorming activity to ensure accuracy (but do not have to)
- iv. Confidentiality cannot be guaranteed because of public location
- v. This research requires a follow-up part that will happen 2 months from now (over the phone and by email) – This part will take approx. 20-30 minutes also.
- vi. Part of the follow-up involves the researcher sending the participant an email once a week relating to what they learned

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today and give them ideas for how to become more environmentally sustainable

3. Informed Consent

- i. Go-over consent form, and ensure that they understand that they are free to leave the study at any point in time and if they have any questions/comments/concerns they can contact me anytime
- ii. Don't need to respond to any questions they don't feel comfortable responding to
- iii. Ensure them that their information will be kept confidentially and locked up
- iv. 1 sheet for participant, and one for us to keep
- v. Follow-up participation form: ensure email and phone number are legible. If not willing to do follow-up – not eligible to participate. Thank them for their time.
- vi. Give zoo coupon when consent form is completed

4. Questionnaire

- i. Do questionnaire on computer with participant. Fill in PMM ### and then have them start. Sit nearby, but do not be looking over their shoulder. Be available to help with computer related or other questions. (If they are not comfortable with computers or cannot read the text you can fill it out for them and read it to them)

5. Brainstorming activity (Personal Meaning Map)

- i. Begin audio-recording and ensure that participant is comfortable, if not, do not record
- ii. Write PMM ### on the top of the page
- iii. Write down any words, ideas, images, or phrases that relate to your understanding of “climate change and sustainability”

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

6. Interview (probing) Questions

- i. USE A DIFFERENT COLOURED PEN and indicate what is what on the PMM after
- ii. Ask why the participant wrote/drew what they did and why any connections were made, or if they would connect any concepts if they did not (participant does not need to respond verbally if uncomfortable – can do this just over writing)

7. Thank Participant!

- i. GIVE THE PARTICIPANT THE PVAR PACKAGE!
- ii. Remind participant that they will be contacted in 2 months for the follow-up part of the research and that they will received a weekly email from the researcher once/week for the next 8 weeks
- iii. Free to withdraw at any time by contacting the researcher (Jill)

8. Ensure all data and recordings are coded and organized properly before starting next one

- i. Ensure the PMM number is on everything – and paperclip or staple all forms together

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Appendix B

Learning and Sustainability

1. Please have the researcher/research assistant enter the PMM #:

2. Please tell us how knowledgeable you are about the following topics:

	Not at all	Somewhat	Moderately	Very	Extremely
Climate Change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global Warming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Species at Risk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conservation Research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Please tell us how interested you are in the following:

	Not at all	Somewhat	Moderately	Very	Extremely
Climate Change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global Warming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Species at Risk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conservation Research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Please tell us about the learning outcomes you feel you achieved by visiting this centre:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I learned facts about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I learned general information about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will be able to apply the information I learned	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I gained an understanding about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Appendix C

Post-PVAR Control Group Questionnaire

Learning and Sustainability: Follow-Up

1. Please tell us how knowledgeable you are about the following topics:

	Not at all	Somewhat	Moderately	Very	Extremely
Climate Change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global Warming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Species at Risk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conservation Research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Please tell us how interested you are in the following:

	Not at all	Somewhat	Moderately	Very	Extremely
Climate Change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global Warming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Species at Risk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conservation Research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Please tell us about any learning outcomes that you feel you achieved AFTER your visit to the International Polar Bear Conservation Centre (IPBCC) (in relation to the topics at the IPBCC):

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have learned additional facts about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have learned additional general information about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was able to apply the information I learned	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I gained a further understanding about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please describe how your learning about the topics at the IPBCC has (or has not changed) SINCE your visit to the IPBCC

Post-PVAR Treatment Group Questionnaire

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Learning and Sustainability: Follow-Up

1. Please tell us how knowledgeable you are about the following topics:

	Not at all	Somewhat	Moderately	Very	Extremely
Climate Change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global Warming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Species at Risk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conservation Research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Please tell us how interested you are in the following:

	Not at all	Somewhat	Moderately	Very	Extremely
Climate Change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global Warming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Species at Risk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental Sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conservation Research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Please tell us about any learning outcomes that you feel you achieved AFTER your visit to the International Polar Bear Conservation Centre (IPBCC) (in relation to the topics at the IPBCC):

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have learned additional facts about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have learned additional general information about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was be able to apply the information I learned	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I gained a further understanding about the topics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please describe how your learning about the topics at the IPBCC has (or has not changed) SINCE your visit to the IPBCC

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Post-PVAR PMM Interview Questions

Post-Visit email/telephone follow-up (if consent given)

E-mail or telephone follow-up script

Hello,

My name is Jill and I am a student at the University of Manitoba. About 2 months ago you participated in some research with me at the Assiniboine Park Zoo where you agreed to a follow-up interview. Are you still interested in participating in a follow up interview?

If no

Thank you for your time.

If yes

Are you able to participate now? (it will take about 5 minutes)

If no

When would be a good time to call again?

If yes

Your participation is voluntary and you can stop participating at any time. Your personal information will not be stored with or connected to your responses to the interview.

1. On a final note, I have one last open-ended question for you. It will be similar to a few of the questions in the final questionnaire, but is designed to capture anything that might have been missed:

Do you have any comments about why your learning about sustainability and climate change may or may not have changed since your visit?

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Do you have any comments about why your sustainable behaviours may or may not have changed since your visit?

Do you have any comments about what would help you learn more after your visit and help you become more sustainable?

That's all the questions I have.

Thank-you again for your participation!

Appendix D

‘Flick It Off’ Fact Sheet

Flick It Off: Turn off lights and electronics when you are done

Main Barriers to ‘Flicking it off’

- **It’s inconvenient** and takes too much time to turn off lights and electronics.
- It’s difficult to **break old habits**.
- **I don’t care** or feel it will not make any difference.

Main Benefits to ‘Flicking it off’:

- **Using less electricity** is good for both your wallet and the environment!
- **It only takes a minute and it is easy to do!** Walk around the house once at the end of the day and see what changes you can make.
- **Reducing your “standby power”** will make a big difference! Standby power can equal up to 10% of all energy used in Canada! ¹

WHAT CAN I DO?

- **Turn off the lights** when you leave a room.
- **Turn off electronics, TVs, DVD players, cable or satellite boxes and gaming devices** when finished using them, for night and when away for an extended period of time. ²
- **Try using “standby mode”** on your computers instead of a screen saver. Screen savers use just as much energy as when the computer is being used normally. ²
- **Unplug devices** when not in use. Try using a power bar for electronics and computers to make this even easier. ²
- **Purchase ENERGY STAR®** products to reduce the amount of standby power needed and improve overall energy efficiency. ²

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

References:

1. http://www.hydro.mb.ca/your_home/appliances_electronics/standby_power.shtml
2. http://www.hydro.mb.ca/your_home/appliances_electronics/electronic_tips.shtml
3. [http://www.thedailygreen.com/going-green/tips/energy-conservation-turn-off-lights-460107\](http://www.thedailygreen.com/going-green/tips/energy-conservation-turn-off-lights-460107)

‘Buying Locally’ Fact Sheet

Buy Locally: Choose locally produced and processed food

Main Barriers to ‘Buying locally’:

- Locally produced food is often is **more expensive**.
- It is difficult to know **what is local and where to buy it**, and it takes too much time to sort through labels.
- It may not **taste as good as my favourite brands**.

Main Benefits to ‘Buying locally’:

- **Prices for locally grown foods are usually similar**, and often cheaper, because transportation costs are cut when food is grown and processed locally. Plus, less transportation emissions is better for the environment!
- **There are many places to buy locally grown food in Manitoba and it’s easy to find** (often available at your local supermarket)! Buying local also supports local farmers, economies, and retailers.
- Locally produced food will be as good as your favourite brands and probably better! Buying local fruit and veggies is as **fresh and delicious** as it gets!
- **Enjoy Manitoba’s high standards to ensure food is healthy and safe** for the whole family.

