UNDERSTANDING HEALTH AND PHYSICAL ACTIVITY MESSAGES

Understanding Health and Physical Activity Message Strategies: Risk Information and Message Framing

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Abstract

The purpose of this dissertation was to examine the use of health risk communications as a strategy to change risk perceptions and motivate leisure time physical activity (LTPA) among people with spinal cord injury (SCI). Guided by protection motivation theory (PMT; Rogers, 1983) and the extended parallel processing model (EPPM; Witte, 1992), two strategies were examined as unique approaches to enhancing the effectiveness of health risk information. First, risk information was tailored to individualized, objective data regarding participants' health risk. Second, risk information was supplemented with framed leisure time physical activity (LTPA) efficacy messages. Gain-framed messages emphasized the benefits of LTPA, whereas loss-framed messages emphasized the risks of inactivity. The relative effectiveness of gain- versus loss-framed messages was considered within the context of the EPPM (Witte, 1992). A secondary purpose of the dissertation was to explore cognitive processing in relation to framed LTPA messages. The attention and elaboration phases of cognitive processing were examined for gain- and loss-framed LTPA messages following exposure to health risk information.

Three experiments were conducted to 1) test the effectiveness of individualized health risk information for changing health risk perceptions and LTPA among people with SCI, 2) test the relative effectiveness of gain- and loss-framed LTPA efficacy messages presented following health risk information for changing LTPA response efficacy and LTPA intentions among people with SCI, and, 3) investigate the relative attention given to gain-framed versus loss-framed LTPA response efficacy messages following presentation of health risk information to university students. The theoretical and pragmatic contributions are discussed.

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List of Abbreviations

ANCOVA	Analysis of co-variance
ANOVA	Analysis of variance
BMI	Body mass index
CVD	Cardiovascular disease
EPPM	Extended parallel process model
LTPA	Leisure time physical activity
MANOVA	Multiple analysis of variance
PARA-SCI	Physical activity recall assessment for people with spinal cord injury
PMT	Protection motivation theory
RHI	Rick Hansen Institute
SCI	Spinal cord injury

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CHAPTER 1

Review of Literature

1.0 SPINAL CORD INJURY AND INACTIVITY-RELATED HEALTH PROBLEMS

Spinal cord injury (SCI) is most often the result of a traumatic event such as a fall or motor vehicle accident that causes permanent damage to the spinal cord and results in varying degrees of disability. There are approximately 44,000 people in Canada living with traumatic SCI and an estimated 1,800 new injuries occur each year (Rick Hansen Institute [RHI], 2010). Individuals who incur an injury to the cervical region of the spinal cord are said to have tetraplegia and are likely to sustain impairments to the function of their upper and lower extremities. Alternatively, individuals who incur an injury to the thoracic or lumbar regions of the spinal cord are said to have paraplegia and are likely to sustain impairments to the lower extremities only. The SCI population is approximately 55% people with tetraplegia and 45% people with paraplegia. The degree of impairment is dependent on the severity of the injury and can vary from minimal functional deficits to complete loss of physical function below the level of the injury. Most individuals preserve some functional abilities following SCI (RHI, 2010).

Physiological and lifestyles changes following SCI can result in poor health. For example, muscle impairment and paralysis can lead to increased fat mass and reduced muscle mass (Jones, Legge, & Goulding, 2003), while reduced physical activity and increased sedentary behaviour further contribute to severe physical deconditioning for many individuals (Jacobs & Nash, 2004). Accordingly, people with SCI are at an increased risk for inactivity-related diseases such as cardiovascular disease, type 2 diabetes, and obesity (Nash, 2005). These secondary health complications, combined with the potential psychosocial impact of SCI (e.g., decreased self-esteem and self-efficacy, reduced quality of life) lead to an increased risk for psychological health problems such as depression, chronic pain, and fatigue (Kennedy & Rogers, 2000; Turner, Cardenes, Warms, & McClellan, 2001; Hammell, Miller, Forwell, Forman, & Jacobsen, 2009).

2.0 SPINAL CORD INJURY AND LEISURE TIME PHYSICAL ACTIVITY

2.1 Benefits of Leisure Time Physical Activity for People with Spinal Cord Injury

Emerging evidence suggests that in the SCI population, leisure time physical activity (LTPA; physical activities people choose to do during free time such as LT-wheeling, exercise or sports) but not necessarily lifestyle activities (activities people need to do in their daily lives such as dressing and bathing) may be essential in maintaining good health and attaining health benefits. Indeed, participation in regular LTPA has the ability to reduce the risk of secondary complications and inactivity-related diseases including heart disease, type-two diabetes, and obesity among people with SCI (Nash, 2005; Buchholz, Martin Ginis, Bray, Craven, Hicks, Hayes, et al., 2009). There is also substantial evidence that regular participation in LTPA can improve psychological well-being and reduce the risk of psychological health problems including depression, chronic pain, and fatigue (Hicks, Martin, Ditor, Latimer, Craven, Bugaresti, & McCartney, 2003; Martin Ginis, Jetha, Mack, & Hetz, 2009). Indeed, there are copious physical and psychological health benefits of LTPA for people with SCI.

2.2 Leisure Time Physical Activity Among People with Spinal Cord Injury

Lifestyle activities make up a substantial portion of the daily physical activity for people with SCI (Pentland, Harvey, Smith, & Walker, 1999), however they do not contribute to improved health in this population (Jacobs & Nash, 2004). Despite the recognized benefits of LTPA, 50% of people with SCI do no LTPA whatsoever (Martin Ginis, Latimer, Arbour-Nicitopoulos, Buchholz, Bray, Craven, et al., 2010). Initiatives to increase LTPA participation among people with SCI are necessary to optimize the physical and psychological health of this population.

3.0 INCREASING LEISURE TIME PHYSICAL ACTIVITY AMONG PEOPLE WITH SPINAL CORD INJURY

In recognition of the need to increase LTPA participation, a recent program of research has developed evidence-based LTPA guidelines specific to the SCI population (Martin Ginis, Hicks, Latimer, Warburton, Bourne, Ditor, et al., 2011). These guidelines specify *how much* and *what types* of LTPA are necessary for people with SCI to obtain fitness benefits. The guidelines are an important first step to *inform* people with SCI about LTPA. However, the guidelines are not designed to *motivate* individuals to engage in LTPA. Thus, in order to be effective, the guidelines must be supplemented with additional strategies to motivate and encourage adherence to the LTPA recommendations (see Latimer, Brawley, & Bassett, 2010).

3.1 Health Risk Information: Increasing Risk Perceptions and Leisure Time Physical Activity

Many individuals underestimate their risk for health problems (Weinstein, 1982) including various diseases and psychological disorders (Weinstein, 1987). This optimistic bias is a common tendency to perceive personal risk as lower than that of similar others (Weinstein, 1989). Many individuals with SCI may be unaware of the increased risk of disease and psychological health problems associated with SCI, which may exacerbate the optimistic bias phenomenon. Unrealistically optimistic beliefs about one's risk for health problems can be problematic in that they may thwart motivation or effort to engage in risk-reducing behaviours such as LTPA (Weinstein, 1989).

In some cases, individuals develop an optimistic bias regarding health risks as a defensive denial mechanism, which serves to protect them from worry or anxiety that may be associated with acknowledging a threat (see Weinstein, 1987). In other cases, an optimistic bias can serve to enhance or maintain self-esteem (Weinstein, 1984). This is particularly true when the health risk is preventable (e.g., type-two diabetes) and acknowledging risk would necessitate recognition of

one's irresponsibility in taking measures to prevent the risk (Weinstein, 1987). For some, an optimistic bias may result from a legitimate lack of knowledge regarding personal risk. For example, a sedentary individual may not be aware that inactivity is contributing to increased risk for heart disease. Likewise, many individuals with SCI may be unaware that they are at an increased risk for disease and psychological health problems by virtue of living with an SCI.

Whatever the contributing cause(s) of one's optimistic bias, information about risk for disease and psychological health problems may serve to increase awareness of risk and decrease optimistic bias. A narrative literature review suggests that communicating risk information can effectively change risk perceptions (Gerrard, Gibbons, & Reis-Bergan, 1999). With regard to health risk per se, risk communication strategies have proven effective in increasing risk perceptions for various inactivity-related diseases such as heart disease (Avis, Smith, & MacKinlay, 1989; Milne, Orbell, & Sheeran, 2002; Grover, Lowensteyn, Joseph, Kaouache, Marchand, Coupal, & Boudreau 2007) and cancer (McGowan & Prapavessis, 2010). Indeed, these aforementioned studies found that providing participants with generic information about heart disease and cancer resulted in enhanced perceived risk. Furthermore, in some instances, enhanced risk perceptions resulted in increased LTPA intentions (Milne et al., 2002) and LTPA behaviour (Wurtele & Maddux, 1987).

Despite the promise of risk communication strategies to promote LTPA, there are some instances where risk information has not successfully enhanced perceived risk for inactivity-related disease. For example, in multiple interventions, the presentation of cancer risk information did not change participants' perceived cancer risk (e.g., Courneya & Hellsten, 2001; Graham, Prapavessis, & Cameron, 2006). Even more discouraging, is the fact that even among the studies that enhanced perceived risk, the increased perceptions of risk for inactivity-related

disease did not always translate to changes in intentions to engage in LTPA (e.g., McGowan & Prapavessis, 2010), or changes in LTPA (Milne et al., 2002). Certainly, further research is necessary to investigate strategies to improve the effectiveness of health risk information as a tool to enhance perceived risk for inactivity-related disease and to promote LTPA.

4.0 STRATEGIES FOR USING RISK INFORMATION TO PROMOTE LEISURE TIME PHYSICAL ACTIVITY

4.1 Individualizing

Individualizing of risk information may prove beneficial as a strategy to enhance its effectiveness in changing risk perceptions, intentions, and LTPA (see Albada, Ausems, Bensings, & Van Dulmen, 2009; Noar, Benac, & Harris, 2007). Individualizing refers to the process of matching risk information to some individual aspect of the recipient. Previous risk information interventions have tailored information to social-cognitive (e.g., beliefs about risk), demographic (e.g., age), behavioural (e.g., current LTPA level), and cultural (e.g., race) characteristics of the information recipient. Reviews of the effectiveness of individualized versus generalized risk information demonstrate the value of individualized risk information for enhancing knowledge, increasing realistic health risk perceptions (Albada et al., 2009), and health changing behaviours (Noar et al., 2007).

At the most simplistic level, tailoring health risk information might highlight the risks associated with population characteristics. For example, heart disease risk information presented to an individual with SCI might be targeted to the population in the following manner: “People with SCI are at an increased risk of heart disease compared to the general population. Heart disease is a major cause of death among people with SCI.” Alternatively, the ultimate form of individualizing health information might be in the form of providing personal, objective health

risk information such as: “Your waist circumference is 110cm. People with a waist circumference greater than 102cm are at risk for heart disease.”

The use of individualized, objective health risk information has been tested as an intervention to increase risk perceptions for various diseases. There is evidence, albeit limited by a relatively small number of empirical studies, that individualized health risk information may be an effective tool for changing risk perceptions (see Gerrard et al., 1999). For example, feedback from heath risk appraisals (e.g., assessments of cholesterol levels, blood pressure, body weight) increased perceived risk for heart attack, particularly among those who were at or above average risk based on their objective health risk information (Avis et al., 1989). Likewise, perceived risk for stroke and cancer increased among individuals who received individualized health risk feedback (Kreuter & Strecher, 1996). Some research suggests that the use of individualized health risk information may be superior to the use of generic risk information for changing perceptions of risk for health problems (Albada et al., 2009).

4.2 Limitations of Existent Individualizing Risk Information Research

Despite the evidence that individualized risk information can change perceptions of disease risk, there are limitations to the extant research, which undermine the conclusions that can be drawn from the literature. A first major inadequacy of the research is the limited understanding of whether changes in risk perception translate to changes in health behaviour. We are aware of only one study in the exercise science literature which applied individualized health risk information as an intervention to change disease risk perceptions *and* subsequently tested the effect on LTPA (Avis et al., 1989). In that study, changes in perceived risk following health risk appraisal feedback were not significantly related to changes in LTPA behaviour. However, the study was statistically underpowered to detect such as relationship, which may account for the

null findings particularly if the effects of the individualized health risk information on behaviour were small. Further research is certainly warranted to examine the relationship between changes in perceived risk for disease and LTPA.

An additional limitation is the lack of research investigating the use of individualized risk information in special populations such as individuals with SCI. We are unaware of any research that has examined the effectiveness of individualized health risk information among people with SCI. Given the increased risk for inactivity-related disease and health problems among the SCI population (Nash, 2005), knowledge of disease risk may be an important determinant of health behaviour. It has been suggested that perceived risk for health problems may be a particularly salient predictor of LTPA among people with chronic disease and disabilities (Plotnikoff & Trihn, 2010). As such, research examining the effectiveness of individualized health risk information for changing risk perceptions and LTPA among people with SCI could provide valuable information regarding health risk communication strategies.

4.3 Message Framing

The effectiveness of health risk information as a strategy to promote LTPA can be enhanced through supplementing the risk information with behaviour change messages (Kreuter & Strecher, 1996). Behaviour change messages provide information about a given behaviour and its relationship to the targeted health risk. For example, after presenting individuals with information about their increased risk for heart disease, a behaviour change message might be one that illustrates the negative relationship between regular LTPA and heart disease. Obviously, the use of optimally persuasive messages is ideal. Message framing is one recommended strategy for enhancing the effectiveness of LTPA behaviour change messages (Latimer et al., 2010). Message framing refers to the strategic emphasis of the benefits of engaging in habitual LTPA

(i.e., gain-framed messages) versus the risks of not engaging in LTPA on a regular basis (i.e., loss-framed messages). An example of a gain-framed message is "by engaging in regular LTPA you reduce your risk of diabetes." An example of the same information presented as a loss-framed message is "by not engaging in regular LTPA you increase your risk of diabetes." Although the messages are contextually identical and the differences are subtle, there is conclusive evidence that people respond differently depending on the message frame (see Rothman & Salovey, 1997). This psychological phenomenon begs the question; which types of messages are most effective for persuading LTPA behaviour change following health risk information?