WHAT CAN I DO?

- **Buy locally grown food** at Farmer’s Markets, the Forks Market, Peak of the Market, products in grocery stores labeled “Buy Manitoba” or indicated as Manitoban on the packaging, or buy directly from the producer!
- **Read the label:** Products will say Made/Grown in Manitoba, ‘Peak of the Market’, ‘Buy Manitoba’ or indicate where they were grown on the label.
- **Eat at restaurants** that serve locally grown and processed food. Check out this guide produced by *Food Matters Manitoba* to find a restaurant that serves local food: http://www.foodmattersmanitoba.ca/sites/default/files/Restaurant_Caterer_brochure_2011_online.pdf

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

References:

1. <http://greenactioncentre.ca/learn/food/>
2. <http://www.foodmanitoba.ca/local-foods/>
3. <http://www.buymanitobafoods.ca/mb-foods/find-food/all-products/>

‘Growing Your Own’ Fact Sheet

Grow Your Own: Try chemical free gardening, lawn care, and composting

Main Barriers to ‘Growing your own’:

- **Lack of space:** compost bins will take up lots of space on my yard. Compost bins and rain barrels can be purchased in a **variety of sizes** (even small counter top sizes). Plus, composting can even be done indoors and year round!
- Composting and chemical free gardening/lawn care will **take up too much time** and I’m not that interested.
- **Composting may create odors, and attract rodents.** Actually, composts only smell bad when something is wrong (something added that cannot be composted or too much “green” or new material). Plastic composting bins are already quite rodent proof, but you can even add mesh to the bottom of your bin to be extra cautious.⁸

Main Benefits to ‘Growing your own’:

- It takes the **same amount of time** to throw something into the garbage as the compost.
- **Composting is free!** No more buying fertilizers or chemicals! Composting also helps retain soil moisture so you can water less (save water and costs)!
- **Less garbage. Did you know** that approximately 40% of all household garbage could be composted? Composting helps reduce the amount of waste going into landfills.⁷
- Chemical free lawn care and gardening means a **healthier backyard environment** for you and your family, and there are many **cost-effective** ways to maintain your lawn and garden.

WHAT CAN I DO?

- **Buy a composting bin** or build your own! Get started today! Not sure what to do? Try taking a composting class:
<http://greenactioncentre.ca/program/composting/> or read more on your own:
<http://www.fortwhyte.org/files/File/Branta/Composting.pdf>

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- **Not sure where to buy a composting bin?** Here are some ideas: (approx. cost is \$30) <http://www.winnipeg.ca/waterandwaste/recycle/composting.stm>
<http://greenactioncentre.ca/content/compost-bin-options/>
- **Buy a rain barrel:** <http://www.fortwhyte.org/rainbarrels> (approx. cost is \$60)
- **Try green lawn care:** start cutting your grass with an electric lawn-mower or push-mower. Also, try “grass-cycling” by leaving the clippings on your lawn and letting them fertilize your yard! Avoid pesticides and herbicides – try organic or other green options.¹

References:

1. <http://www.winnipeg.ca/waterandwaste/recycle/composting.stm>
2. <http://mbeconetwork.org/projects/organic-lawn-care>
3. <http://climatechangeconnection.org/Solutions/Yardgarden.htm>
4. <http://www.fortwhyte.org/files/FWA-RainBarrel-FactSheet-v01.pdf>
5. <http://www.fortwhyte.org/files/File/Branta/Composting.pdf>
6. <http://greenactioncentre.ca/program/composting/>
7. <http://greenactioncentre.ca/content/why-should-i-compost/>
8. <http://greenactioncentre.ca/content/pest-proofing-your-compost-bin/>
9. <http://www.safelawns.org/blog/volunteer-handouts/>

‘Doubling Up’ Fact Sheet

Double Up: Reduce, reuse, and recycle

Main Barriers to ‘Doubling Up’:

- It takes **more time and effort** to sort recyclable goods and it’s easier to throw them away instead.
- It is **difficult to recycle and reuse things** and I don’t know what can be recycled or how to start.
- **Does it even make a difference? Did you know** that recycled paper requires 70% less energy than making it from raw materials? And “1 recycled plastic bottle saves enough energy to power a 60-watt light bulb for 3 hours!”¹

Main Benefits to ‘Doubling Up’:

- It takes **about the same amount of time** to throw something in the garbage as in the recycling.
- Recycling, reducing waste, and reusing products means there will be **less garbage/waste** in landfill sites and **less energy and raw resources** needed in manufacturing new materials.
- **It only takes a few minutes** to educate yourself on how and what can be recycled, reduced or reused!
- **Help contribute to a healthier environment** to live in today and tomorrow!

WHAT CAN I DO?

- Not sure what can or cannot be recycled? Try calling 311 or check out these great videos by the City of Winnipeg:
<http://www.winnipeg.ca/waterandwaste/garbage/newCollection/videos.stm>
- **Things that can be recycled in Winnipeg:** “milk cartons, glass food and beverage containers, plastic bottles, juice boxes, margarine containers, aluminum cans, cardboard, newspapers, cereal boxes, steel food containers and more! For more information on what other materials (tires, oils, electronics, batteries) you can recycle and collection sites, please visit www.recyclemanitoba.ca.”²

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- Instead of buying plastic water bottles **get a re-useable water bottle** and fill it yourself! Save money and stay healthy!
- **Buy products with minimal packaging or in bulk** to reduce the amount of waste.
- **Need a recycling bin or have more questions?** Call 311 or visit this website: <http://www.winnipeg.ca/waterandwaste/recycle/cartcollection.stm>

References:

1. <http://recycling-guide.org.uk/facts.html>
2. <http://www.simplyrecycle.ca/wp/faq>
3. <http://www.winnipeg.ca/waterandwaste/recycle/cartcollection.stm>
4. <http://www.recycleeverywhere.ca>
5. <http://www.takepride.mb.ca>

‘Slow the Flow’ Fact Sheet

Slow the Flow: Buy low-flow toilets, faucets, showerheads, or other appliances

Main Barriers to ‘Slowing the Flow’:

- Low-flow toilets, faucets, or showerheads are **hard to find**.
- This is something new, so it must be **expensive to purchase**.
- Removing old toilets, faucets, or showerheads is costly, **time consuming and difficult** to dispose of old ones.

Main Benefits to ‘Slowing the Flow’:

- **Less water consumption and lower water bills.** Did you know that a leaking faucet can waste up to 11,000 litres (2,400 gallons) of water a year? ³ “That’s enough to fill a swimming pool that is 8 feet long, 10 feet wide and 4 feet deep!” ⁶
- **Lower water bills.** Long-term benefit of lower water bills.
- **Cost-effective.** Eco-responsible and low flow appliances/products are very common and often the same price as non-efficient options!
- **Removing faucets and showerheads can be easy to do!** Need some direction on how to get started? Check out these videos from Manitoba Hydro:
http://www.hydro.mb.ca/your_home/lieep/index.shtml

WHAT CAN I DO?

- **Get a FREE Power Smart & Energy Saver Kit** from MB Hydro and Eco-fitt! The kit includes an energy-efficient massage showerhead (that uses up to 40% less water but still gives a satisfying shower), water-saving aerators for bathroom and kitchen faucets (which also use up to 40% less water), and 3 metres of pipe insulation (up to 12% of heating bill costs come from heating water which is often lost because of non-insulated pipes)! You can get a kit online at: <http://www.ecofitt.ca/mbhydro/> or call or 1-877-ECO-FITT (326-3488) toll-free.
- **Check for water leaks:** tighten faucets and replace washers wherever leaks occur. This can save lots of water, money and it’s quick and easy to do!
- **Replace old water heaters and washing machines with more efficient ones.** Look for ENERGY STAR® products.

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- **Need a quicker and more affordable option?** Try washing only full loads of laundry and dishes.

References:

1. <http://www.ecofitt.ca/mbhydro/>
2. http://www.hydro.mb.ca/your_home/water_use/water_energy_saver_program/ps_standards.shtml
3. http://www.hydro.mb.ca/your_home/water_use/tips.shtml
4. http://www.hydro.mb.ca/your_home/water_use/index.shtml
5. http://www.hydro.mb.ca/your_home/resources/index.shtml
6. <https://cramberry.net/sets/45525-water-measurements-math-review-and-formula-study-guide>
7. <http://climatechangeconnection.org/Solutions/Bathroom.htm>

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

‘Getting Involved’ Fact Sheet

Get Involved: Volunteer with an environmental organization or participate in local environmental activities

Main Barriers to ‘Getting Involved’:

- **Inconvenience/expense** to travel to volunteer locations.
- **Lack of time and commitment** to volunteer.
- I’m not sure **which organizations exist** and if they **really make a difference**.

Main Benefits to ‘Getting Involved’:

- **Gain volunteer experience** while doing something you enjoy. Plus, volunteer experience always looks good on your resume!
- **There are many opportunities and organizations in Manitoba** to volunteer with. Look for local organizations in the links below (there are even search options to find opportunities in your specific area!)
- **Enjoy some time outdoors with family and friends** while making a difference!
- **Teamwork:** help be a part of the solution and contribute to your community becoming more sustainable.

WHAT CAN I DO?

- **Volunteer with the Assiniboine Park Zoo or other local organization** that support the environment and sustainability
- **Find a list of volunteer opportunities on these websites:**
 - www.assiniboinepark.ca/volunteers
 - www.mbvolunteer.ca
 - www.mbeconetwork.org/resources/volunteer-opportunities
 - www.mbeconetwork.org/support-our-work/volunteer
 - www.mbeconetwork.org/members

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Appendix E

The Future

Is it too late to stop climate change?

Scientists agree that the current warming trend cannot be stopped or reversed, but that it can be slowed down to allow biological systems and human society more time to adapt. Some scientists predict that a 2°C rise in the GAST is the point at which some of the most undesirable and dangerous processes brought on by climate change could become unavoidable¹⁶.

These include:

- The melting of the West Antarctic and Greenland ice sheets, which between them could raise global sea levels by up to 7 meters¹⁷
- The drying of many parts of Africa, and the inundation by salt water of the aquifers used by many coastal cities¹⁸
- The risk of water shortages for between 2.3 and 3 billion people¹⁹. The melting of glaciers will jeopardize people who depend on their melt water as a source of drinking water²⁰

How will climate change impact our economy? Is our economy at risk because of climate change?

A healthy economy needs a healthy climate. Taking action on climate change will not threaten our economy. The Stern Review, an economic report for the British Government, concludes that it would cost less to take strong preventive action against climate change than to react to changes as they unfold.

Action on climate change will create significant business opportunities, as new markets are created for low-carbon energy technologies and other low-carbon goods and services.


Won't we be better off with a warmer climate?

There are more costs than benefits to a warmer climate.

Costs	Benefits
<ul style="list-style-type: none"> - Enhanced drought conditions - Sea level rise and ocean surges - Increased intensity of rainfall and flooding - More severe weather events - Lower freshwater levels - Adverse effects on human health - Loss of species and forested area - Melting of permafrost, glaciers, and sea ice - Loss of traditional economies - Spread of diseases and pests - Increased need for air-conditioning 	<ul style="list-style-type: none"> - Longer growing seasons and increased productivity - Reduced space-heating costs - Opportunities to expand into new areas of environmental technology and services

What can we do?

Take action! This is a global issue that requires all of us to do our part. At home, on the road, and at work, there are simple things all Manitobans can do to reduce their GHG emissions. Whether it is composting household organic waste, cycling to work, buying local products, making our homes more energy efficient with the help from "PowerSmart", or setting up an office car pool, every step helps. With small changes to our daily activities, planning and priorities, Manitobans can become Climate Champions. For more information about reducing your GHG emissions, please visit www.climatechangeconnection.org.




Puzzled about CLIMATE CHANGE

The Basics

What is the difference between climate change and global warming?

Climate change refers to long-term shifts or alterations in climate. A region's climate results from an extremely complex interaction of elements, including temperature, precipitation, winds, and other factors. These changes vary from region to region. Global warming refers specifically to a sustained increase in the Global Average Surface Temperature (GAST). In other words, **global warming is one type of climate change.** Global warming is the trigger for many other types of changes.



What is the greenhouse effect (GHE)?

The greenhouse effect is a natural process that helps to regulate the temperature of our planet. The sun's energy passes through the atmosphere and heats the Earth like a greenhouse. Some of the heat, rather than escaping back to space, is trapped in the atmosphere by clouds and greenhouse gases (GHGs). **When the amount of GHGs increases, more heat is trapped, leading to a rise in GAST.** This is the enhanced greenhouse effect.

What is the difference between climate and weather?


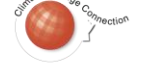
Weather refers to atmospheric conditions over a short period of time, and climate is how the atmosphere "behaves" over relatively long periods of time. Climate change refers to the change in long-term averages of daily weather.

What are the GHGs and where are they coming from?

The GHGs include: water vapour (H2O), carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), halocarbons (HFC), ozone (O3).

Unsustainable activities related to fossil fuel use, agricultural production, industrial processes, transportation, consumption, waste production, community infrastructure design, and societal habits have added large amounts of GHGs to the atmosphere.

Funding Provided by:

Learn more about solutions to climate change at www.climatechangeconnection.org/solutions

Learn more about climate change's impact at www.climatechangeconnection.org/impact

Climate Change Connection

3rd Floor, 303 Portage Avenue
Winnipeg, Manitoba R3B 2B4

Tel: (204) 943.4836
Fax: (204) 989.8476

Climate Change Connection (CCC) is a hub for information about climate change in Manitoba, Canada. For more information or to learn how to schedule for a group presentation visit www.climatechangeconnection.org or e-mail climate.connection@mts.net

climatechangeconnection.org

Appendix F

Post-Visit Action Resource Email: Introduction

Hello,

This last week you participated in a research project at the Assiniboine Park Zoo after your visit to the International Polar Bear Conservation Centre. Thank you for your participation and interest! For the next two months you will receive a weekly email (8 emails in total) with post-visit action resources regarding climate change and sustainability from me.

These emails are intended to remind you about what you learned during your visit to the International Polar Bear Conservation Centre at the Assiniboine Park Zoo and give you ideas about how to put this information into practice in your everyday life.

For the next 7 weeks you will receive emails that include:

- Updates on Hudson the Polar Bear at the Assiniboine Park Zoo
- Links for more information about polar bears, climate change, conservation and research, and sustainability
- Ideas to become more environmentally sustainable

These emails will have a similar format each time, but always with new information and will focus on one idea to become more sustainable each week (based on the fact sheets that you received). I hope you enjoy the information and participating in this research project. Please remember that you are free to withdraw from this research and cease receiving emails from the researcher at any point in time by sending an email stating your intent to withdraw.

Remember all the Ideas to Become More Environmentally Sustainable?

If you have a minute...

- **Flick it Off:** Turn off lights and electronics when you are done
- **Double Up:** Reduce, reuse, and recycle

If you have an hour...