Researchers have looked to prospect theory (Kahneman & Tversky, 1979) as a framework for understanding differences in the relative effectiveness of gain- and loss-framed messages. Prospect theory proposes that individuals make behavioural decisions based on perceptions of the risks associated with the outcome of performing a given behaviour. According to prospect theory, an individual is more likely to be persuaded by potential gains when the target behaviour is perceived to have low risk outcomes, and will be persuaded by an emphasis on losses when the target behaviour is perceived to have high risk outcomes. This tenet of prospect theory has been applied to understanding framed messages designed to persuade health behaviour change. Health prevention behaviours (e.g., LTPA) are thought to have low risk outcomes (e.g., improved health), while health detection behaviours (e.g., cancer screening) are thought to have high risk outcomes (e.g., possible detection of cancer). Accordingly, under the application of prospect theory, gain-framed messages are thought to be more persuasive for LTPA than contextually equivalent loss-framed messages (Rothman & Salovey, 1997).

A recent systematic review of message framing studies targeting LTPA promotion suggests that gain-framed messages may be superior to loss-framed messages (Latimer et al., 2010). Likewise, meta-analytic results support the notion that gain-framed messages may have an advantage, albeit small, over loss-framed messages for persuading LTPA (O'Keefe & Jensen, 2007). Some researchers suggest there is "sufficient evidence to recommend the use of gain-framed messages when developing initiatives to promote health prevention behaviours" such as LTPA (Rothman, Bartels, Wlaschin, & Salovey, 2006). Indeed, several separate studies have demonstrated gain-framed messages were more effective than loss-framed messages (e.g., Gray & Harrington, 2011) and mixed-framed messages (Latimer, Rench, Rivers, Katulak, Materese, Cadmus, et al., 2008; Parrot, Tennant, Olejnik, Poudevigne, 2008) for increasing LTPA intentions.

4.4 Limitations of Existent Message Framing Research

Although there is a body of evidence promoting the use of gain-framed messages in LTPA promotion, there are some important limitations that need to be addressed in further research. First, there are mixed findings regarding the relative effectiveness of gain- versus loss-framed LTPA messages. For example, there are instances where message effects on LTPA intentions and behaviour did not differ as a function of message frame (e.g., Jones, Sinclair, Rhodes, & Courneya, 2004). In other cases, the relative effectiveness of gain- and loss-framed messages was moderated by an additional variable such as message source credibility (e.g., Jones et al., 2004), participant LTPA levels (e.g., Parrott et al., 2008) and message topic (e.g., self-esteem versus health; Robberson & Rogers, 1988). The equivocal evidence suggests that further research in the area is certainly warranted.

Second, we are unaware of any research that has tested the relative effectiveness of gain- and loss-framed messages following the presentation of health risk information. Given that health risk information can change perceptions of health risk (e.g., Grover et al., 2007), and LTPA intentions (Milne et al., 2002), it follows that exposure to health risk information could impact the effect of subsequent framed LTPA messages.

Third, there is a paucity of LTPA message framing research among people with disabilities such as SCI. Given the increased risk for inactivity-related disease in this population (Nash, 2005), the need for LTPA-enhancing initiatives, and the promise of message framing as a strategy to enhance LTPA (Latimer et al., 2010), research in this area should be extended to the SCI population. We are unaware of any message framing research in the SCI population.

Fourth, there is a major gap in message framing research regarding the mechanisms underlying message framing effects (Rothman & Updegraff, 2009). It is important to understand the mechanisms responsible for message framing effects so that we can determine the context in which a message is most likely to influence LTPA (Brinol & Petty, 2006). Unfortunately, there is very limited empirical evidence to elucidate message framing mechanisms. Accordingly, there has been a call for research to investigate the processes underlying message framing effects. To date, the following three mechanisms have been proposed: 1) cognitive processing of the message content; 2) message fluency; and 3) cognitive and affective responses (see Rothman & Updegraff, 2009). Cognitive processing is a particularly interesting potential mechanism of framing effects.

4.5 Cognitive Processing as a Mechanism of Message Framing

There are two aspects of cognitive processing that may explain the differential effects of gain- versus loss-framed LTPA messages. First, a framed message must capture sufficient attention

from the recipient. Indeed, attention is a critical stage of cognitive processing which is necessary for message elaboration and persuasion (Greenwald & Leavitt, 1984). Second, a framed message must be sufficiently elaborated upon (i.e., thought about and considered). It has been suggested that relative differences in attention and elaboration of gain- and loss-framed messages may explain variations in the message effects. Consistent with this logic, one might hypothesize that greater attention and elaboration of gain-framed LTPA messages compared to loss-framed LTPA messages may explain the gain-framed message advantage observed in previous research (e.g., Jones et al., 2003).

Traditionally, message elaboration is measured by participants' accurate recall of the message content or the number of message-relevant thoughts generated by the message exposure. More accurate recall of the message content and more message-relevant thoughts are believed to be indicative of greater message elaboration. A meta-analysis examining the relative processing of framed messages targeting health prevention behaviours (e.g., LTPA) found greater elaboration of gain- versus loss-framed messages (O'Keefe & Jensen, 2008). Unfortunately, there is little research examining the relationship between framed LTPA message effects and message elaboration. However, one study found more accurate message recall and more message-relevant thoughts following gain- compared to loss-framed LTPA messages (Jones et al., 2003). Certainly, more research is necessary to explore message elaboration as a mechanism of LTPA message framing effects.

Although the attention component of cognitive processing has also been suggested as a potential mechanism of message framing (independent of message elaboration; see O'Keefe & Jensen, 2008), there is little research examining the attention component of cognitive processing. In fact, previous researchers have only drawn assumptions about attention based on participants'

elaboration of the message. For example, it has been suggested that greater message recall and more message-relevant thoughts must be the result of greater attention paid to the message content (e.g., Higgins & Tykocinski, 1992). However, this assumption does not further our understanding of attention as a potential mechanism of message framing effects because researchers have not directly measured attention; research that directly assesses attention is necessary to advance our knowledge in this regard. Eye dwell time on message content is a biometric indicator of attention that is directly related to other aspects of cognitive processing (Krugman, Fox, Fletcher, Fletcher, Rojas, 1994). Research that explores the relationship between dwell time and message framing effects could contribute to our understanding of attention as a mechanism to explain framing effects.

5.0 THEORETICAL FRAMEWORKS FOR UNDERSTANDING RISK INFORMATION AND LEISURE TIME PHYSICAL ACTIVITY MESSAGES

It is important to employ a theoretical framework for investigating risk information and LTPA message interventions. In order to be most effective, all LTPA interventions should be theory-driven (Baranowski, Anderson, & Carmack, 1998). In the current dissertation, the protection motivation theory (PMT; Rogers, 1983) and the extended parallel process model (EPPM; Witte, 1992) were chosen as both a guide for message development, and a framework for studying and interpreting the effects of the messages. These theories are useful for examining risk communications (see Witte, 1992) and are helpful in understanding the relationship between risk perceptions and behaviour change. Further, the EPPM (Witte, 1992) provides a conceptual framework for exploring cognitive processing as a mechanism of message framing effects.

5.1 Protection Motivation Theory

Protection motivation theory (PMT; Rogers, 1983) considers perceptions of personal risk as a cognitive process influencing health behaviours such as LTPA. Accordingly, PMT may be a useful theoretical framework for examining the effects of health risk information on risk perceptions and LTPA. In this context, PMT asserts that an individual is more likely to engage in LTPA when he or she perceives a high personal risk of disease or health problems (i.e., high vulnerability). PMT is useful in developing and understanding persuasive communications aimed at changing health behaviours (Norman, Boer, & Seydel, 2005). PMT considers *protection motivation* (i.e., intention to engage in a given health behaviour) as the most proximal predictor of health behaviour. In turn, *threat appraisal* and *coping appraisal* are thought to predict *protection motivation. Rewards, perceived vulnerability* (i.e., perceived disease risk) and *perceived severity* (i.e., perceived severity of the disease) are the components of *threat appraisal,* while r*esponse efficacy* (i.e., beliefs about the effectiveness of a given health behaviour in reducing disease risk), *self-efficacy* (i.e., confidence to perform a given health behaviour), and *response costs* comprise *coping appraisal*.

Although each construct of PMT is important for understanding motivation for health-protective behaviours such as LTPA, the perceived vulnerability (i.e., perceived health risk) construct is most salient among the PMT constructs for investigating the effects of health risk communications targeting perceived risk. Further, given the increased risk for disease and health problems following SCI, there may be benefit in targeting the perceived risk variable through the use of health risk communications. Within the PMT, perceived disease risk may have a particularly important influence on LTPA change for many individuals with SCI.

Supplementing health risk information with subsequent framed LTPA messages may prove beneficial in targeting the response efficacy construct of PMT. Messages providing information

about the benefits/risk of LTPA/inactivity may serve to enhance one's beliefs about the efficacy of LTPA to act as a risk-reduction strategy. Within the framework of PMT, enhanced response efficacy could motivate LTPA (Rogers, 1983). For individuals with SCI, a lack of knowledge regarding the benefits of LTPA is often cited as a barrier to LTPA participation (Rimmer, Rubin, & Braddock, 2000). Accordingly, messages that enhance LTPA response efficacy may also have an important influence on LTPA among people with SCI.

Taken together, PMT (Rogers, 1983) is a useful framework for designing and evaluating the effectiveness of health risk communication strategies and framed LTPA messages. However, the tenets of PMT do not provide a theoretical framework for investigating mechanisms of message framing effects. That is, PMT does not offer an explanation for *how* differences in the relative effectiveness of gain- and loss-framed messages transpire.

5.2 Extended Parallel Process Model

"The extended parallel process model (EPPM) picks up where the original PMT left off" (Witte, 1992, p. 337). EPPM suggests that individuals who receive risk information will first appraise their personal risk. Similar to PMT (Rogers, 1983), this appraisal of personal risk is related to protection motivation, or intentions to engage in a recommended behaviour. However, EPPM extends our understanding of the impact of risk information on behaviour by describing the processes expected to follow risk appraisal and lead to behaviour change. According to EPPM, when individuals perceive moderate to high personal risk, fear is triggered, and they are motivated to process the subsequent messages and evaluate the efficacy of the recommended response. Conversely, if individuals perceive low personal risk, fear will not be evoked, and they will not be motivated to process and evaluate the efficacy of the recommended response (Witte, 1992). When both perceived risk *and* response efficacy are high following risk information and

message exposure, individuals will be motivated to engage in the recommended behaviour. Therefore, health risk information messages should be developed to evoke personal risk perception; accompanying LTPA messages should target response efficacy in order to motivate changes in LTPA.

EPPM (Witte, 1992) maintains that perceived personal health risk initiates and motivates processing of subsequent LTPA messages. As such, cognitive processing of the LTPA messages acts as a mechanism influencing their effectiveness. The cognitive processing mechanism may also extend to explain message framing effects. Fitting with EPPM, differential levels of cognitive processing may explain differences in the relative effectiveness of gain- and loss-framed LTPA messages. Accordingly, the EPPM may be a useful framework for examining message framing effects following the presentation of health risk information.

6.0 GENERAL PURPOSE OF DISSERATION

The primary purpose of the dissertation was to examine the use of health risk communications as a strategy to change risk perceptions and motivate LTPA among people with SCI. Two strategies were examined as unique approaches to enhancing the effectiveness of health risk information. First, risk information was tailored to individualized, objective data regarding participants' health risk. Second, risk information was supplemented with framed messages advocating the benefits/risks of LTPA/inactivity. A secondary purpose of the dissertation was to explore cognitive processing in relation to framed LTPA messages.

6.1 Study 1

Within the framework of PMT (Rogers, 1983), Study 1 examined individualized health risk information as a tool for increasing perceived risk for inactivity-related disease among people with SCI. Participants received the results of an individual assessment of objective indicators of

risk for inactivity-related disease (e.g., waist circumference, blood glucose). It was hypothesized that there would be a significant increase in perceived risk for disease among those who were at risk based on the objective indicators. Further, the relationship between changes in perceived risk following the intervention and changes in LTPA behaviour was examined. Based on PMT, it was hypothesized that increases in perceived risk for disease would predict increases in LTPA.

6.2 Study 2

Guided by PMT (Rogers, 1983) and EPPM (Witte, 1992), Study 2 examined the relative effectiveness of health risk information supplemented with gain- versus loss-framed LTPA messages as a tool for increasing motivation for LTPA among people with SCI. First, participants received information outlining the risk of inactivity-related disease and health problems following SCI. It was hypothesized that perceived risk would increase following the risk information. Next, participants read a series of LTPA messages highlighting the benefits of LTPA (i.e., gain-framed messages) or the risks of inactivity (i.e., loss-framed messages). It was hypothesized that response efficacy and LTPA intentions would increase to a greater extent following gain- versus loss-framed messages. Finally, message elaboration (i.e., accurate message recall and message-relevant thoughts) was measured following exposure to framed LTPA messages. It was hypothesized that message elaboration would be greater following gain- versus loss-framed LTPA messages.

6.3 Study 3

Guided by EPPM (Witte, 1992), Study 3 examined the relative attention given to gain- versus loss-framed LTPA messages following risk information regarding inactivity-related disease and health problems. Dwell time on message content was assessed as an indicator of attention and was measured while participants read risk information and subsequent LTPA messages. It was

hypothesized that dwell time on loss-framed LTPA messages would be greater than gain-framed as a result of greater congruency of the loss-framed messages following exposure to risk information. The relationships between dwell time on LTPA messages and message elaboration, perceived risk for disease, fear arousal, and personal relevance were also explored. It was hypothesized that dwell time would be positively related to these variables.

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CHAPTER 2

Risky business: The Effects of an Individualized Health-Information Intervention on Health Risk Perceptions and Leisure Time Physical Activity Among People with Spinal Cord Injury

Preamble

Risky business: The Effects of an Individualized Health-Information Intervention on Health Risk Perceptions and Leisure Time Physical Activity Among People with Spinal Cord Injury is the first study in the dissertation series. The study examines the effects of an individualized health risk information intervention for changing health risk perceptions and LTPA among people with SCI. The manuscript was accepted for publication in the journal *Disability and Health,* and permission was granted to include the manuscript in this dissertation. The page proof version of the manuscript is included in the dissertation because the final manuscript is in press and unavailable.

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Risky business: The effects of an individualized health information intervention on health risk perceptions and leisure time physical activity among people with spinal cord injury

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Abstract

Background: Individuals with spinal cord injury (SCI) are at an increased risk for inactivity-related diseases such as heart disease, type 2 diabetes, and obesity. According to protection motivation theory, perceptions of disease risk predict motivation to engage in health-protective behaviors such as leisure time physical activity (LTPA).

Objective: The purposes of this study were to (1) examine changes in perceived risk for disease following an individualized health information intervention and (2) examine changes in perceived risk for disease as a predictor of changes in LTPA.

Methods: Perceived risk for disease and LTPA were measured at baseline among 62 people with SCI. Objective disease risk information (e.g., waist circumference, BMI, blood glucose) was collected and individual risk information was mailed to each participant. Perceived risk for disease and LTPA were remeasured 1 and 2 weeks following receipt of individualized information, respectively.