- **Slow the Flow:** Buy low-flow toilets, faucets, showerheads, or other appliances

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- **Buy Locally:** Choose locally produced and processed food

If you have a few hours or a day:

- **Get Involved:** Volunteer with an environmental organization or participate in local environmental activities
- **Grow Your Own:** Try chemical free gardening, lawn care, and composting

Interested in learning more? Try these links!

Learn more about *Polar Bears*:

- [Click here](#) to see Polar Bears tracked by the World Wildlife Foundation!
*With this link you can see live the routes polar bears in the wild have walked via their radio collars! Be sure to check out the polar bears that are being tracked in Churchill, MB! *This webpage takes a few extra seconds to load because of the interactive map – be patient, it's worth the wait!*

Learn more about *Conservation and Research*:

- [Click here](#) to learn more about conservation and research at the Assiniboine Park Zoo.

Learn more about *Climate Change*:

- [Click here](#) to read about information from the Manitoba Government on climate change.
- [Click here](#) to watch a one-minute YouTube video showing Arctic ice changes from 1978 to 2012.

Learn more about *Sustainability*:

- [Click here](#) to measure your carbon footprint (how much carbon you contribute to the atmosphere in one year) and find out how many earths it would take to sustain your current lifestyle!

Sincerely,

Jill Bueddefeld

M.A. Student

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Kinesiology and Recreation Management

Room 314 – Leisure and Tourism Laboratory (Max Bell)

University of Manitoba

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Post-Visit Action Resource Email 2

Hello!

Hope you are doing well since my last email and enjoyed the resources that were included last time.

This week I will be focusing on an activity that you can do that only takes a minute!

- **Flick it Off: Turn off lights and electronics when you are done**

Turning off just one 60-watt bulb for one hour/day when not in use can save up to 0.18 tonnes of greenhouse gas emissions / year! Turning off computers at night can also save up to 0.20 tonnes of greenhouse gasses/year! These are quick and easy things to do and ways you can become more sustainable right now! ¹

Remember to check your fact sheet for more ways to “Flick it Off”!

References:

1. <http://www.seedsfoundation.ca/otc/act/watt.htm>

Have a great week and don't forget about all our ideas to become more sustainable below!

Sincerely,

Jill Bueddefeld

M.A. Student

Kinesiology and Recreation Management

University of Manitoba

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Ideas to Become More Environmentally Sustainable:

If you have a minute...

- **Flick it Off:** Turn off lights and electronics when you are done
- **Double Up:** Reduce, reuse, and recycle

If you have an hour...

- **Slow the Flow:** Buy low-flow toilets, faucets, showerheads, or other appliances
- **Buy Locally:** Choose locally produced and processed food

If you have a few hours or a day:

- **Get Involved:** Volunteer with an environmental organization or participate in local environmental activities
- **Grow Your Own:** Try chemical free gardening, lawn care, and composting

Interested in learning more? Try these links!

Learn more about this week's *sustainable activity*:

- [Click here](#) to learn more tips about how to save energy on your electronics from Manitoba Hydro.
- Want to know more about “standby” or “vampire” power? [Click here!](#)

Learn more about *Polar Bears*:

- [Click here](#) to learn more facts about Polar Bears from the World Wildlife Fund

Learn more about *Conservation and Research*:

- [Click here](#) to learn more about the role of zoos and aquariums in conservation and climate change.

Learn more about *Climate Change*:

- [Click here](#) to learn about the role of zoos and aquariums in climate change. [Here](#) are more specific details from the Canadian Association of Zoos and Aquariums.

Learn more about *Sustainability*:

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- **Did you know?** The average Canadian emits more than **5 tonnes** of green house gasses per year! Reduce your carbon footprint by taking the One Tonne Challenge today! [Click here](#) for more information and [here](#) to start today!

Post-Visit Action Resource Email 3

Hello!

Hope you are doing well since my last email and enjoyed the resources that were included in the last week.

This week I will be focusing on an activity that you can do that only takes an hour (or less)!

- **Buy Locally: Choose locally produced food and other products**

Most food travels approximately 1,500 – 3,000 miles (2,400 – 4,800 kms) to get from the farm to you!¹ By reducing the distance food has to travel you can help directly reduce the burning of fossil fuels which emit greenhouse gasses!² Small changes add up!

Remember to check your fact sheet for more ways to “Buy Locally”!

References:

2. <http://www.sustainabletable.org/254/local-regional-food-systems>
3. <http://greenactioncentre.ca/content/local-vs-sustainable-food/>

Have a great week and don't forget about all our ideas to become more sustainable below!

Sincerely,

Jill Bueddefeld

M.A. Student

Kinesiology and Recreation Management

University of Manitoba

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Ideas to Become More Environmentally Sustainable:

If you have a minute...

- **Flick it Off:** Turn off lights and electronics when you are done
- **Double Up:** Reduce, reuse, and recycle

If you have an hour...

- **Slow the Flow:** Buy low-flow toilets, faucets, showerheads, or other appliances
- **Buy Locally:** Choose locally produced and processed food

If you have a few hours or a day:

- **Get Involved:** Volunteer with an environmental organization or participate in local environmental activities
- **Grow Your Own:** Try chemical free gardening, lawn care, and composting

Interested in learning more? Try these links!

Learn more about this week's *sustainable activity*:

- [Click here](#) to learn about food grown in Manitoba.
- [Click here](#) for Manitoba's Local Produce Guide.
- Want to know where your nearest Farmers' Market is? [Click here!](#)
- Still not sure what "local food" is and why it's important? [Click here!](#)

Learn more about *Polar Bears*:

- [Click here](#) to learn more about myths and misconceptions about Polar Bears from Polar Bears International

Learn more about *Conservation and Research*:

- [Click here](#) to learn more about the role of zoos and aquariums in Polar Bear and Arctic habitat conservation and climate change.

Learn more about *Climate Change*:

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- [Click here](#) to learn how climate change will affect Manitoba.

Learn more about *Sustainability*:

- Are you wondering what Manitoba is doing to become more sustainable? [Click here](#) to read Manitoba's Green Plan.

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Post-Visit Action Resource Email 4

Hello!

Hope you are doing well since my last email and enjoyed the resources that were included in the last email.

This week I will be focusing on an activity that is more challenging!

- **Grow Your Own: Try chemical free gardening, lawn care, and composting**

Did you know? By composting you can reduce your weekly garbage to about half the amount!¹ In the United States, it was found that one hour of lawn mowing can equal the same amount of pollution as driving a car for about 360 miles (or 580 km)!² Also, approximately 60% of nitrogen (used on lawns) can end up in groundwater!² These are all good reasons to reduce chemicals on your lawn, use rain water and start composting today!

Remember to check your fact sheet for more ways to “Grow Your Own”!

References:

4. <http://www.winnipeg.ca/waterandwaste/recycle/composting.stm>
5. http://www.safelawns.org/blog/wp-content/uploads/2012/09/Handout-Lawns_and_the_Environment.pdf

Have a great week and don't forget about all our ideas to become more sustainable below!

Sincerely,

Jill Bueddefeld

M.A. Student

Kinesiology and Recreation Management

University of Manitoba

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Ideas to Become More Environmentally Sustainable:

If you have a minute...

- **Flick it Off:** Turn off lights and electronics when you are done
- **Double Up:** Reduce, reuse, and recycle

If you have an hour...

- **Slow the Flow:** Buy low-flow toilets, faucets, showerheads, or other appliances
- **Buy Locally:** Choose locally produced and processed food

If you have a few hours or a day:

- **Get Involved:** Volunteer with an environmental organization or participate in local environmental activities
- **Grow Your Own:** Try chemical free gardening, lawn care, and composting

Interested in learning more? Try these links!