Results: Changes in perceived risk of heart disease and obesity were dependent on objective risk status. There were no significant changes in perceived risk of diabetes. Changes in perceived risk of heart disease negatively predicted, while changes in perceived risk of diabetes positively predicted, changes in LTPA. Changes in obesity did not significantly predict changes in LTPA.

Conclusions: Among people with SCI, individual health-risk information can change perceptions of disease risk. Increased perceived risk of diabetes may motivate LTPA, while increased perceived risk of heart disease may encourage avoidance behavior regarding LTPA.

Keywords: ■■■

Following spinal cord injury (SCI), physiologic and lifestyle changes can result in poor health. Accordingly, individuals with SCI are at an increased risk for inactivity-related diseases such as heart disease, type 2 diabetes, and obesity [1]. Regular participation in leisure time physical activity (LTPA; physical activity done during one's free time; e.g., sports and exercise) has the ability to reduce the risk of inactivity-related disease among people with SCI [1-3]. Yet, 50% of people with SCI do no LTPA whatsoever [4]. Initiatives to increase LTPA participation among people with SCI are necessary to optimize the health of this population.

Are people with SCI aware of their increased risk for inactivity-related disease? The answer is unknown, but important, as inaccurate perceptions of disease risk can have health consequences. In general, people have an optimistic bias when it comes to estimating their personal risk for disease [5]. The optimistic bias refers to the tendency for people to view personal risk as lower than that of similar others [6]. It is common regarding various diseases (e.g., heart disease, obesity, diabetes) and has been termed an ''illusion of invulnerability'' [7-9]. Optimistic, or unrealistic, perceptions may seriously thwart efforts to engage in risk-reducing behaviors [6]. For example, individuals with the most unrealistically optimistic perceptions of health-related risks were found to have the greatest decreases in exercise behavior across a 6-week study period [10]. Indeed, individuals who underestimate disease risk may be less motivated to engage in health- protective behaviors than those who have accurate perceptions of disease risk.

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Can an individualized health-risk information intervention increase disease risk perceptions among people with SCI who are objectively at risk for disease?

Interventions aimed at increasing risk perceptions could be valuable for motivating health behavior, particularly among individuals objectively at risk for disease. In the current study, objective risk is defined as the presence of physiological disease risk factors. We are unaware of any research examining the effect of information interventions on perceptions of disease risk among people with SCI. Among the general population, however, *generalized* and *individualized* health-risk information interventions have been used to manipulate perceived risk.

Generalized health information refers to risk information that is not specific to the recipient, such as: ''If a young adult does not engage in regular exercise, atherosclerosis is already causing progressive narrowing of the coronary artery'' [11]. Alternatively, *individualized* health information is objective risk information that is specific to the recipient, such as: ''Your waist circumference is 110 cm. People with a waist circumference greater than 102 cm are at risk for type 2 diabetes.'' Most health-risk information studies have used *general* health information.

Several studies suggest that general health information interventions are not successful at changing perceived risk for disease and overcoming the optimistic bias [11-13]. Furthermore, in cases where general health information has successfully changed perceived disease risk, the intervention did not have sufficient impact to alter LTPA. For example, Milne and colleagues used *general* health-risk information to manipulate perceived risk for heart disease among undergraduate students. Although the intervention resulted in increased risk perceptions, there was no effect on exercise behavior. Perhaps an intervention based on *individualized* health-risk information could impact perceived disease risk sufficiently to evoke changes in LTPA.

Indeed, it has been stated that a strongly persuasive information intervention is required to overcome optimistic bias [12]. Participants may not find *general* health information personally relevant [14]. Conversely, given its personal relevance, *individualized* health-risk information could be more successful at changing perceived disease risk. We are unaware of any research that has directly compared the effectiveness of generalized versus individualized health information in altering perceived risk for disease. However, two review articles suggest that tailoring health information to individuals' risk factors can increase realistic risk perceptions in comparison to generic information [15,16]. Consistent with this notion, individualized health-risk feedback has successfully increased perceived risk of stroke and cancer among people who had initially underestimated their risk [17]. In addition, the greatest changes in perceived disease risk following individualized health feedback have been observed among individuals with higher-than-average disease risk [17,18]. Accordingly, objective disease risk may moderate the effects of an individualized health-risk information intervention, such that the intervention has a larger effect on individuals objectively at risk compared to those not objectively at risk.

Do changes in perceived disease risk predict changes in LTPA?

The notion of risk perception as a cognitive process influencing health behavior is recognized in several theories of health behavior change including the protection motivation theory (PMT) [2]. PMT asserts that individuals are more likely to engage in a health protective behavior when their perceived risk of an adverse health outcome is high. PMT has been used to predict health-protective behaviors and to develop and understand persuasive communications aimed at changing health behaviors [19]. PMT considers *protection motivation* (i.e., intention) as the most proximal predictor of health behavior. In turn, *threat appraisal* and *coping appraisal* are thought to predict *protection motivation. Rewards, perceived vulnerability* (i.e., perceived disease risk) and *perceived severity* are the components of *threat appraisal,* while *response efficacy* (i.e., beliefs about the effectiveness of a given health behavior in reducing disease risk), *self-efficacy*, and *response costs* comprise *coping appraisal*.

Although each construct of PMT is important for understanding motivation for health-protective behavior, the current study focuses only on the vulnerability/ perceived disease risk construct. A review of exercise studies based on PMT determined that threat components of the PMT (i.e., perceived risk) are salient predictors of LTPA behaviors among populations with chronic disease and disability [20]. Therefore, perceived disease risk may have a particularly important influence on health behavior change for many individuals with SCI. If people with SCI underestimate their risk for inactivity-related disease, this may partially explain the dismal rates of LTPA participation within the SCI population.

In other populations, there are mixed findings regarding the role of perceived disease risk in motivating LTPA. Studies have found a positive [11,21], negative [22], or nonsignificant [12,23] relationship between perceived disease risk and exercise. We are aware of only one study that has used *individualized* health information to manipulate perceived disease risk *and* subsequently test the effect on LTPA behavior [17]. In that study, changes in perceived risk for heart attack were not significantly related to changes in LTPA among healthy adults. However, the study was statistically underpowered to detect this relationship.

The equivocal findings have led some researchers to conclude that threat variables, such as perceived disease risk, have little salience when predicting LTPA [24]. However, a major limitation of the extant research is that the majority of LTPA studies have employed cross-sectional [22] or nonexperimental longitudinal designs [24] and have not

manipulated perceived disease risk. Given that people tend to underestimate perceived disease risk, without manipulation, risk perceptions may be inaccurate and unreliable predictors of LTPA. Further, these are not appropriate designs for theory testing [25]. Another limitation is that among the few studies that have used an experimental design, most have attempted to manipulate disease risk by providing *general* health- risk information rather than *individualized* health-risk information. Finally, changes in perceived disease risk may be a more salient predictor of LTPA among people with chronic disease or disability compared to the general population,[20] which has been the focus of many studies. These limitations were addressed in the present experiment.

Summary and hypotheses

A better understanding of the relationship between perceived disease risk and LTPA would be useful for determining factors which motivate LTPA among people with SCI. We are unaware of any published research that has examined this issue. The current study focused on perceived risk of heart disease, diabetes, and obesity. These particular diseases were chosen because they are linked to inactivity [3] and people with SCI are at particular risk [3,26,27]. A first purpose was to examine the effect of an *individualized* health-risk information intervention on perceived disease risk and the moderating effects of objective disease risk. It was hypothesized that there would be a significant increase in perceived disease risk among individuals who were at objective risk for disease. A second purpose was to examine the relationship between changes in perceived disease risk and changes in LTPA. Based on the tenets of the PMT [2], it was hypothesized that increases in perceived disease risk following the individualized health information intervention would predict increases in LTPA.

Method

Participants

Participants included 52 men and 10 women (mean age 43 years) from a subset of participants who completed objective health-risk testing as part of the Study of Health and Activity in People with Spinal Cord Injury (SHAPE-SCI) [28]. SHAPE-SCI is an epidemiologic study examining the relationship between health and physical activity among 700 people with SCI. Participants who completed the objective health-risk testing (n = 68) were then invited to participate in the present study. Participants gave verbal consent to participate. Participant demographic characteristics are summarized in Table 1.

Table 1
Participant Demographic Characteristics

Variable	No. of Patients
Sex	
Male	52 (84%)
Female	10 (16%)
Age (yr)	42.98 ± 12.23
Years post injury	13.82 ± 10.60
Lesion level	
Paraplegic	28 (45%)
Quadriplegic	34 (55%)
Primary mode of mobility	
Manual wheelchair	43 (69%)
Power wheelchair	14 (23%)
Other gait aid (e.g., cane)	5 (8%)
Highest level of education	
High school	22 (36%)
College	13 (21%)
University	19 (31%)
Postgraduate	6 (10%)
Other	2 (3%)
Family history HD	13 (22%)
Family history T2D	9 (16%)
Currently smoke cigarettes	17 (27%)

HD, Heart disease; T2D, type 2 diabetes.

Baseline perceived disease risk

Participants responded to the following three questions on a 7-point Likert-type scale (i.e., −3 = *very unlikely* to +3 = *very likely*): ''What is the likelihood that you will develop (a) heart disease, (b) obesity, and (c) diabetes in your lifetime?'' This measure was adapted from previous research [8,11] to specifically address perceived risk of inactivity-related diseases (i.e., heart disease, obesity, diabetes). Absolute risk judgments (i.e., How likely is it to happen to me?) were used for the current study rather than relative risk judgments (i.e., How likely is it to happen to me compared to an average person in my peer group?) as they are more likely to vary with an individual's perceived standing on personally relevant risk factors [8]. Given that high correlations have been observed between single-item measures of perceived disease risk and valid and reliable multi-item scales [29], to reduce participant response burden, single-item measures were used in the present study.

Postintervention perceived disease risk

The postintervention measure of perceived disease risk was identical to baseline. However, the items were prefaced with the statement, ''Keep in mind your own personal objective risk information as you answer the following questions.''

Objective risk

Objective risk for each disease was determined by comparing participants' body composition and blood work results with established guidelines for disease risk. The guidelines included (1) body mass index (BMI) >25 kg/m^2, (2) waist circumference >102 cm (males) and >89 cm (females), (3) C-reactive protein (CRP) >3 mg/L, (4)

triglycerides >1.7 mmol/L, (5) glucose <3.8 or >6.0 mmol/L, and (6) insulin <43 or >194 pmol/L. All risk factor data were gathered by the same research assistants, after participants had fasted for at least 10 hours. A brief description of the protocols used to collect the risk factor data is presented next. Readers are referred to Buchholz et al. [3] for a detailed description of risk factor data collection protocols. All risk factor variables were measured twice and averaged if the difference was ≤5%; if ≥5%, a third determination was made and the two closest measures were averaged.

Body mass index

BMI was calculated as weight (kg)/length (m^2). Weight was measured using a portable, digital, wheelchair scale (Health O Meter 2450KL, Brooklyn, NY). Length was measured while participants were supine on a spine board.

Waist circumference

Waist circumference was measured around the lowest rib while participants were supine. The circumference was recorded after normal expiration.

C-reactive protein, triglycerides, glucose, and insulin

Venous blood samples were collected into vacutainer tubes and analyzed on the day of collection at the McMaster Medical Centre, Hamilton. Insulin values of 6 participants were lower than detectable by assay (<15 pmol/L); these were assigned a value of 14 pmol/L during statistical analyses. Individuals whose CRP levels were indicative of acute inflammation (≥10 mg/L)[30] were excluded from CRP statistical analyses.

Leisure time physical activity

At baseline and postintervention, a short version of the Physical Activity Recall Assessment for People with SCI (PARA-SCI) [31] was used to measure LTPA. At each time point, participants reported the number of days they performed mild-, moderate-, and/or heavy-intensity LTPA over the previous 7 days. Participants then reported the average number of minutes they performed mild-, moderate-, and heavy-intensity LTPA on each of the days they were physically active. Minutes of moderate- and heavy-intensity LTPA were summed and averaged over the 7 days for a composite score of total LTPA per day. Minutes of mild LTPA were not included in the composite score because of previous research suggesting LTPA performed at a mild intensity may not be sufficient to affect objective disease risk [31]. The short version PARA-SCI has demonstrated validity and reliability measure of LTPA among people with SCI [32].

Change in LTPA was calculated as postintervention LTPA minus baseline LTPA. Positive values indicated an increase in LTPA.

Procedure

The first author and a research assistant visited each participant at his or her home to measure objective risk (i.e., body composition and blood analyses) and family history of disease (i.e., ''Has anyone in your family had (a) heart disease or (b) type 2 diabetes before the age of 60?''). These data were collected for SHAPE-SCI [28]. Upon completion of data collection for SHAPE-SCI, individuals were invited to participate in this follow-up investigation, which involved 3 telephone interviews. During the first interview, participants completed baseline measures of LTPA and perceived disease risk. Each participant then received (via regular mail) individualized health-risk information in a letter detailing the participant's personal results from the body composition assessments (i.e., BMI, waist circumference) and blood work analyses (i.e., CRP, triglycerides, insulin, glucose). The letter also included definitions of the uncommon risk factors (e.g., ''CRP is a marker of inflammation related to cardiovascular disease''), and for each risk factor, (1) the able-bodied average value and (2) the able-bodied population healthy value. Averages and healthy values specific to the SCI population do not exist for these risk factors and were not included. The information letter did not indicate if participants were at risk for any particular disease (see Appendix).

One week later, participants were contacted for a second telephone interview (i.e., postintervention). At the start of the second interview, participants were asked to confirm that they had received, read, and understood the information. To avoid misinterpreted results, participants were invited to ask questions about their results. Perceived disease risk was then remeasured after prompting participants to consider their personal objective risk results. Finally, 2 weeks later, participants were contacted for a third interview, during which LTPA was measured. Participants were debriefed and thanked for their time. All procedures were approved by the Hamilton Health Sciences Research Ethics Board and were in accordance with the Helsinki Declaration of 1975, as revised in 2000.

Statistical analysis approach

Prior to analyses, data were inspected for outliers. Sample sizes vary across analyses as a result of missing data and removal of statistical outliers (i.e., values >3.29 standard deviations from the mean) [33]. The statistical assumptions of each analysis were tested and satisfied [34].

Testing for possible covariates

Previous research has found variations in perceived disease risk across different age, sex, and education groups [17,35]. In the SCI population, characteristics of one's injury may also impact an individual's perceived disease risk. Accordingly, sex, age, and education level, as well as injury level, number of years post injury, and primary

Table 2
Results of Repeated Measures ANOVA Comparing Perceived Risk of Heart Disease by Time and Objective Risk Status (Controlling for Family History of Heart Disease)

	Perceived disease risk						
Objective heart disease risk factor	Baseline M (SD)	Postintervention M (SD)	Time F (partial η^2)	Family F (partial η^2)	Time × family F (partial η^2)	Objective risk F (partial η^2)	Time × objective risk F (partial η^2)
Waist circumference			15.33** (0.23)	3.58† (0.06)	3.22† (0.06)	5.90* (0.10)	3.51† (0.06)
At risk (n = 18)	−0.22 (1.83)	1.06 (0.94)					
Not at risk (n = 37)	−0.81 (2.03)	−0.46 (1.89)					
BMI			9.78** (0.17)	3.32† (0.07)	3.59† (0.07)	0.48 (0.01)	1.21 (0.03)
At risk (n = 25)	−0.56 (1.73)	0.24 (1.59)					
Not at risk (n = 25)	−0.80 (2.12)	−0.4 (1.96)					
C-reactive protein			5.15* (0.13)	2.58 (0.07)	2.19 (0.06)	0.001 (0.00)	0.13 (0.00)
At risk (n = 14)	−0.21 (2.15)	0.00 (2.04)					
Not at risk (n = 25)	−0.84 (2.06)	−0.08 (1.93)					
Triglycerides			8.51** (0.16)	2.73 (0.06)	3.70† (0.07)	1.75 (0.04)	0.01 (0.00)
At risk (n = 11)	0.00 (2.00)	−0.82 (1.96)					
Not at risk (n = 38)	0.64 (1.21)	−0.16 (1.91)					

Family, self-reported family history of heart disease. Perceived disease risk scale range −3 to +3. Partial η^2 = effect size.
† $p < .10$.
* $p < .05$.
** $p < .01$.

mode of mobility, were tested as potential covariates of perceived disease risk. Given that smoking behavior and family history may be well-known predictors of disease risk, these factors were also tested as potential covariates. Possible covariates were identified by computing 1-way ANOVAs for dichotomous variables and Pearson's correlations for continuous variables.

Hypothesis 1. There will be a significant increase in perceived risk of heart disease, obesity, and diabetes among individuals who are at objective risk for these diseases according to body composition and blood work analyses.

A series of 2 (at risk vs not at risk) × 2 (preintervention vs postintervention) repeated measures ANOVAs were calculated to examine the effects of the intervention on perceived disease risk and the moderating effects of objective disease risk. Separate ANOVAs were calculated for perceived risk of heart disease, diabetes, and obesity. Participants were to be classified as "at-risk" if they had one or more risk factors for a given disease and as "not at risk" if they did not have any risk factors. Unfortunately, about 95% of the sample had at least 1 risk factor for each disease, and therefore this classification method became inappropriate. The authors considered creating a continuous variable for disease risk with higher values representing higher disease risk. It was determined that a continuous variable for disease risk would also be inappropriate due to limited variability, missing data, and the loss of information regarding the salience of each individual risk factor. Alternatively, for each perceived risk variable (i.e., perceived risk of heart disease, obesity, and diabetes), separate ANOVAs were calculated using each relevant objective risk factor as an independent variable. For example, given that objective risk for obesity was based on BMI and waist circumference, 2 ANOVAs were conducted on perceived risk for obesity. In the first ANOVA, people were classified as at risk/not at risk based on BMI. In the second ANOVA, people were classified as at risk/not at risk based on waist circumference. Tables 2 through 4 show the ANOVAs calculated for each dependent variable. Effect sizes (partial η^2) were calculated in order to estimate the magnitude of the effect with .02 constituting a small effect, .13 constituting a medium effect, and ⩾.26 constituting a large effect [36]. Post hoc analyses were performed for any interaction with an ES constituting at least a small effect. Table 5 displays the results of the post hoc analyses.

Hypothesis 2. Changes in perceived disease risk will predict changes in LTPA.

Hierarchical regression analyses were calculated to test hypothesis 2. Three separate regression models were computed to determine if changes in (1) perceived risk of heart disease, (2) perceived risk of obesity, and (3) perceived risk of diabetes predicted change in LTPA from preintervention to postintervention. For each model, baseline perceived disease risk was entered on step 1. On step 2, postintervention perceived disease risk was added to the model. The dependent variable for each regression model was change in LTPA. Effect sizes (f^2) were calculated to estimate the size of the effect with .02 constituting a small effect, .15 constituting a medium effect, and .35 constituting a large effect [36].

Results

Descriptive statistics

The percentage of participants at objective risk for disease based each risk factor were (1) 31% at risk based on waist circumference, (2) 47% based on BMI, (3) 10% based on glucose, (4) 64% based on insulin, (5) 34% based on CRP, and (6) 21% based on triglycerides. Descriptive

Table 3
Results of Repeated Measures ANOVA Comparing Perceived Risk of Obesity by Time and Objective Disease Risk Status

Objective obesity risk factor	Perceived disease risk: Baseline, mean (SD)	Perceived disease risk: Postintervention, mean (SD)	Time F (partial η^2)	Objective risk F (partial η^2)	Time × objective risk F (partial η^2)
Waist circumference			7.2** (0.11)	33.73** (0.37)	0.03 (0.00)
At risk (n = 19)	0.42 (2.06)	1.05 (1.75)			
Not at risk (n = 43)	−0.00 (1.58)	−1.44 (1.67)			
BMI			5.92* (0.10)	17.5** (0.25)	3.07 (0.06)
At risk (n = 27)	−0.54 (2.34)	0.31 (2.05)			
Not at risk (n = 30)	−2.03 (1.48)	−1.90 (1.21)			

Perceived disease risk scale range −3 to +3. Partial η^2 = effect size.
* $p < .05$.
** $p < .01$.

statistics for baseline and postintervention perceived disease risk are found in Tables 2 to 4.

Testing for possible covariates

Participants with a family history of heart disease (n = 11) had higher baseline perceived risk of heart disease compared to those without (n = 45; $F(1, 54) = 7.55$, $p < .01$). Under such conditions, Tabachnick and Fidell [33] would recommend treating family history as a second independent variable. However, the study was underpowered to detect a 3-way interaction (i.e., time × objective risk × family history), so family history of heart disease was treated as a covariate in the ANOVA regarding perceived risk for heart disease. Also, age was positively correlated with postintervention perceived risk of heart disease ($r = .26$, $p < .05$) so it was treated as a potential covariate in analyses involving perceived risk of heart disease. No other variables were significantly related to perceived disease risk.

Hypothesis testing

Hypothesis 1: There will be a significant increase in perceived risk of heart disease, obesity, and diabetes among individuals who are at objective risk for these diseases based on their body composition and blood work analyses.

Perceived risk of heart disease

* † Table 2 displays the results of four repeated measures ANOVAs calculated with perceived risk of heart disease as the dependent variable. Family history was a significant covariate in each of the ANOVAs (with the exception of the analysis considering CRP). Accordingly, the results presented control for the role of family history. In the ANOVA considering waist circumference as the independent variable and objective risk factor, there was a significant main effect for time ($p < .01$; partial $\eta^2 = .23$) and objective risk ($p < .05$; partial $\eta^2 = .10$). There was a significant main effect for time in the ANOVAs treating BMI ($p < .01$; partial $\eta^2 = .17$), triglycerides ($p < .01$; partial $\eta^2 = .16$), and CRP as the risk factor ($p < .05$; partial $\eta^2 = .13$) indicating that

Table 4
Results of Repeated Measures ANOVA Comparing Perceived Risk of Diabetes by Time and Objective Risk Status

Objective diabetes risk factor	Perceived disease risk: Baseline mean (SD)	Perceived disease risk: Postintervention mean (SD)	Time F (partial η^2)	Objective risk F (partial η^2)	Time × objective risk F (partial η^2)
Waist circumference			0.67 (0.01)	13.42** (0.19)	0.14 (0.00)
At risk (n = 19)	0.32 (1.45)	0.58 (1.12)			
Not at risk (n = 43)	−1.27 (2.01)	−1.17 (2.01)			
BMI			0.37 (0.01)	2.31 (0.04)	0.37 (0.01)
At risk (n = 27)	−0.42 (1.86)	−0.42 (1.92)			
Not at risk (n = 30)	−1.28 (2.00)	−1.03 (1.94)			
Glucose			0.80 (0.01)	6.26* (0.10)	0.32 (0.01)
At risk (n = 6)	0.67 (2.94)	1.17 (2.23)			
Not at risk (n = 55)	−0.98 (1.79)	−0.87 (1.81)			
Insulin			0.23 (0.00)	−12.24** (−0.18)	0.83 (0.01)
At risk (n = 39)	−1.46 (1.83)	−1.16 (1.92)			
Not at risk (n = 22)	0.27 (1.72)	0.18 (1.68)			

Perceived disease risk scale range −3 to +3. Partial η^2 = effect size.
* $p < .05$.
** $p < .01$.

Table 5
Results of Post Hoc Analyses Conducted on Time × Objective Risk Interactions

	Perceived disease risk				
Objective heart disease risk factor	Baseline mean (SD)	Postintervention mean (SD)	*t*	*p*	Partial η^2
Waist circumference					
At risk (n = 15)	−0.33 (1.76)	1.07 (0.70)	−3.86	<0.01	0.72
Not at risk (n = 29)	−1.21 (1.74)	−0.62 (1.72)	−1.77	0.09	0.32
BMI					
At risk (n = 18)	−0.83 (1.54)	0.39 (1.46)	−3.51	<0.01	0.65
Not at risk (n = 21)	−1.19 (1.78)	−0.71 (1.64)	−1.17	0.26	0.25
C-reactive protein					
At risk (n = 7)	−0.14 (2.04)	0.00 (1.83)	−0.31	0.77	0.13
Not at risk (n = 21)	−1.38 (1.69)	−0.29 (1.85)	−2.77	0.01	0.53
Objective obesity risk factor					
BMI					
At risk (n = 27)	0.42 (2.06)	1.05 (1.75)	−2.52	0.02	0.45
Not at risk (n = 30)	−2.00 (1.58)	−1.44 (1.67)	−0.44	0.66	0.09

Note. Perceived disease risk scale range −3 to +3. Partial η^2 = effect size.

perceived risk increased postintervention regardless of risk status.

Although no interaction effects reached conventional significance at the $p < .05$ level, small effect sizes for the time × objective risk interaction were observed for waist circumference (partial $\eta^2 = .06$) and BMI (partial $\eta^2 = .03$). When considering CRP and triglyceride levels as the objective risk factor, there were no interaction effects. Post hoc analyses indicated that when considering waist circumference or BMI as the objective risk factor, there was a significant increase in perceived risk of heart disease only among those objectively at risk ($p < .06$; partial $\eta^2 = .88$ and .48).

Perceived risk of obesity

Table 3 displays the results of 2 repeated measures ANOVAs calculated with perceived risk of obesity as the dependent variable. Significant main effects for time ($F(1,60) = 7.2$, $p < .01$; partial $\eta^2 = .11$) and objective risk ($F(1,60) = 33.73$, $p < .001$; partial $\eta^2 = .37$) were present when considering objective risk for obesity based on waist circumference. These results indicate that overall, those at objective risk perceived themselves to be at greater risk and that perceived risk increased from preintervention to postintervention regardless of risk status. There were no significant interaction effects when considering objective risk based on waist circumference ($p > .10$; partial $\eta^2 < .001$).

Significant main effects for time ($F(1,56)$ 5.92, $p < .05$; partial $\eta^2 = .10$) and objective risk ($F(1,56)$ 17.50, $p < .01$; partial $\eta^2 = .25$) were also observed when considering objective risk based on BMI. Although the interaction did not reach significance at the $p < .05$ level, a small effect size (partial $\eta^2 = .06$) was observed and post hoc analyses were conducted. There was an increase in perceived risk of obesity from baseline to postintervention only among individuals objectively at risk for obesity based on BMI ($t = -3.51$, $p < .01$; partial $\eta^2 = .65$).

Perceived risk of diabetes

Table 4 displays the results of 4 repeated measures ANOVAs calculated with perceived risk for diabetes as the dependent variable. There were no significant main effects for time and no significant interactions in any of the ANOVAs, suggesting that perceived risk of diabetes did not change as a result of the intervention regardless of objective risk status. However, significant main effects for objective risk were present in the ANOVAs that classified people as at risk/not at risk for diabetes based on waist circumference ($F(1,60) = 13.42$, $p < .01$; partial $\eta^2 = .19$), glucose ($F(1,59) = 6.26$, $p < .05$; .10; partial $\eta^2 = .10$), and insulin levels ($F(1,59) = -12.24$, $p < .01$; partial $\eta^2 = -.18$), but not BMI. Thus, compared to those not at risk, people who were at risk for diabetes based on waist circumference and glucose had higher overall perceived risk of diabetes, whereas those at risk based on blood insulin had lower overall perceived risk than those not at risk. There were no significant interaction effects ($p < .10$; partial $\eta^2 \leqslant .01$).

Hypothesis 2: Changes in perceived disease risk will predict changes in LTPA.

Results of paired-samples *t*-tests indicated that LTPA increased from preintervention (18 min/day) to postintervention (25 min/day; $t = -1.97$, $p < .05$). In 3 separate regression models, change in LTPA was regressed on perceived risk of heart disease, perceived risk of diabetes, and perceived risk of obesity (see Table 6).

Perceived risk of heart disease

‡ After controlling for family history by entering the variable in the first step of the regression, change in perceived risk of heart disease was a significant negative predictor of change in LTPA ($\beta = -.38$, $p < .05$) suggesting that increases in perceived risk of heart disease were associated with decreases in LTPA. The overall model explained 12% of the variance in LTPA change ($F(3,53) = 2.21$, $p < .10$) representing a medium-sized effect[36] (Cohen, 1992; $f^2 = .14$).

Table 6
Results of Hierarchical Regression Analyses Predicting Changes in LTPA

Perceived risk variable	R2	R2Δ	*p*	B	f^2
Heart disease (N = 57)					0.14
Step 1	0.02	0.02	0.64		
Family history				−0.14	
Perceived risk T1				0.08	
Step 2	0.12	0.10	0.02		
Family history				−0.16	
Perceived risk T1				0.30	
Perceived risk T2				− 0.38*	
Diabetes (N = 55)					0.09
Step 1	0.005	0.005	0.6		
Perceived risk T1				0.07	
Step 2	0.08	0.07	0.05		
Perceived risk T1				−0.20	
Perceived risk T2				0.38*	
Obesity (N = 56)					0.12
Step 1	0.11	0.11	0.01		
Perceived risk T1				0.33**	
Step 2	0.11	0.004	0.64		
Perceived risk T1				0.39*	
Perceived risk T2				−0.08	

f^2 = effect size.
* $p < .05$.
** $p < .01$.