Learn more about this week's *sustainable activity*:

- [Click here](#) to watch a short video about how to compost from the City of Winnipeg
- [Click here](#) to learn more and watch a short video about how to recycle your grass!
- Still have questions about composting and not sure if it's something you can do? [Click here](#) and find out why composting is easy and good for both your garden and the environment!
- Rain barrels are a great way to save on water bills and water your lawn/garden naturally! [Click here](#) for more information and to find out where you can get a barrel today!

Learn more about *Polar Bears*:

- [Click here](#) to learn more about the current status of Polar Bears from Polar Bears International

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Learn more about *Conservation and Research*:

- [Click here](#) to watch a short video about biodiversity, species conservation, and Arctic habitat conservation in relation to zoos and aquariums.

Learn more about *Climate Change*:

- [Click here](#) to watch a video about Greenhouse Gasses.
- [Click here](#) to see a breakdown of Manitoba's Greenhouse Gas emissions

Learn more about *Sustainability*:

- [Click here](#) to learn more about how **you** can become more sustainable today!

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Post-Visit Action Resource Email 5

Hello!

Hope you are doing well since my last email and enjoyed the resources that were included in the last email.

This week I will be focusing on an activity that only takes a minute!

- **Double Up: Reduce, reuse, and recycle**

Did you know? “Last year alone, we collected 73,592,481 kgs. of residential recyclable materials in Manitoba; that’s enough to fill Canad Inns Stadium up to 5 feet deep. Recycling ensures useful materials aren’t wasted, and reduces the related consumption of raw materials and energy in manufacturing.”¹

Remember to check your fact sheet for more ways to “Double Up”!

References:

6. <http://www.simplyrecycle.ca/wp/faqs>

Have a great week and don’t forget about all our ideas to become more sustainable below!

Sincerely,

Jill Bueddefeld

M.A. Student

Kinesiology and Recreation Management

University of Manitoba

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Ideas to Become More Environmentally Sustainable:

If you have a minute...

- **Flick it Off:** Turn off lights and electronics when you are done
- **Double Up:** Reduce, reuse, and recycle

If you have an hour...

- **Slow the Flow:** Buy low-flow toilets, faucets, showerheads, or other appliances
- **Buy Locally:** Choose locally produced and processed food

If you have a few hours or a day:

- **Get Involved:** Volunteer with an environmental organization or participate in local environmental activities
- **Grow Your Own:** Try chemical free gardening, lawn care, and composting

Interested in learning more? Try these links!

Learn more about this week's *sustainable activity*:

- [Click here](#) to watch a short video about what can and cannot be recycled!
- Wondering what else can be recycled? Find out where you can recycle tires, electronics and batteries [here!](#)
- Want to find out more facts about recycling? [Click here!](#)

Learn more about *Polar Bears*:

- [Click here](#) to learn more about the Hudson the Polar Bear, at the Assiniboine Park Zoo!
- [Click here](#) to watch a video about the state of polar bears and their threats, from National Geographic.

Learn more about *Conservation and Research*:

- [Click here](#) to "Meet the Expert" from the World Wildlife Foundation on Polar Bear conservation and research.

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Learn more about *Climate Change*:

- Want to read more about climate change? [Click here](#) to check out some good books!

Learn more about *Sustainability*:

- [Click here](#) to learn more about sustainable development in Manitoba from the International Institute for Sustainable Development

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Post-Visit Action Resource Email 6

Hello!

Hope you are doing well since my last email and enjoyed the resources that were included in the last email.

This week I will be focusing on an activity that only takes an hour!

- **Slow the Flow: Buy low-flow toilets, faucets, showerheads, or other appliances**

Did you remember? That a leaking faucet can waste up to 11,000 litres (2,400 gallons) of water a year? ³ “That’s enough to fill a swimming pool that is 8 feet long, 10 feet wide and 4 feet deep!” ⁶ Get a FREE Power Smart & Energy Saver Kit from MB Hydro and Eco-fitt! The kit includes an energy-efficient massage showerhead (that uses up to 40% less water but still gives a satisfying shower), water-saving aerators for bathroom and kitchen faucets (which also use up to 40% less water), and 3 metres of pipe insulation (up to 12% of heating bill costs come from heating water which is often lost because of non-insulated pipes)! You can get a kit online at: <http://www.ecofitt.ca/mbhydro/> or call or 1-877-ECO-FITT (326-3488) toll-free.

Remember to check your fact sheet for more ways to “Slow the Flow”!

References:

7. <http://recycling-guide.org.uk/facts.html>

Have a great week and don’t forget about all our ideas to become more sustainable below!

Sincerely,

Jill Bueddefeld

M.A. Student

Kinesiology and Recreation Management

University of Manitoba

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Ideas to Become More Environmentally Sustainable:

If you have a minute...

- **Flick it Off:** Turn off lights and electronics when you are done
- **Double Up:** Reduce, reuse, and recycle

If you have an hour...

- **Slow the Flow:** Buy low-flow toilets, faucets, showerheads, or other appliances
- **Buy Locally:** Choose locally produced and processed food

If you have a few hours or a day:

- **Get Involved:** Volunteer with an environmental organization or participate in local environmental activities
- **Grow Your Own:** Try chemical free gardening, lawn care, and composting

Interested in learning more? Try these links!

Learn more about this week's *sustainable activity*:

- [Click here](#) to learn more about water saving tips from Manitoba Hydro.
- Wondering what else you can do to slow the flow? [Click here](#) to try more cost effective and easy ideas!

Learn more about *Polar Bears*:

- [Click here](#) to watch an interesting video all about the “numbers” of Polar Bears!

Learn more about *Conservation and Research*:

- **Did you know?** There is a Churchill Northern Studies Centre dedicated to “Understand and Sustain the North” where researcher’s come from all over the world to do their research? Check out this amazing centre [here](#)! They even do [learning vacations](#)!

Learn more about *Climate Change*:

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- Looking for a good documentary on climate change? Check out Al Gore's *An Inconvenient Truth* (you can find it on NetFlix or rent it from your usual movie rental place). Want an abbreviated version? [Click here](#) to watch this Tedx Talk! (approx. 30 minutes)

Learn more about *Sustainability*:

- Wondering what sustainability means for Winnipeg? [Click here](#) to read this excellent document on sustainability and Winnipeg, Manitoba!

Post-Visit Action Resource Email 7

Hello!

Hope you are doing well since my last email and enjoyed the resources that were included in the last email.

This week I will be focusing on an activity that is more challenging and rewarding!

- **Get Involved: Volunteer with an environmental organization or participate in local environmental activities**

Volunteering is an easy and fun way to have a direct and positive impact on your local environment and community. There are many great organizations in Winnipeg and Manitoba to volunteer with! [Click here](#) to find a volunteer opportunity today!

Remember to check your fact sheet for more ways to “Get Involved”!

For this week there is also a special video of Hudson swimming: check it out below! (no audio)

Have a great week and don't forget about all our ideas to become more sustainable below!

Sincerely,

Jill Bueddefeld

M.A. Student

Kinesiology and Recreation Management

University of Manitoba

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Ideas to Become More Environmentally Sustainable:

If you have a minute...

- **Flick it Off:** Turn off lights and electronics when you are done
- **Double Up:** Reduce, reuse, and recycle

If you have an hour...

- **Slow the Flow:** Buy low-flow toilets, faucets, showerheads, or other appliances
- **Buy Locally:** Choose locally produced and processed food

If you have a few hours or a day:

- **Get Involved:** Volunteer with an environmental organization or participate in local environmental activities
- **Grow Your Own:** Try chemical free gardening, lawn care, and composting

Interested in learning more? Try these links!

Learn more about this week's *sustainable activity*:

- Click these links to learn more about the benefits of volunteering and to find opportunities near you!
 - [Assiniboine Park](#) [MB Volunteer](#) [MB Eco-Network](#)

Learn more about *Polar Bears*:

- Wondering how exactly climate change impact polar bears? Find out [here!](#) (Click on Threats)

Learn more about *Conservation and Research*:

- **Did you know?** There is a Churchill Northern Studies Centre dedicated to “Understand and Sustain the North” where researcher’s come from all over the world to do their research? Check out this amazing centre [here!](#) They even do [learning vacations!](#)

Learn more about *Climate Change*:

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- [Click here](#) to watch this great video on climate change and why one scientist felt the need to speak out. Looking for more videos? [Click here](#) for a playlist of 8 more climate change talks from experts!

Learn more about *Sustainability*:

- Want to learn more about what sustainability is, through a fun animation? Then [click here](#), this video is for you! (Only 2 minutes long!)

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Post-Visit Action Resource Email: Conclusion

Hello,

This is the final email of this research project. I would like to thank you personally for your participation and interest throughout this research project. I hope you found the information interesting and useful in your everyday life.

Attached is your original personal meaning map that you created after your visit to the International Polar Bear conservation centre. Please take a few moments to look at it and think about any changes, deletions, or additions you would make. When I call you, we can discuss these changes.

You will also receive a link via email for the follow-up questionnaire. This final questionnaire will be very similar to the first one you did with me at the zoo, but shorter. **Please complete this final questionnaire as soon as possible as this is very important for my research.**

Thank you once again for your participation!

Also, please remember that your participation is voluntary and you can stop participating at any time.

If you are interested in staying connected with the Assiniboine Park Zoo you can connect with them on the following social media:

Facebook: <https://www.facebook.com/assiniboineparkzoo>

Twitter: <https://twitter.com/assiniboinezoo>

YouTube: <http://www.youtube.com/user/AssiniboinePark>

Instagram: Follow the zoo @assiniboineparkzoo to see the latest park & zoo photos. Don't forget to hashtag #assiniboineparkzoo when your own zoo pictures!

Sincerely,

Jill Bueddefeld

M.A. Student

Kinesiology and Recreation Management

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

University of Manitoba

Don't forget all the Ideas to Become More Environmentally Sustainable!

If you have a minute...

- **Flick it Off:** Turn off lights and electronics when you are done
- **Double Up:** Reduce, reuse, and recycle

If you have an hour...

- **Slow the Flow:** Buy low-flow toilets, faucets, showerheads, or other appliances
- **Buy Locally:** Choose locally produced and processed food

If you have a few hours or a day:

- **Get Involved:** Volunteer with an environmental organization or participate in local environmental activities
- **Grow Your Own:** Try chemical free gardening, lawn care, and composting

Appendix G

Hudson Updates

Hudson

This is Hudson the polar bear.
He was born on October 11 of
2011.

Here his is just 66 days old! 



Week 1

Polar Bear Facts

There are approximately only 20,000 – 25,000 polar bears left in the world.^{3,4}

Polar bears are currently classified as **vulnerable**, which means that they are at a high probability of becoming extinct in the wild.⁴

References:

1. assiniboineparkzoo.ca
2. torontozoo.com
3. polarbearsinternational.org
4. worldwildlife.org

Hudson's Background

Hudson was the only cub to survive his litter of three. He received around the clock care by the Toronto Zoo veterinary staff until he was three months old, at which time he was big enough (17 KG) to move to the Toronto Zoo's Tundra Exhibit in an enclosure adjacent parents Aurora (mother) and Inukshuk (father).^{1,2}

Did you know? Hudson's name was chosen as a result of a "Name the Cub" contest posted on Toronto Zoo's facebook page where "Hudson" was the most popular.⁴



This is Hudson when he is only 1 day old!

[Click here](#) to see more pictures of Hudson growing up at the Toronto Zoo.

[Click here](#) to watch videos of Hudson as a newborn, 2 month and 3 months old!

Fun Fact!

Polar Bears are born with pink noses that turn black when they are about 14 days old! ⁴

Hudson Updates

Hudson

This is Hudson the polar bear. He lives in the Assiniboine Park Zoo.

Here Hudson is 6 months old! ✍️



Week 2

Polar Bear Facts

Approximately 60% of the world's polar bears live in Canada.³

Other countries that have polar bears include: U.S.A (Alaska), Greenland, Russia, and Norway.³

References:

1. assiniboineparkzoo.ca
2. torontozoo.com
3. polarbearsinternational.org

Hudson's Background

Hudson was the only cub to survive his litter of three. He received around the clock care by the Toronto Zoo veterinary staff for the first three months of his life until he was big enough (17 KG) and was able to move to the Toronto Zoo's Tundra Exhibit to join his parents Aurora (mother) and Inukshuk (father).^{1,2}

Did you know? Hudson's Dad (Inukshuk) weighs 434 kg or 954 lbs!²



Photo Source: Toronto Zoo

This is Hudson when he is only 42 days old!

[Click here](#) to see more pictures of Hudson growing up at the Toronto Zoo.

[Click here](#) to check out Hudson's future home in the Journey to Churchill exhibit at the Assiniboine Park Zoo!

Fun Fact!

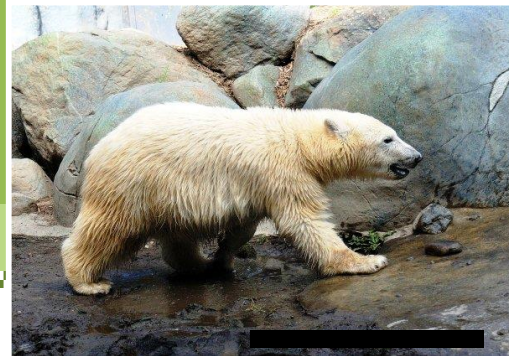
Polar Bears paws can measure up to 12 inches across!
Perfect for walking across thin sea ice.³

Hudson Updates

Hudson

This is Hudson the polar bear! He will be the first polar bear to live in the new Journey to Churchill exhibit coming in 2014!

Here Hudson is 11 months old! ✍



Week 3

Polar Bear Facts

Polar bears usually have 2 cubs per litter and typically only have 5 litters in their lifetime! This means they do not reproduce quickly or easily and we need to protect all the bears we can!³

References:

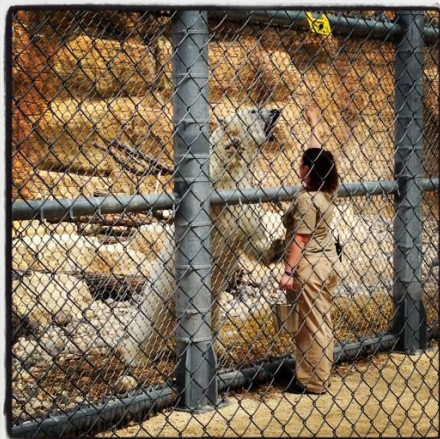
1. assiniboineparkzoo.ca
2. polarbearsinternational.org
3. cbc.ca/news

Hudson's Training

The Assiniboine Park Zoo uses positive reinforcement training to help in Hudson's daily care. Positive reinforcement training involves voluntary participation from Hudson to help keepers check his mouth, teeth, gums, feet and stomach to keep track of his health.^{1,4} You can watch and learn as the keeper explains this process daily outside the International Polar Bear Conservation Centre at 11:00 a.m.! You don't want to miss it!

Did you know? Hudson is often referred to as a "Ham" – he loves to be the centre of attention and get a reaction from visitors!²

[Click here](#) to scheduled times for positive reinforcement training happening at the Assiniboine Park Zoo!



Here Hudson is receiving Positive Reinforcement Training.

Fun Fact!

Polar bears live an average of 15-18 years in the wild. In zoos they can live up to their mid-late 30s. The previous polar bear at the Assiniboine park zoo, Debby, lived to be 42!⁵

Hudson Updates

Hudson

There is a team of people at the International Polar Bear Conservation Centre, working hard to ensure polar bears like Hudson will not become extinct.