Perceived risk of obesity

Change in perceived risk of obesity was not a significant predictor of change in LTPA. However, baseline perceived risk of obesity was a significant and positive predictor of change in LTPA change ($\beta = .39$, $p < .05$), suggesting that higher baseline perceived risk of obesity was associated with greater increases in LTPA from preintervention to postintervention. The model explained 11% of the variance in LTPA change ($F(2,52) = 3.41$, $p < .05$), which is a small to medium-sized effect[36] (Cohen; $f^2 = .12$).

Perceived risk of diabetes

Change in perceived risk of diabetes was a significant and positive predictor of LTPA change ($\beta = .38$, $p < .05$) suggesting, as hypothesized, that greater increases in perceived risk of diabetes were associated with greater increases in LTPA. The overall model explained 8% of the variance in LTPA change ($F(2,51) = 2.16$, $p = .13$), which is a small effect[36] (Cohen; $f^2 = .09$).

Discussion

This study examined the effects of individualized health-risk information on perceived disease risk among people with SCI. Within the framework of PMT [2], the study also examined the relationship between changes in perceived disease risk and changes in LTPA. It was hypothesized that perceived disease risk would increase following the intervention among individuals who were objectively at risk for heart disease, diabetes, and obesity. Further, it was hypothesized that changes in perceived disease risk would positively predict changes in LTPA. Partial support was found for both hypotheses.

Can an individualized health-risk information intervention increase perceived disease risk among people with SCI who are objectively at risk for disease?

Individuals who were informed that they were at risk for heart disease based on their waist circumference and BMI had a significant increase in perceived risk of heart disease. Similarly, individuals who were informed of their risk for obesity based on their waist circumference and BMI had a significant increase in perceived risk of obesity. These findings suggest that, consistent with findings in the general population [35], individualized health-risk information is an effective way to increase disease risk perceptions among people with SCI who are objectively at risk for disease. The effects observed for the intervention suggest that many people with SCI may be unaware of their elevated risk for chronic disease post SCI. Thus, providing such information can affect risk perceptions.

Contrary to hypothesis, changes in perceived disease risk not only occurred among individuals at risk for a given disease, but also among some individuals who were not at objective risk. For example, individuals who were not at objective risk for heart disease based on CRP and triglycerides experienced a significant increase in perceived risk of heart disease. Unfortunately, the small number of participants in the "at risk" group based on CRP (n = 14) and triglycerides (n = 11), limit our understanding of the group differences. However, individuals who were not at objective risk for obesity based on waist circumference (n = 43) also experienced a significant increase in perceived risk of obesity. Although previous research has observed a positive relationship between objective disease risk and the effectiveness of individualized risk information [18], people with objective disease risk statuses below the risk criterion may also increase their risk perceptions if the individualized health-risk information reveals they are at a higher risk than they originally believed. Accordingly, individualized health-risk information may act to reduce optimistic or inaccurate perceptions of risk among individuals both at objective risk and not at immediate risk of disease. Another reason why perceived risk may have increased regardless of risk status is that some individuals who were not at risk for a disease according to one risk factor (e.g., CRP) may have been at risk for the same disease according to another risk factor (e.g., waist circumference).

Interestingly, perceived risk of diabetes did not significantly change as a function of objective risk or feedback regarding any of the risk factor criteria. One possibility is that the feedback regarding waist circumference, BMI, glucose, and insulin did not provide meaningful information with regard to perceived risk of diabetes. Furthermore, compared to those not at risk, individuals at objective risk based on waist circumference and glucose had higher

perceived risk before and after the intervention, suggesting that these individuals may have already been aware of their heightened risk for diabetes and thus there was little room for further change (i.e., a ceiling effect). For these individuals, the intervention may have served to confirm what they already knew.

Another interesting finding regarding diabetes risk was that compared to those not at risk, individuals at objective risk based on insulin had lower perceived risk of diabetes before and after the intervention. This finding may be best explained by the presence of an optimistic bias coupled with a misinterpretation of risk factor feedback. At baseline, low perceived risk of diabetes may reflect a general optimistic bias. At postintervention, low perceived risk may be explained by participants' misinterpretation of feedback regarding insulin. Risk for disease is usually indicated by values *above* the risk criterion (e.g., waist circumference >102, BMI >25, CRP >3.0). However, determining risk for diabetes based on insulin is unusual in that both low (i.e., <43 pmol/L) and high (i.e., >194 pmol/L) insulin levels are indicative of risk. Most at-risk participants (87%) had insulin levels *below* the risk criterion. Participants may have misinterpreted low levels of insulin as indicating low risk for diabetes, thus sustaining their preintervention perceptions of risk of diabetes.

An additional finding worthy of discussion is the moderating role of family history. Compared to those without a family history of heart disease, individuals with a family history had higher perceived risk of heart disease at baseline and postintervention. Further, unlike those without a family history, regardless of objective risk status, there was no change in perceived risk of heart disease following the intervention. Individuals with a family history may have less optimistically biased perceptions of heart disease risk because of an increased awareness of personal health status or awareness that family history is a risk factor. Alternatively, knowledge of family history may override the effects of individualized risk information. Individuals with a family history of heart disease may already assume they are at a higher risk and therefore may not be significantly influenced by health-risk information.

The results regarding changes in perceived disease risk have practical implications. First, health practitioners should consider providing individualized health-risk information to people with SCI in order to increase awareness of inactivity-related disease risk. This strategy may be beneficial to individuals who are *and* are not objectively at immediate risk for disease given that, depending on the given disease and risk factor, objective risk status does not always moderate the effects of individualized health-risk information on perceived disease risk.

Second, our results suggest that information regarding certain risk factors may have a greater influence on perceived risk than others. For example, health risks associated with waist circumference and BMI are emphasized regularly in the media; feedback regarding these risk factors may be well understood and thus have a large influence on perceived disease risk. Other risk factors such as CRP and insulin may be misinterpreted or overlooked as a source of meaningful feedback for formulating perceptions of disease risk. Individuals may not be aware of the relationship between CRP and heart disease for example, or may not understand the meaning of the risk factor criterion itself (e.g., insulin). Further, perhaps the observable nature of one's waist circumference or BMI allows information regarding these risk factors to resonate more soundly than a more unobservable factor such as CRP or insulin. Nevertheless, such information may be useful for educating individuals about disease risk so long as the meaning of the feedback is well understood. Future interventions may benefit from providing participants with a detailed explanation of the relationship between each risk factor and its associated diseases.

Finally, health practitioners should still consider using individualized health-risk information to inform individuals with a family history of disease. Under these circumstances, practitioners should highlight that although family history is a nonmodifiable risk factor, other risk factors such as BMI and waist circumference are modifiable. In summary, the use of individualized health-risk information can effectively change perceived risk of heart disease and obesity among people living with SCI.

Do changes in perceived risk predict changes in LTPA?

Individuals with an increase in perceived risk of heart disease had a decrease in LTPA. This finding is contrary to the general principles of PMT [2]. However, some research in the general population has found a negative relationship between perceived disease risk and motivation for exercise [22]. Perhaps those who had an increase in perceived risk of heart disease also had increased fear. The fear-drive model [37] suggests that for some individuals, health communications which evoke fear can lead to maladaptive coping responses including avoidance or denial [19]. Furthermore, because the information intervention in the current study did not provide behavioral advice (i.e., participants were not told to engage in LTPA) participants with increased perceived risk of heart disease may have lacked knowledge about the benefits of LTPA or may have been fearful that engaging in LTPA could be dangerous.

Contrary to hypothesis, changes in perceived risk of obesity were not significantly related to changes in LTPA. However, individuals with higher baseline perceived risk of obesity engaged in greater LTPA following the intervention. Many individuals may have had a sense of their risk for obesity prior to the intervention because of the relatively observable nature of obesity risk factors (e.g., one can observe his or her waist circumference). Perhaps simply asking them to think about their risk for obesity motivated an increase in activity. This notion is consistent with the principle of PMT [2] and previous research, which

indicates that greater perceived risk is related to greater health behavior [38,39].

Finally, changes in perceived risk of diabetes were a positive predictor of changes in LTPA. This finding is congruent with PMT [2] and meta-analytic evidence of an effect for perceived disease risk on health behavior in general [38,39]. Previous research on LTPA in particular has typically found no effect of general health-risk information on LTPA [13]. Thus, the use of individualized health-risk information may be more effective for changing LTPA.

The results regarding changes in perceived disease risk as a predictor of LTPA have both theoretical and practical implications. With regard to PMT [2], some researchers have suggested that threat variables, such as perceived disease risk, have little salience in predicting LTPA [25]. Our findings contradict this notion by showing that among people with SCI, perceived risk for certain diseases (e.g., diabetes), may be an important predictor of LTPA. Perhaps diseases that are known to be most prevented by LTPA are most likely to change LTPA.

Indeed, individuals' understanding of the relationship between a given disease and LTPA may be critical in determining whether health-risk information about the disease motivates LTPA. This notion is consistent with the response efficacy construct of PMT [2], which suggests that perceptions of the effectiveness of a given behavior (e.g., LTPA) to reduce the risk of a negative health outcome (e.g., disease) is a predictor of participation in the behavior. Therefore, practitioners should educate patients about the benefits of LTPA for reducing risk of inactivity-related diseases such as heart disease, obesity, and diabetes. People at risk of heart disease should be given information on how to safely engage in LTPA. Otherwise, as our data indicate, at-risk individuals may avoid LTPA as a maladaptive coping response [19] or due to a fear that LTPA could be dangerous.

Limitations and future directions

A couple of limitations warrant mention. First, participants volunteered to be part of the study. Thus, self-selection bias could be a threat to the external validity of our results. Further, the study did not include a control group so it cannot be concluded that the individualized health-risk information per se caused changes in perceived disease risk. The inclusion of a control group would rule out the possibility of an alternative explanation for the results such as reactivity of measurement or the effect of an external factor. Future research would also benefit from the inclusion of a *generalized* health information group to allow for direct comparison of general versus individualized health information.

A second limitation was the absence of other PMT [2] variables in the design. Although the purpose of the study was not to test the PMT, the inclusion of other constructs such as response-efficacy and self-efficacy would have allowed for the examination of possible interaction effects with perceived risk. Indeed, task and barrier self-efficacy are important predictors of LTPA among people with disabilities [40]. Future research should include these factors to determine the strongest predictors of LTPA among people with SCI. Nevertheless, the manipulation and measurement of a single theoretical construct can advance our understanding of how that construct operates both within the larger theoretical framework and in practice [25].

A third limitation was that participants were not told specifically about the relationship between each individual risk factor, inactivity-related disease, and LTPA. Although, the purpose of the current study was to examine the isolated effects of individualized health-risk feedback, future interventions may have a greater impact by highlighting a strong link between disease risk and LTPA [35]. Furthermore, we did not consider the role of participants' numeracy, which may have impacted some individuals' abilities to interpret the risk information.

The short follow-up period of 1 week is a fourth limitation as it does not allow for assessment of the long-term effects of individualized health-risk information. Finally, in order to maximize the effects of individualized health-risk information interventions, future research should aim to determine which risk factors are most effective in improving disease risk perceptions, and which disease types should be targeted in order to motivate LTPA.

In summary, the current study suggests that use of individualized health-risk information is a promising strategy for changing perceived disease risk, which in turn, may impact LTPA among people with SCI. Future research should consider PMT as a framework for examining LTPA among people with SCI, and aim to determine the most effective individualized health-risk information intervention strategies.

Uncited reference

30.

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Appendix

Sample Participant Objective Risk Letter

YOUR INDIVIDUAL RESULTS

Measure	Your results	Able bodied average	Reference range
BMI, kg/m^2	29.8	25.5	See below
Weight, kg	97.1	—	—
Waist circumference, cm	107.2	90.9	<102
Glucose, mmol/L	4.7	5.0	3.8-6.0
Insulin, pmol/L	56	59	43-194
Total cholesterol, mmol/L	2.97	5.0	<5.2
HDL ("good" cholesterol)	1.79	1.5	>1.0, >1.3 (W)
LDL ("bad" cholesterol)	0.85	2.8	<3.4
Triglycerides, mmol/L	0.72	1.5	<1.7
C-reactive protein, mg/L	1.5	1.6	<3.0

BMI: Body mass index is a simple index of weight-for-height that is commonly used to classify underweight,

overweight, and obesity in able-bodied adults (we currently working on lowering the cutoffs for persons with SCI)

Classification	Obesity class	BMI cutoff points, kg/m^2
Underweight		<18.5
Normal weight		18.5-24.9
Overweight		25.0-29.9
Obesity	I	30.0-34.9
	II	35.0-39.9
Extreme obesity	III	>40.0

Insulin resistance: a relative measure of how resistant your body is to action of insulin, with 1.0 as ''normal''. Insulin resistance can increase your risk for diabetes.

C-reactive protein: a marker of inflammation related to cardiovascular risk

0-1 Low risk
1-3 Average risk
3-10 Increased risk for cardiovascular disease
>10 Active infection (not related to cardiovascular disease risk)

CHAPTER 3

Do you want the good news or the bad news?

Gain- versus loss-framed messages following health risk information:

The effects on leisure time physical activity beliefs and cognitions**.**

Abstract

Purpose: The primary purpose was to examine the relative effectiveness of chronic disease and psychological health risk information combined with gain- versus loss- framed LTPA messages for changing perceived personal risk, LTPA response efficacy (i.e., the belief that LTPA can effectively reduce risk), and LTPA intentions. A secondary purpose was to explore the relationship between message framing and message elaboration. **Method:** Baseline assessments of perceived risk for inactivity-related disease and psychological health problems, LTPA response efficacy and intentions were assessed among individuals with SCI (N=96). Participants read population-specific information about the risk for inactivity-related disease and psychological health problems following SCI, and perceived risk was reassessed. Participants were then randomized to read LTPA response efficacy messages emphasizing the benefits of LTPA (gain-framed) or the risks of inactivity (loss-framed). Immediately following message exposure, message elaboration (i.e., thought listing and message recall), LTPA response efficacy and LTPA intentions were reassessed. **Results:** Changes in perceived risk were observed following exposure to health risk information. Changes in LTPA response efficacy and intentions were greater following loss-framed messages targeting psychological health, compared to gain-framed messages. Greater message elaboration was observed following loss-framed messages compared to gain-framed. **Conclusion:** Following exposure to psychological health risk information, loss-framed messages may be more effective than gain-framed messages for eliciting elaboration and changing LTPA beliefs and intentions.