Week 4

Polar Bear Facts

Adult male polar bears usually weigh 775 – 1,200 lbs! Females typically weigh 330 – 650 lbs. Pregnant females often weigh 600 lbs when they are about to have their young.¹

References:

1. polarbearsinternational.org



Meet the Team

Heather Penner, Conservation Specialist

(pictured above with Hudson)

I am both a zoo keeper and a part of the Conservation and Research team. This allows me to work directly with animals like Hudson and to help visiting researchers do their work in a manner that is safe for them and the animals.



Lucy Johnson, Laboratory Technician

I extract DNA from various samples that are collected within the zoo or from field research. From this DNA, we can learn more about an animal's genetic background and contribute to the conservation and health of the species.

Stephen Petersen, Head of Conservation and Research

My job is to guide the conservation and research efforts for the zoo. This means I get to do everything from conducting research on the genetics of polar bears and ringed seals, to doing fieldwork in the Arctic, to making sure that the Assiniboine Park Zoo is contributing to the conservation of species.

Fun Fact!

Polar bears usually spend more than 50% of their life hunting for food with only about 2% of those hunting trips resulting in a meal.¹

Hudson Updates

Hudson

Behind the scenes: Hudson's care at the Assiniboine Park Zoo.



Week 5

Polar Bear Facts

Polar bears usually sleep for about 7-8 hours at a time and often nap throughout the day. Polar bear naps happen anytime, and anywhere – often right after a meal. Naps help to conserve their energy. ¹

References:

1. polarbearsinternational.org



On my behind the scenes tour – definitely the best part of my research yet!

Hudson's Care

I had the incredible opportunity to see some behind the scenes aspects of Hudson's care for this project. What impacted me the most was every staff member I spoke to was so passionate about giving Hudson the best possible life. His keepers took care of every possible detail of his food, and gave him plenty of positive reinforcement as he ate his fish reward for going on the scale for a weight. You could tell that he was excited to see his keepers and recognized the sound of their voices. After eating his fish Hudson picked up his favourite toy (his kong – a large plastic chew toy) and lay down suckling his kong and making a deep purring noise (a sound of contentment).

I asked Heather (one of his primary keepers) what the best part of her job was and she said that it was having a relationship with a polar bear, having him recognize her voice, and being able to read his facial expressions. You could tell how much all the staff care about Hudson, and while we have to remember that he is still a polar bear, and not a pet – there is certainly a special bond between Hudson and the people who take care of him.

It is amazing to know and see how well Hudson is taken care of here at the Assiniboine Park Zoo and how much all the staff love and care for him.

Fun Fact!

Polar bears do not hibernate in the usual way (except for pregnant females who den for 3 months), instead they use "walking hibernation" which means their metabolism slows. ¹

Hudson Updates

Hudson

Here is Hudson keeping cool in summer.



Week 6

Polar Bear Facts

Polar bears eat the blubber of ringed and bearded seals. A typical adult ringed seal weighs about 150 lbs and is approximately 4 feet long!¹

References:

1. polarbearsinternational.org



Hudson's daily meal of fish is weighed in his kitchen, behind his enclosure.

What does Hudson eat?



Here Heather (one of Hudson's primary zoo keepers) is preparing Hudson's fish. She is injecting thymine and vitamin E which are important for Hudson's growth and development. Thymine and vitamin E occur naturally in fish, but break down when the fish are frozen, which is why it is supplemented in his diet. Everything Hudson eats is weighed and recorded so that his keepers can carefully monitor his health, growth, and development. Hudson will get 3-4 kilograms of fish daily and about 6 kilograms of his main carnivore diet (ground horse meat). Polar bears have growth spurts until about 4 years old, which is why Hudson's zoo keepers weigh him weekly and adjust the amount of food he needs according to his appetite and growth needs.

Did you know? Hudson gets all kinds of special enrichment food daily, like different types of fish, lettuce, pears, and carrots! His zoo keepers even hide peanut butter and jam around his enclosure so that he has to sniff it out and find it. This keeps his meals fun and challenging!

Fun Fact!

Hudson's pool is kept nice and cool for him in summer so that he won't get too hot, and his keepers give him icy treats a couple times a day to keep cool!

Hudson Updates

Hudson

A day in the life of Hudson:
Starting the day off right with breakfast!



Week 7

Polar Bear Facts

Polar bears are classified as marine mammals because they spend the majority of their lives on sea ice.²

References:

1. polarbearsinternational.org
2. worldwildlife.org



Hudson getting ready to jump into his pool!

Hudson's Routine

Hudson starts his day with the carnivore diet (ground up horse meat) for breakfast. Something nice and soft to help with his digestive system. After breakfast he will typically forage for hidden food and then play in his pool most of the morning. After tiring himself out from playing all morning he typically lays down for his mid-afternoon nap. After his nap he will usually spend the rest of the day playing in his pool and exploring his enclosure - remember how his keepers like to make it challenging and hide food in different places for him daily? While Hudson doesn't use a toothbrush like us, he still needs to clean his teeth! Hudson is given something harder, like bones, carrots or yams, to help keep his teeth clean and healthy. Then it's off to bed for Hudson. He will typically sleep about 6 hours every night and will wake up ready to play again!

Did you know? Hudson gets special enrichment items to stimulate his senses! These include spices like sage, mint, nutmeg, cloves, basil, oregano, rosemary, rose hips/petals, allspice, cinnamon, garlic, and ginger!

Fun Fact!

Polar bears have white fur to help camouflage them when hunting, but black skin to help soak up the sun and keep them warm!¹

Hudson Updates

Hudson

Hudson's future home in the Journey to Churchill exhibit.



Week 8

Hudson Facts

As Hudson grows the Assiniboine Park Zoo hopes he will become an integral part of the polar bear species survival program. To learn about the Canadian Endangered Species Plan (CESP) [click here](#).

References:

1. assiniboineparkzoo.ca
2. worldwildlife.org

Hudson's Future Home

The Journey to Churchill exhibit will feature three areas: Wapusk Lowlands, Gateway to the Arctic, and Churchill Coast. The Wapusk Lowlands will feature, snowy owls, muskox, Arctic fox, and caribou. The Gateway to the Arctic will feature land and underwater viewing of polar bears and ringed seals (in separate tanks of course!). The Churchill Coast will feature polar bears and aspects resembling the town of Churchill. The Tundra Grill is the final piece where visitors can sit down for a meal while watching polar bears walking by! ¹

[Click here](#) to watch a video about the future Journey to Churchill exhibit!

[Click here](#) to help build a home for Hudson!



Future polar bear viewing area in the Journey to Churchill exhibit.

Fun Fact!

When polar bears swim they paddle with their front paws and use their hind legs like a rudder! ²

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Appendix H

Categorical Coding Rubric

1. Environmental Impacts of Climate Change

People contribute to impacts, but do not directly cause them

a. Global (large scale impact)

i. Immediate impacts

- Melting
- Weather change – getting hotter, storms, earthquakes
- Extreme weather
- Acid rain

ii. Temporal impacts

- Global warming
- Climate change
- Long term weather patterns
- Ozone
- Global Warming (connected to polar bears, seals and extinction) temperatures are warmer, harder to live where they are

b. Regional (small scale impacts)

i. Immediate impacts

- Ice caps: polar bears losing food sources and transportation routes
- Calgary flood

ii. Temporal impacts

- American drought in 40s and 50s
- Low flow in Bow River
- Arctic Ice is 30% less
- Less Arctic Ice

2. Human Impacts on the Environment/Animals

People directly contribute to impacts

a. Global

i. Immediate impacts

- Waste going into oceans, pollutes
- Wars (violent) and often due to oil
- Everything we buy
- Pollution – how people pollute
- Bulldozing

ii. Temporal impacts

- Hundreds of years – problems with oil, power plants,
- Fossil fuels – how people use them, what they're used for

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- Coal
- Nuclear: not the greatest
- Run out of non-renewable natural resources
- Population growth: more people is harder to sustain
- Lots of mining companies
- Global Warming
- Extinction – danger
- Increase of CO₂
- Human illness/respiratory problems
- Need to look after them, God given authority, forcing out of natural habitat, saving species, need bees to pollinate crops, how we affect them [animals]
- Animals: how we affect them
- People – how they affect everything
- Water as a human right

b. Regional

i. Immediate impacts

- Tear down forest for bipole
- Conservation issues – taking away their (animals) home, rainforest
- Selkirk river issue

ii. Temporal impacts

- Losing one species affects everything else (butterfly effect)
- Canadian government gave people more rights to mine the land
- Bee colony collapse (since this is always specific to a region)
- Impact on endangered and invasive species (also specific to a region – typically)
- Churchill and polar bear references

3. Components of Environmental Sustainability

a. Personal Components

i. Energy

- Home power generation: using your home to solar and wind power systems
- Energy efficient housing
- Turn off lights
- Electricity Saving
- be Powersmart!
- Conserve resources, emissions,

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

ii. Waste Management

- Buying secondhand
- Composting – same as recycling, less for garden
- How we recycle
- Recycle, reuse helps with sustainability
-

iii. Chemical Use

- Pesticide control in garden
- Chemicals on lawn

iv. Transportation

- Biking
- Taking the bus

v. Food

- Buying local *this could be under energy since it saves fossil fuels

vi. Environment/Animals

- Environmentally friendly
- Purchase environmentally friendly products

vii. Individual Action

- Boycott (won't work for companies producing waste)
- Join environmental organization like WWF
- The most important part is me: I make better choices in my consumption, purchases, what I advocate for, and teach kids

b. Societal Components

i. Energy

- Wind, tidal, hydro
- Energy efficiency
- Alternative energies
- European cities not only energy neutral , produce more power than they consume
- Power plants: Some good some bad
- Renewable resources
- Conserve energy

ii. Waste Management

- Cut down on landfill and waste
- Societal level recycling programs

iii. Chemical Use

- Pesticide and chemical use on crops

iv. Transportation

- Electric rail lines
- Small local farming is solution to transportation issue
- Bike Lanes

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

v. Food

- Family farms more viable
- People need to grow their own

vi. Environment/Animals

- Conservation animals
- Saving species
- Beekeeping: important because bees are dying, pollinate flowers and crops, make honey
- IPBCC exhibit shows how they monitor polar bears and their health
- Conserve the environment
- trees, glue for earth, absorb CO₂,

4. Education and Awareness

a. Environmental Education

- Research
- Places like the IPBCC
- Educate students
- Arming people with the right education is key
- Correct information
- Knowledge in university – has opened eyes to wastefulness of society
- Organizations like WWF

ii. Specific to the IPBCC

- Learning in IPBCC
- Saw how polar ice caps change from now to 2040 (in IPBCC)

iii. Education Issues

- Education for public isn't adequate (people don't like to be lectured they like to be informed – small percent will follow, not majority)
- Telling us that we are causing change, general public doesn't get the just (gist)
- Educate so people know what is going on - a lot of people don't care because they don't know

b. Media/Mediums

- Coca-coal ads
- Commercials
- Videos about polar bears
- Discovery channel
- Heard on CBC
- Heard on the Radio
- Heard on Fox news

c. Uncertainty

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

i. Lack of awareness/concern

- don't know why waste water goes into rivers
- people don't know about this or would be concerned
- We don't know the history and climate extremes
- Education and public acceptance of climate change: still a lot of deniers, still some questions
- What are the causes (of climate change)
- How are they monitoring climate change
- How can everyone do their part
- How does climate change affect animals, the planet
- What tells us we cause the change
- **Incorrect facts**

ii. Questioning climate change

- how are they monitoring climate change?
- Some is natural some is not, the climate always changes
- not compelling enough evidence, could be natural, not necessarily man-made
- climate always changes
- Climate change: going up one degree and science are not compelling

5. The Future

a. Benefits

i. Personal

- teaching children, learning, making a difference for kids and future generations
- family farms, grow own produce and meat, interact with people
-

ii. Societal/Global

- Have an environment for our kids to live in
- Make life better for the animals and everything around us
- Save money on shipping things around the world
- Everyone pitches in,
- University student jobs (planting trees)

b. Barriers

i. Personal

- would take the bus but need better public transit

ii. Societal

- People need more details and need to be respected
- Need to be wealthy because no government support
- Need more efficient transportation
- Driving around a lot, hard to avoid when camping and hauling the camper (feel guilty)

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

- Recycling: cost is on consumers rather than businesses
- Can't do anything about neighbours who use pesticides
- Kids not recycling, throwing garbage on the ground – why do they feel they have the right to throw it on the ground?
- People don't know about waste going into rivers and lakes
- People think about money not impact
- 3rd world uses/produces more (garbage)
- People in N.A. toss out whatever
- All about the individual - If all the other individuals out there ignore it than won't make a difference
- World hunger – need to feed people
- Government support and action – government in Canada aren't doing much to support people
- Railroads and public transit, high burning fuel cars, suburbs and no place to buy food
- Government in Canada aren't doing much to support people
- society doesn't make this easy, social aspect – people don't engage in communal activities

Appendix I

Quantitative Rubric:

Extent: The number of words/phrases/images in each breadth category – “quantity of appropriate vocabulary used” (Falk et al., 1998, p. 111)

Count individual words/sentences as separated by commas or semi-colons. Refer to the original when in doubt. Do not count duplicates or words/sentences that are irrelevant i.e. I love ice cream

Number of Words/Images/Phrases:

1-5	=	Extent score of 1
6-10	=	2
11-15	=	3
16-20	=	4
21-25	=	5
26-30	=	6
31-35	=	7
36-40	=	8
41-45	=	9
46+	=	10

Breadth: The number of conceptual categories “range of conceptual understanding” (Falk et al., 1998, p. 111).

Depth: “quality of use of each concept” (Bowker & Jasper, p. 144), in general – the level of sophistication, “how detailed and complex, within a conceptual category descriptions were” (Falk et al., 1998, p. 111).

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

Depth	Very Poor	Below Avg.	Average	Good	Excellent
Score	1	2	3	4	5
Description	Limited understanding/ no elaboration/ no connections	Some understanding/ attempted elaboration/ few connections	Reasonable understanding/ average elaboration/ average connections	Good understanding/ good elaboration/ good connections	Detailed and in-depth understanding/ significant elaboration/ significant connections

(Adapted from Bowker & Jasper, p. 144)

*For connections – look for meaningful connections, not just lines drawn at random.

Mastery: “overall facility with which visitors described their understanding” (Scale of 1-5; 1= novice, 5= expert)

EXPLORING THE ROLE OF POST-VISIT ACTION RESOURCES

1 = Novice

2 = Below Average

3 = Average

4 = Good

5 = Expert

Mastery	Novice	Below Avg.	Average	Good	Expert
Score	1	2	3	4	5
Descripti on	Limited understandin g, vocabulary, quite a few misconceptio ns, only 1-2 breadth categories	Some understandin g and a few misconceptio ns, 1-3 breadth categories	Reasonable understandin g/ average elaboration, little or no misconceptio ns, 2-4 breadth categories	Good understandin g and descriptions, no misconceptio ns, 2-5 breadth categories	Detailed and in-depth understandin g with correct vocabulary, no misconceptio ns, 3-5 breadth categories