Persons with spinal cord injury (SCI) are at risk for inactivity-related diseases such as heart disease, type 2 diabetes, and obesity (Nash, 2005), as well as psychological health problems such as depression, chronic pain, and fatigue (Kennedy & Rogers, 2000; Turner, Cardenes, Warms, & McClellan, 2001; Hammell, Miller, Forwell, Forman, & Jacobsen, 2009). Leisure time physical activity (LTPA; physical activity done during one's free time; e.g., sports and exercise) can reduce the risk of these health problems (Nash, 2005; Buchholz, Martin Ginis, Bray, Craven, Hicks, Hayes, et al., 2009; Hicks, Martin, Ditor, Latimer, Craven, Bugaresti, & McCartney, 2003). Yet, 50% of people with SCI do no LTPA whatsoever (Martin Ginis, Latimer, Arbour-Nicitopoulos, Buchholz, Bray, Craven, et al., 2010). Initiatives to increase LTPA are necessary to optimize the physical and psychological health of the population.

The use of persuasive communications (e.g., messages) is a promising strategy to encourage the development of LTPA intentions (Latimer, Brawley, & Bassett, 2010), which are an important determinant of LTPA (Ajzen, 1991). The results of study one suggest that exposure to risk information may be effective for changing perceptions of vulnerability, which in some instances may motivate LTPA. However, risk information should be supplemented with persuasive messages promoting LTPA to reduce one's risk. Optimizing the effectiveness of a persuasive message requires the use of evidence-based strategies. One recommended strategy for creating LTPA messages is message framing (see Latimer et al., 2010), which refers to the strategic emphasis of the benefits of performing a behaviour (i.e., gain-framed messages) or the risks of not performing a behaviour (i.e., loss-framed messages). Prospect theory (Kahneman & Tversky, 1979) is commonly employed as a guiding framework in message framing research. According to prospect theory (Kahnman & Tversky, 1979), individuals are motivated to act according to their perceptions of the risks associated with the outcome of performing a given

behaviour. Drawing on prospect theory, it has been hypothesized that loss-framed messages are more effective than gain-framed for persuading health behaviours with high risk outcomes (e.g., HIV testing). Alternatively, gain-framed messages are hypothesized to be more effective than loss-framed for persuading behaviours with low risk outcomes (e.g., LTPA). Under the guiding framework of prospect theory, one would hypothesize a gain-framed advantage for messages encouraging LTPA.

Indeed, in a systematic review of approaches for constructing LTPA messages, evidence from six message framing studies suggests that gain-framed messages may be more effective than loss-framed messages for enhancing LTPA intentions and behaviour (Latimer et al., 2010). For example, in recent health communication studies, gain-framed health messages targeting LTPA were significantly more effective than loss-framed messages for increasing LTPA intentions (Gray & Harrington, 2011). Likewise, among sedentary adults, gain-framed messages were more persuasive in changing LTPA intentions compared to loss-framed or mixed-framed messages (Latimer, Rench, Rivers, Katulak, Materese, Cadmus, et al., 2008; Parrott, Tennant, Olejnik, & Poudevigne, 2008). Given this evidence, it has been cautiously recommended that gain-framed messages be employed to encourage LTPA behaviour (Latimer et al., 2010).

There are however, several limitations of the extant LTPA message-framing literature which prompt further investigation. A first limitation is the absence of LTPA message-framing studies among persons with disabilities such as SCI. Given the need for LTPA initiatives among people with SCI, and the promise of message-framing as an effective strategy to enhance LTPA intentions (see Latimer et al., 2010; Latimer, Salovey, & Rothman, 2007), research should be extended to the SCI population. The current study addressed this limitation by employing a sample of individuals with SCI.

A second limitation is the fact that not all previous message-framing studies have targeted theory-based determinants of LTPA intentions or behaviour. In order to be maximally effective, LTPA interventions should be theoretically-driven (Baranowski, Anderson, & Carmack, 1998). Although, there are no known LTPA message-framing studies specifically targeting constructs of protection motivation theory (PMT; Rogers, 1983). PMT may be a particularly useful theory for developing persuasive LTPA communications for people with SCI. According to PMT, "vulnerability" and "response efficacy" are two cognitions influential in the development of intentions (i.e., protection motivation) to engage in health protective behaviours (e.g., LTPA). In the context of the current study, vulnerability refers to a perceived personal risk for disease and psychological health problems, while response efficacy refers to the belief that LTPA can effectively reduce the risk.

As in the general population, people with SCI have a tendency to underestimate their risk for disease and psychological health problems (Bassett & Martin Ginis, In press). LTPA response efficacy may also be underestimated among persons with a disability who sometimes cite a lack of understanding of the health benefits of LTPA as a barrier to participation (Rimmer, Rubin, & Braddock, 2000). Consistent with PMT (Rogers, 1983), underestimating vulnerability and response efficacy may inhibit the formation of LTPA intentions, whereas increased vulnerability and response efficacy should lead to increased intentions (Rogers, 1983).

A review of PMT-based studies in the LTPA domain concluded that change in response efficacy is an important predictor of change in LTPA intentions, and vulnerability may be a particularly salient construct for persons with chronic disease and disability (Plotnikoff & Trihn, 2010). Evidence from intervention studies supports both of these cognitions as predictors of intentions. For example, following exposure to risk information and persuasive messages

targeting LTPA, change in vulnerability for colon cancer and cardiovascular disease (CVD) were positively correlated with change in LTPA intentions (McGowan & Prapavessis, 2010; Wurtele & Maddux, 1987). Similarly, change in response efficacy positively predicted change in intentions following exposure to health and LTPA messages (McGowan & Prapavessis, 2010; Graham, Prapavessis, & Cameron, 2006). These research examples also provide evidence that vulnerability and response efficacy can be enhanced through exposure to risk information combined with persuasive communications regarding health and LTPA benefits (e.g., Milne, Orbell, & Sherran, 2002; McGowan & Prapavessis, 2010). Accordingly, the current study addressed a key limitation of the extant literature by utilizing a theory-driven intervention whereby disease and psychological health risk information were provided to target vulnerability, and framed LTPA messages were provided to target response efficacy.

A third limitation of the extant literature is the paucity of evidence regarding the *mechanisms* underlying message-framing effects (Rothman & Updegraff, 2009). Cognitive processing has been proposed as one possible mechanism (Rothman & Updegraff, 2009), such that the extent to which a recipient processes a message is an important determinant of its persuasive processes and effects (O'Keefe & Jensen, 2008). The extended parallel process model (EPPM; Witte, 1992) may be a useful framework for exploring cognitive processing in relation to risk information and framed messages targeting vulnerability and response efficacy.

According to the EPPM (Witte, 1992), if risk information elicits sufficient vulnerability to arouse fear, people will be motivated to process the information regarding a recommended response (e.g., LTPA as the recommended response to reduce vulnerability to CVD). If risk information elicits little or no perceived vulnerability, it is unlikely that fear will be aroused, and people will not be motivated to process further information. Therefore, according to the EPPM

(Witte, 1992), perceived vulnerability initiates and motivates message processing. In the current study, disease and psychological health risk information was presented to evoke sufficient vulnerability to motivate processing of framed-LTPA messages. Differences in cognitive processing of gain- versus loss-framed messages were then examined.

There is empirical evidence, albeit limited, that cognitive processing may vary for gain- and loss-framed messages. Memory for message content (i.e., recall) and the number of message-related thoughts generated are indicative of cognitive processing (see O'Keefe & Jensen, 2008). A meta-analysis of message framing effects on cognitive processing found a significantly greater level of cognitive processing following gain- versus loss-framed messages (O'Keefe & Jensen, 2008). When behaviour-type was examined as a moderator variable, the gain-framed effect for cognitive processing was present only for messages targeting health protective behaviours (e.g., LTPA) but not for health detection behaviours (e.g., cancer screening). This finding is interesting in light of the gain-framed advantage for messages targeting health-protective behaviours (Rothman & Salovey, 1997) and supports the notion that cognitive processing may be related to message framing effects.

Unfortunately, only three LTPA message-framing studies have measured cognitive processing, and the results have been mixed. One study found greater message recall and more message-relevant thoughts following gain- versus loss-framed LTPA messages (Jones, Sinclair, & Courneya, 2003). However, subsequent studies reported no significant difference in the number of message-relevant thoughts generated (Jones, Sinclair, Rhodes, & Courneya, 2004), nor recall (McCall & Martin Ginis, 2004) following exposure to gain- versus loss-framed exercise promotion messages. Clearly, further research is necessary to understand the relationship between message framing and cognitive processing. The current study addressed this

research gap through an exploratory examination of the relationship between framed LTPA messages and cognitive processing.

In summary, the purpose of the current study was to examine the relative effectiveness of health risk information combined with gain- versus loss- framed messages targeting LTPA for increasing vulnerability, response efficacy, and intentions. Further, the current study examined the effects of message frame on cognitive processing. Drawing on PMT (Rogers, 1983), Prospect theory (Kahneman & Tversky, 1979), and previous research (e.g., Latimer et al., 2010; O'Keefe & Jensen, 2008), the following hypotheses were tested: 1) participants exposed to the health risk information will show greater increases in vulnerability than the control group, 2a) participants exposed to framed LTPA messages (gain or loss) will show a greater increase in response efficacy and intentions conditions compared to the control group, 2b) the increase for response efficacy and intentions would be greater for the gain- versus loss-framed condition, 3) change in vulnerability and response efficacy would be positively related to change in intentions, and 4) cognitive processing would be greater for the gain- versus loss-framed condition.

Method

Participants

Participants were community-dwelling men (n=58) and women (n=38) with SCI, recruited through a) a database of volunteer participants from previous research, b) web advertisements targeted to the population, and c) word-of-mouth in the SCI community. Individuals were excluded from the study if they were a) less than 18 years of age, b) less than one year post injury, c) unable to speak and read English, or d) engaged in regular LTPA for six or more months. Regular LTPA was defined as at least 30 minutes of moderate to heavy intensity LTPA

on at least four days of the week (Health Canada, 1998)[1]. It was important to include individuals who had not established a regular LTPA routine because informational messages targeting risk perceptions and outcome expectancies are more persuasive in the early stages of behaviour change (Schwarzer, 2008). Additional demographic characteristics are summarized in Table 1.

Materials

Disease and Psychological Health Risk Information. Participants read health risk information regarding a) disease (i.e., cardiovascular disease [CVD], diabetes, obesity) and b) psychological health (i.e., depression, chronic pain, fatigue). The information described each health problem and provided facts and statistics about the risk among the SCI population. For example, "CVD refers to disease of the heart and blood vessels. CVD can result in heart attack or stroke caused by blockages to the heart or brain. CVD is a major cause of death in people with SCI. CVD risk is greater among people with SCI compared to the general population. Among Canadians under the age of 65, 7.6% of men and 5.5% of women with disabilities report CVD compared to just1.6% and 1.1% of men and women without disabilities." Risk information was not framed.

Framed LTPA Messages. Participants viewed framed messages describing the relationship between each health condition and LTPA. Each participant read a series of six exclusively gain- *or* loss-framed messages. Gain-framed messages outlined the *benefits* of engaging in regular LTPA while loss-framed messages outlined the *risks* of not engaging in regular LTPA. For each health condition, a series of framed messages included: a) facts about benefits (gain-framed) or risks (loss-framed), b) quotations from SCI experts and persons with SCI, and c) summary statements about research evidence regarding LTPA. All aspects of the material were

[1] The definition of regular LTPA was based on the Canada's Physical Activity Guide (1998). Since the completion of this study, there are new Physical Activity Guidelines for people with SCI, which advise twice weekly aerobic activity and twice weekly strength training activity for fitness benefits (Martin Ginis et al., 2011).

consistently gain-framed or loss-framed. For example, "Adding LTPA to your day can help you manage your pain" (i.e., gain-framed) or "By not adding LTPA to your day you miss an opportunity to manage your pain" (i.e., loss-framed).

Measures

Vulnerability. Participants responded to the following six questions on 7-point scales*:* "My chances of developing a) CVD, b) obesity, c) diabetes, d) depression, e) pain, and f) fatigue in the future are" (-3 *not at all strong* to +3 *very strong*), and "I am unlikely to develop [CVD, obesity, etc.] in the future" (-3 *strongly disagree* to +3 *strongly agree*; reverse scored). The items were averaged for an overall disease vulnerability score (items a-c; Cronbach's α=.88) and psychological health risk vulnerability score (items d-f; Cronbach's α=.86). Higher scores were indicative of higher vulnerability. The measure was adapted from Milne (2002) to address perceived risk of inactivity-related diseases and psychological health problems.

Response Efficacy. Participants responded to 14 questions on a 5-point scale (1 *Definitely Not* to 5 *Definitely Yes*). The items targeted the perceived efficacy of LTPA to reduce the risk of inactivity-related diseases (7 items) and psychological health problems (7 items). This measure was adapted from Plotnikoff and Higginbottom (1998; 2002) by including items to address diseases and psychological health problems related to inactivity among people with SCI such as diabetes and depression. The items were averaged to create an overall response efficacy for disease risk score (Cronbach's α =.66) and psychological health risk score (Cronbach's α =.69). Four items were removed in order to improve the measure's reliability for disease risk (Cronbach's α =.77) and psychological health risk (Cronbach's α =.76). Examples of the removed items include "Regular LTPA will increase my risk of obesity" and "…increase my

chances of developing depression," which were likely misinterpreted as a result of their reverse wording.

Intention. Participants responded to two items assessing the strength of their intentions to "accumulate 30 minutes of moderate to heavy LTPA at least 4 days per week over the next two weeks" (i.e., "I intend to" and "I will try to"). These items were measured on 7-point scales (1 *definitely false/very unlikely* to 7 *definitely true/very likely).* One item assessed the frequency of intentions by measuring the number of days per week (i.e., 1-7 days) participants intended "to accumulate 30 minutes of moderate to heavy LTPA over the next two weeks." The items were averaged to create an overall intention score (Cronbach's α =.92). This measure was developed based on recommendations for assessing behavioural intentions (Ajzen, 2006).

Cognitive Processing. Two indicators of cognitive processing were assessed. First, immediately following message exposure, participants listed thoughts they had during message viewing. Two independent scorers coded each thought as unfavourable (i.e., described undesirable attributes or negative associations of the messages), favourable (i.e., described desirable attributes or positive associations of the messages), or neutral/irrelevant (i.e., without affect toward messages or unrelated). Interrater reliability was high (κ>0.94, p <.0.001; Landis & Koch, 1977). Any coding discrepancies were resolved between the two scorers through discussion. The following scores were calculated for each participant's thoughts: a) total, b) favourable, and c) unfavourable. Higher scores on each are believed to be indicative of greater cognitive processing (Cacioppo & Petty, 1981). Second, message recall was evaluated. Participants read six statements and indicated if each was or was not included verbatim in the LTPA messages. A total recall score was calculated by summing the number of correctly

identified statements. This message recall measurement strategy was adopted from previous message framing research (Block & Keller, 1995).

Procedure

Following participant recruitment and screening, baseline measures of vulnerability, response efficacy, and intentions were electronically mailed to each participant. Once baseline measures were complete, a two-step randomization procedure was followed in order to test the hypotheses regarding the effects of a) risk information on vulnerability, and b) the relative effects of gain- and loss-framed LTPA message on response efficacy, intentions, and cognitive processing.

First, participants were randomized to the risk information or no risk information control condition. Participants randomized to the risk information condition received an electronic link (24-hours after baseline testing) containing risk information on either: a) inactivity-related disease or b) psychological health problems. Participants read the risk information and then completed the vulnerability measure for a second time. Participants randomized to the no risk information control condition also received an electronic link (24-hours after baseline testing). However, this link contained only the vulnerability measure; the control group did not receive the risk information.

The second step involved randomizing participants in the risk information condition to one of two further conditions: 1) gain-framed messages or 2) loss-framed messages. These participants opened an additional link containing either gain- or loss-framed LTPA messages, which targeted the health risk information presented in the first link (i.e., disease risk or psychological health risk). Measures of cognitive processing, vulnerability, response efficacy, and intentions were administered immediately after. Participants in the no risk information control condition were assigned to the no-message control condition and received a link containing only the measures of

vulnerability, response efficacy and intentions. These participants did not receive LTPA messages. This process was repeated 24-hours later for the second health topic (i.e., disease risk or psychological health risk). All procedures were approved by the McMaster University Research Ethics Board. See Figure 1 for a flow diagram illustrating data collection and randomization procedures.

Statistical Analysis Approach

Prior to analyses, data were inspected for outliers. Sample sizes vary across analyses as a result of missing data and removal of statistical outliers (i.e., values >3.29 standard deviations from the mean; Tabachnick & Fidell, 2001). The statistical assumptions of each analysis were tested and satisfied (Kleinbaum, Kupper, Nizam, & Muller, 2008).

Hypothesis Testing. Separate analyses were conducted for each hypothesis regarding vulnerability and response efficacy. For the hypothesis regarding changes in vulnerability, 2 (condition: risk information vs. no risk information control) x 2(time: baseline vs. post- risk information) repeated-measures ANOVAs were calculated to examine changes as a function of condition. In the presence of significant condition x time interaction effects, post hoc analyses (i.e., paired sample *t*-tests) were calculated.

For hypotheses regarding changes in response efficacy, and intentions, a series of 3(condition; gain-framed vs. loss-framed vs. no message control) x 2(time; baseline vs. post LTPA message) repeated-measures ANOVAs were calculated to examine changes as a function of condition. In the presence of a significant ($p < .05$) time x condition interaction effect, three planned comparison, 3(condition) x 2(time) repeated-measures ANOVAs were calculated to compare changes in each variable between each condition (i.e., gain vs. control, loss vs. control, gain vs.

loss). For the planned comparison repeated measures ANOVAs, a Bonferonni correction adjusted the significance criterion to $p < .017$ to reduce the risk of Type 1 error (Field, 2009).

For hypotheses regarding the prediction of changes in intentions, linear regression models were calculated. Residualized change scores were used in the models rather than simple change scores in order to reduce error in calculating change scores and to conserve degrees of freedom. Residualized change in intentions was the dependent variable for each model, while residualized change in vulnerability or response efficacy was the predictor variable.

For the hypothesis regarding differences in cognitive processing for the gain- and loss-framed conditions, the no message control condition was excluded. A MANOVA was calculated using total, favourable, and unfavourable thoughts as the dependent variables. In the presence of a significant ($p < .05$) multivariate effect, post hoc univariate ANOVAs were conducted to examine group differences for each cognitive processing variable. A Bonferroni correction was used to adjust the significance criterion to $p < .013$ to reduce the risk of Type 1 error (Field, 2009).

Results

Hypothesis testing

Changes in vulnerability. Table 2 displays the results of the repeated measures ANOVAs calculated with a) disease vulnerability, and b) psychological health vulnerability, as the dependent variables. In the ANOVA considering disease vulnerability, significant main effects for time ($F(1,74) = 28.48$, $p = .007$; $\eta_p^2 = .28$) and condition ($F(1,74) = 11.60$, $p = .001$; $\eta_p^2 = .14$) were superceded by a significant time by condition interaction ($F(1,74) = 11.72$, $p = .001$; $\eta_p^2 = .14$). Post hoc tests indicated a significant increase in disease vulnerability for the experimental condition only ($t = -7.06$, $p < .001$). In the ANOVA considering psychological health

vulnerability, significant main effects for time ($F(1,75) = 7.72$, $p = .007$; $\eta_p^2 = .10$) were superceded by a significant time by condition interaction effect ($F(1,75) = 5.27$, $p = .02$; $\eta_p^2 = .07$). Post hoc test indicated a significant increase in vulnerability for the experimental condition only ($t = -4.20$, $p < .001$).

Changes in response efficacy. Table 3 displays the results of the repeated measures ANOVAs calculated with a) LTPA response efficacy for disease risk, and b) LTPA response efficacy for psychological health risk, as the dependent variables. In the ANOVA considering response efficacy for disease risk, significant main effects for time ($F(1,76) = 6.65$, $p = .01$; $\eta_p^2 = .08$) were observed. There were no significant main effects for condition ($F(1,76) = 1.66$, $p = .20$; $\eta_p^2 = .04$), nor time by condition interaction effects ($F(2,76) = .38$, $p = .69$; $\eta_p^2 = .01$).

In the ANOVA considering LTPA response efficacy for psychological health risk, main effects for time ($F(1,72) = 34.75$, $p < .001$; $\eta_p^2 = .33$) were superceded by a significant time by condition interaction effect ($F(2,72) = 6.79$, $p = .002$; $\eta_p^2 = .16$). Planned comparisons for each condition indicated a significantly greater increase in LTPA response efficacy for the loss-framed condition compared to the control ($F(1, 44) = 6.09$, $p = .018$; $\eta_p^2 = .12$) and gain-framed conditions ($F(1,51) = 13.27$, $p = .001$; $\eta_p^2 = .21$). There was no significant difference in LTPA response efficacy increase between the gain-framed and control conditions ($F(1,49) = .73$, $p = .40$; $\eta_p^2 = .02$).

Changes in intentions. Table 4 displays the results of the repeated measures ANOVA calculated with intentions as the dependent variable. A significant main effect for time ($F(1,71) = 16.67$, $p < .001$; $\eta_p^2 = .19$) was superceded by significant time by condition interaction effects ($F(2,71) = 3.74$, $p = .03$; $\eta_p^2 = .10$). Planned comparisons for each condition indicated a significantly greater increase in intentions for the loss-framed condition compared to the control

condition ($F(1,45) = 7.20$, $p = .01$; $\eta_p^2 = .14$) and a trend toward a greater increase compared to the gain-framed condition ($F(1,51) = 3.75$, $p = .06$; $\eta_p^2 = .07$). There was no significant difference between the gain-framed and control conditions ($F(1,46) = 0.56$, $p = .46$; $\eta_p^2 = .01$).

Predicting intentions. Separate linear regression models were calculated with change in intentions as the dependent variable and a) changes in vulnerability and b) changes in response efficacy as the predictor variables. Neither change in disease vulnerability ($R^2 = .01$, $\beta = .06$, $p > .05$) nor change in psychological health vulnerability ($R^2 = .01$, $\beta = .10$, $p > .05$) were significant predictors of change in intentions. Change in LTPA response efficacy for disease risk was not a significant predictor of change in intentions ($R^2 = .03$, $\beta = .17$, $p > .05$). However, change in response efficacy for psychological health risk was a significant and positive predictor of change in intentions ($R^2 = .08$, $\beta = .28$, $p < .05$).

Group differences in cognitive processing. Table 5 displays the results of the MANOVA comparing cognitive processing between gain- and loss-framed conditions. Overall, cognitive processing following disease and LTPA messages did not differ between the gain- and loss-framed condition (Wilks' Lambda = .98, $p = .91$; $\eta_p^2 = .02$). However, overall cognitive processing following psychological health and LTPA messages was higher among the loss- than gain-framed condition (Wilks' Lambda = .84, $p = .05$; $\eta_p^2 = .16$). Results of the Bonferroni-corrected post hoc univariate tests are displayed in Table 5. None of the individual cognitive processing variables differed between the gain- and loss-framed conditions at the Bonferroni-adjusted value of $p < .013$: total thoughts ($F(1,56) = 5.70$, $p = .02$), favourable thoughts ($F(1,56) = 4.49$, $p = .04$), unfavourable thoughts ($F(1,56) = 1.48$, $p = .23$), accurate recall ($F(1,56) = 3.55$, $p = .07$). However, across all four processing measures, scores for the loss-framed condition was consistently greater than the gain-framed.

Discussion

The purpose of the current study was to examine the relative effectiveness of chronic disease and psychological health risk information combined with gain- versus loss- framed LTPA messages for changing vulnerability (i.e., perceived personal risk), response efficacy (i.e., belief that LTPA can effective reduce the risk), and LTPA intentions. Further, the current study explored the relationship between message framing and cognitive processing. As hypothesized, increases in vulnerability were observed following risk information, suggesting that participants had enhanced perceived risk for disease and psychological health problems prior to LTPA message exposure. LTPA response efficacy for psychological health problems and LTPA intentions increased among individuals exposed to the loss-framed LTPA messages. Change in response efficacy was a significant predictor of change in intentions. Finally, greater cognitive processing was observed following exposure to loss- versus gain-framed LTPA messages.

Changes in Vulnerability

Consistent with previous research (e.g., McGowan & Prapavessis, 2010), following exposure to risk information, disease and psychological health vulnerability increased among the experimental condition. Unrealistically low perceptions of vulnerability may thwart motivation to engage in risk-reducing behaviours such as LTPA (Weinstein, 1989). Accordingly, the use of risk information may be a relatively simple strategy for health practitioners to employ to increase personal vulnerability for disease and psychological health risk among persons with SCI.

Changes in Response Efficacy

The effects of the framed LTPA messages on response efficacy varied depending on whether the messages targeted chronic disease risk or psychological health risk. Contrary to hypothesis, there were no framing effects for the LTPA messages targeting chronic disease risk. Rather,

response efficacy for disease risk increased for all three conditions which may reflect a mere measurement effect; a common phenomenon when repeatedly measuring psychological variables (Morwitz, Johnson, & Schmittlein, 1993). Nevertheless, this finding is surprising given that previous research employing health and LTPA messages has demonstrated increases in LTPA response efficacy for reducing disease risk compared a control group (e.g., Milne et al., 2002; McGowan & Prapavessis, 2010). The lack of intervention effect in the current study may be related to the relatively high baseline levels of LTPA response efficacy for reducing disease risk, which suggest that participants had knowledge of the disease risk reduction benefits of LTPA prior to message exposure. High baseline levels of response efficacy may have created a ceiling effect that limited any further increases in response efficacy resulting from the message intervention (i.e., beyond the mere measurement effect).

Contrary to hypothesis, compared to the control group, LTPA response efficacy for psychological health risk increased for the loss-framed condition but not for the gain-framed condition. This finding is also somewhat surprising given the hypothesized advantage of gain-framed LTPA messages based on the framing predictions of prospect theory (Kahneman & Tversky, 1979) and previous research findings (Latimer et al., 2010; O'Keefe & Jensen, 2007). However, a plausible explanation may be rooted in the extended parallel process model (EPPM; Witte, 1992).

Specifically, the EPPM (Witte, 1992) posits that a sufficient level of vulnerability must be aroused in order to motivate processing of information regarding a recommended response (e.g., LTPA). Indeed, vulnerability may evoke a sense of fear and personal relevance or "issue involvement" that drives processing of relevant messages in detail (see Maheswaran & Meyers-Levy, 1990). In the context of the current study, risk information elicited a significant increase in

vulnerability for psychological health risk. As a result, participants may have had a sense of fear or high issue involvement prior to exposure to the framed LTPA messages and may have had high motivation to process the subsequent information with regard to a recommended response (i.e., LTPA). This explanation is diagrammed in Figure 2. Participants in the loss-framed condition received LTPA messages which were likely congruent with the negative affect and mind set present as result of increased vulnerability. Accordingly, these participants may have maintained high motivation to process these messages and successfully processed the information because of its congruency with their mind set following the risk information (cf. Lee & Aaker, 2004). This chain of events may explain why the loss-framed LTPA messages successfully persuaded an increase in LTPA response efficacy.

Conversely, participants in the gain-framed condition received LTPA messages which were presumably incongruent with the negative affect and mind set following an increase in vulnerability. Thus, despite the fact that these participants may have felt fear and high personal relevance or issue involvement, motivation to process the gain-framed messages may have been compromised by the incongruently positive nature of the messages. This incongruence may explain why the gain-framed messages did not successfully persuade an increase in LTPA response efficacy.

Findings from previous research support this explanation for the loss-framed advantage in persuading enhanced response efficacy in the current study. First, there are multiple research studies which support the notion that in order to be maximally persuasive, framed messages must be congruent with various aspects of the message recipient. For example, the message recipient's motivational disposition (e.g., Carver & White, 1984; Mann, Sherman, & Updegraff, 2004), perceptions of the behaviour (Toll, Salovey, O'Malley, Mazure, Latimer, & McKee 2008), issue

involvement (Petty & Cacioppo, 1979; Millar & Millar, 2000), and information-processing style (Williams-Piehota, Schneider, Pizarro, Mowad, & Salovey, 2003), have been found to moderate the relative effectiveness of gain- versus loss-framed messages. Messages framed to be congruent with the message recipient's characteristics are generally more effective than incongruently framed messages. In the current study, the loss-framed LTPA message advantage may have resulted due to the congruency between these messages and the participants' mind set following an increase in vulnerability.

Second, there is evidence of a loss-framed advantage over gain-framed messages when issue involvement is high. Indeed, it has been suggested that there is a tendency to place greater weight and influence on negative versus positive information, but *only* when the information recipient is sufficiently motivated to process the message content (e.g., Maheswaran & Meyers-Levy, 1990). For example, in a previous study, issue involvement for heart disease was manipulated via risk information, which resulted in high and low issue involvement conditions. Among the high issue involvement condition, loss-framed information targeting cholesterol reduction and diagnostic testing was more persuasive than the equivalent gain-framed information (Maheswaran & Meyers-Levy, 1990). In the current study, enhanced vulnerability following risk information may be analogous to high issue involvement, which could explain the observed loss-framed advantage for persuading changes in response efficacy.

Changes in Intentions

LTPA intentions increased following exposure to the loss-framed messages only. This finding is consistent with the pattern of findings discussed above which support a loss-framed message advantage. Although the loss-frame advantage contradicts the prospect theory-driven hypothesis for a gain-framed message advantage, it is consistent with the EPPM (Witte, 1992) explanation.

That is, the risk information elicited increased vulnerability, a negative mind set, and high issue involvement. Individuals exposed to loss-framed LTPA messages engaged in greater cognitive processing compared to those exposed to the gain-framed messages due to the loss-framed messages' congruency with the negative mind set and high issue involvement evoked by the risk information. The greater cognitive processing resulted in increased response efficacy and intentions following exposure to loss-framed (i.e., versus gain-framed) LTPA messages.

Cognitive Processing

The cognitive processing data also support the EPPM (Witte, 1992) explanation for the superiority of the loss-framed LTPA messages after receiving risk information. Greater cognitive processing of LTPA messages targeting psychological health risk was observed for the loss- versus gain-framed condition. Fitting with the EPPM (Witte, 1992), heightened vulnerability following exposure to risk information may have motivated cognitive processing of subsequent loss-framed messages, which in turn persuaded an increase in response efficacy and intentions. Indeed, the consistent pattern of higher levels of cognitive processing *and* changes in response efficacy *and* intentions for the loss- versus gain-framed condition suggests there may be a link between cognitive processing and message framing effects.

Predicting Changes in Leisure Time Physical Activity Intentions

Also fitting within the EPPM (Witte, 1992), are the null findings regarding change in vulnerability as a predictor of change in intention. Neither change in disease vulnerability nor change in psychological risk vulnerability was a significant predictor of change in intention. Although a positive relationship between change in vulnerability and change in intention was hypothesized based on PMT (Rogers, 1983), the null findings appear consistent with the EPPM (Witte, 1992). Sufficient levels of vulnerability may be necessary for messages to elicit cognitive

processing and change in response efficacy, which may lead to subsequent change in intentions. Indeed, vulnerability has been proposed as a *precursor* to the development of response efficacy (Tanner, 1991). Although enhanced vulnerability alone may be insufficient to change LTPA intention (i.e., vulnerability does not directly predict change in intention), sufficient vulnerability may be instrumental in cognitive processing of LTPA messages and the development of intentions (Witte, 1992).

In contrast, change in response efficacy for psychological health problems was a significant and positive predictor of change in intention. This finding is consistent with protection motivation theory (PMT; Rogers, 1983) and previous research findings (e.g., McGowan & Prapavessis, 2010), which support a positive relationship between response efficacy and intentions. This finding may also corroborate the EPPM (Witte, 1992) explanation, such that the change in psychological health risk vulnerability may have elicited greater cognitive processing of loss versus gain-framed messages resulting in a subsequent increase in response efficacy, which predicted the change in intentions (see Figure 2). Unfortunately, the current study was underpowered to examine a change in response efficacy by condition interaction as a predictor of change in intentions.

Implications

There are several theoretical implications of the current study. First, although the salience of vulnerability has been questioned as a relevant construct within the PMT (see Plotnikoff & Trihn, 2010), it may be important to elicit processing of messages that persuade changes in response efficacy and result in the formation of intentions. A sequential model of PMT, where increases in response efficacy occurs only following sufficient increases in vulnerability, has been proposed and could be useful in the development and understanding of messages to change

LTPA intentions (Tanner, 1991). Future research should continue to examine the role of vulnerability when applying PMT in persuasive communication research.

Second, although the framework of prospect theory (Kahneman & Tversky, 1979) is often employed within message framing research, the observed loss-framed advantage for messages targeting LTPA and psychological health risk, is not consistent with the theory's framing tenet. It is important to note however, that the current study is not the first to have findings inconsistent with the common application of prospect theory in message framing research (e.g., Jones et al., 2004). Perhaps the appropriateness of prospect theory as a framework for message framing research should be reconsidered. At the very least, moderators such as perceived vulnerability, issue involvement, and risk outcome expectancies should be considered in order to advance our understanding of framing effects based on prospect theory (see Latimer et al., 2007).

Finally, the current study provides support for the EPPM (Witte, 1992) as a model for examining message framing effects. The EPPM may be particularly useful when considering persuasive communication interventions where risk information is combined with framed behavioural messages. Likewise, the EPPM may be a suitable framework for examining cognitive processing as a mechanism of framing effects.

Pragmatically, the current findings support the use of persuasive communications targeting vulnerability and response efficacy to change LTPA intentions among people with SCI. The combination of risk information paired with LTPA information may be a particularly effective messaging strategy for targeting individuals with SCI, who are at increased risk for disease and psychological health problems (Nash, 2005; Kennedy & Rogers, 2000), and who may be unaware of the risk-reducing benefits of LTPA (Rimmer et al., 2000). Second, the findings suggest that loss-framed LTPA messages, when paired with risk information targeting

vulnerability, may have an advantage over gain-framed messages for enhancing LTPA intentions among people with SCI. Similarly, risk information and LTPA messages targeting psychological health risk may be more effective than messages targeting disease risk.

Limitations and future directions

Despite the important implications of the current study, there are limitations which warrant mention. First, the generalizability of the findings outside the SCI population is unknown. Second, the current study did not explore message effects on LTPA per se. Given the complexity of changing LTPA, the use of persuasive communication strategies may be better suited as an intervention targeting behavioural cognitions rather than behaviour (Latimer et al., 2007). However, future research could benefit from an examination of the impact of changes in cognitions due to risk information combined with framing on LTPA among people with SCI. A third limitation reflects the exploratory nature of the investigation of message framing effects on cognitive processing. Specifically, the current study did not conduct statistical tests of mediation to examine cognitive processing as a mechanism of framing effects. Rather, the exploratory analyses were strategic due to the infancy of research examining cognitive processing in relation to message framing. In light of the current findings, further investigation of cognitive processing as a mechanism of framing effects, including statistical meditational analyses, is encouraged. Importantly, future research should examine the EPPM (Witte, 1992) as a framework for understanding message framing effects and the role of cognitive processing.

Conclusion

Initiatives to increase LTPA among people with SCI are essential. The use of psychological health risk information paired with loss-framed LTPA persuasive messages may be effective in changing perceptions of vulnerability, response efficacy, and LTPA intentions among people

with SCI. The EPPM (Witte, 1992) may be a valuable framework for future research to evaluate framed LTPA message effects. Finally, cognitive processing should be further evaluated as a possible mechanism of message framing effects in general, as well as within the framework of the EPPM (Witte, 1992).

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Table 1

Participant Characteristics

Variable	N=94
Sex	
Male	55 (59%)
Female	39 (41%)
Age (yr)	45.20 ± 11.77
Years post injury	18.36 ± 11.62
Lesion Level	
Paraplegic	57 (61%)
Quadriplegic	37 (39%)
Primary Mode of Mobility	
Manual wheelchair	46 (48.5%)
Power wheelchair	33 (35%)
Other gait aid (e.g. cane)	15 (16.5%)
Highest Level of Education	
High school	21 (22.5%)
College	18 (19%)
University	19 (20%)
Post Graduate	23 (24.5%)
Other	13 (14%)

Table 2

Results of Repeated Measures ANOVA of Vulnerability by Time and Condition

	Vulnerability				
	Baseline M (SD)	Post-intervention M(SD)	Time F (partial η^2)	Condition F (partial η^2)	Time x Condition F (partial η^2)
Disease Risk			28.48 (.28)**	11.60 (.14)**	11.72 (.14)**
Control (n=24)	3.07 (1.09)	3.35 (1.35)			
Experimental (n=52)	3.57 (1.49)	4.84 (1.21)[a]			
Psychological Health Risk			7.72 (.10)**	2.56 (.03)	5.27 (.07)*
Control (n=24)	4.14 (1.44)	4.19 (1.22)			
Experimental (n=53)	4.36 (1.23)	4.94 (1.36)[a]			

Note. [a] significantly different from baseline. **p<.01, *p<.05

Table 3

Results of Repeated Measures ANOVA and Planned Comparisons of Response Efficacy by Time and Condition

	Response Efficacy				
	Baseline M (SD)	Post-intervention M(SD)	Time F (partial η2)	Condition F (partial η2)	Time x Condition F (partial η2)
Disease Risk[a]			6.65 (.08)*	1.66 (.04)	0.38 (.01)
Control (n=25)	4.28 (.74)	4.38 (.68)			
Gain-framed (n=26)	4.33 (.51)	4.52 (.53)			
Loss-framed (n=28)	4.46 (.55)	4.69 (.46)			
Psychological Health Risk			34.75 (.33)**	2.98 (.08)†	6.79 (.16)**
Control (n=22)	3.45 (.81)	3.75 (.86)			
Gain-framed (n=29)	3.82 (.67)	3.98 (.57)			
Loss-framed (n=24)	3.66 (.69)	4.40 (.48)			
Contrast 1 – Control vs. Gain			8.05 (.14)**	2.63 (.05)	0.73 (.02)
Contrast 2 – Control vs. Loss			34.01 (.44)**	5.07 (.10)*	6.09 (.12)**
Contrast 3 – Gain vs. Loss			32.14 (.39)**	0.80 (.02)	13.27 (.21)**

Note. [a] planned comparisons were not conducted for response efficacy regarding disease risk due to the lack of interaction effect detected in the original repeated measures ANOVA. **p<.02, *p<.0

Table 4

Results of Repeated Measures ANOVA and Planned Comparisons of LTPA Intentions by Time and Condition

	Intentions				
	Baseline M (SD)	Post-intervention M(SD)	Time *F* (partial η2)	Condition *F* (partial η2)	Time x Condition *F* (partial η2)
Intentions			16.67 (.19)**	0.05 (<.01)	3.74 (.10)*
Control (n=21)	3.90 (1.85)	4.10 (1.27)			
Gain-framed (n=27)	3.89 (1.71)	4.36 (1.29)			
Loss-framed (n=26)	3.52 (1.82)	4.68 (1.37)			
Contrast 1 – Control vs. Gain			3.16 (.06)†	0.09 (<.01)	0.56 (.01)
Contrast 2 – Control vs. Loss			13.97 (.24)**	0.05 (<.01)	7.20 (.14)**
Contrast 3 – Gain vs. Loss			20.86 (.29)**	0.01 (<.01)	3.75 (.07)†

Note. **p<.02, **p<.05, †p<.10.

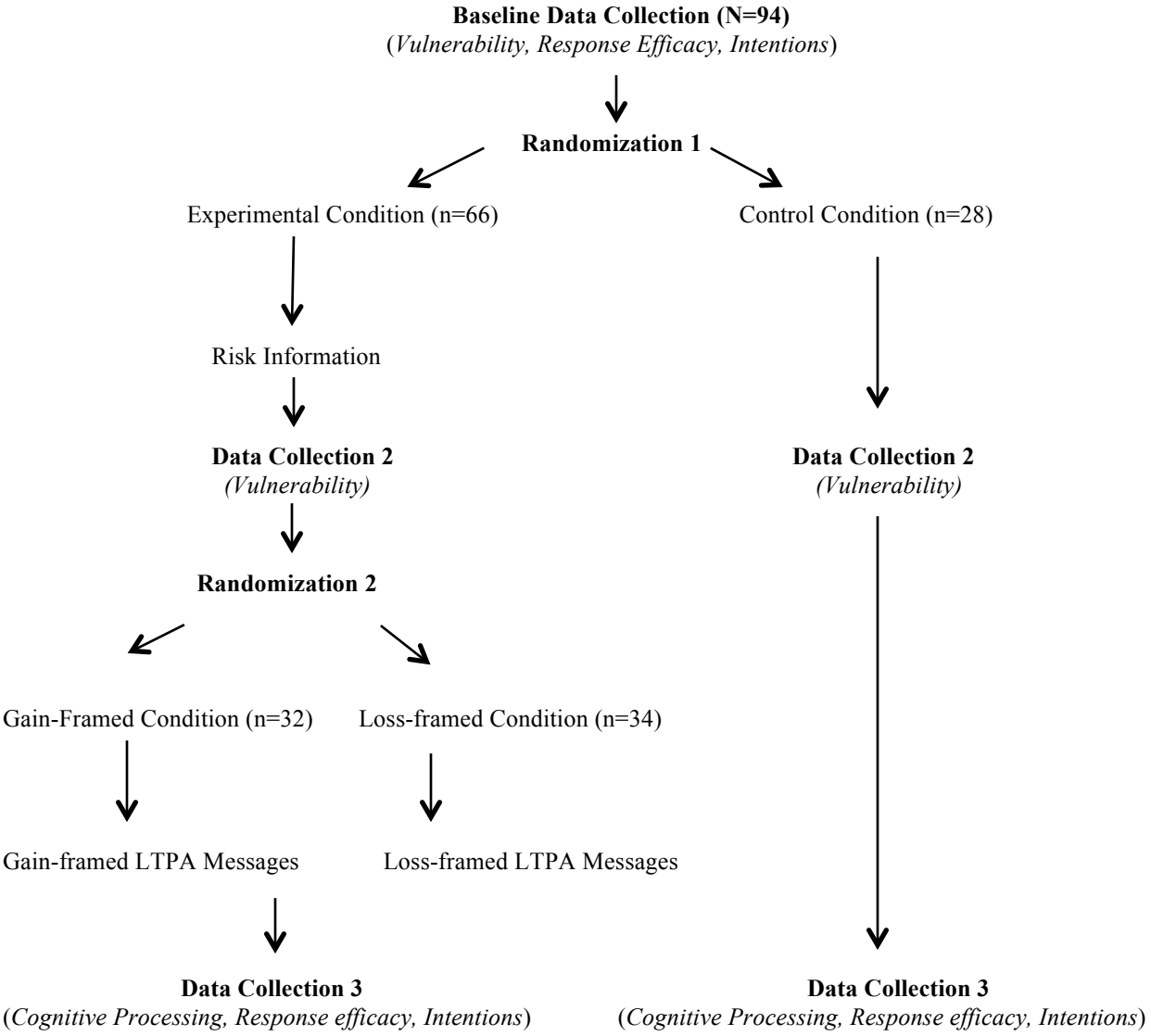
Table 5

Results of MANOVA and Post Hoc ANOVA of Cognitive Processing by Condition

	Loss-Framed(n=28)	**Gain-Framed (n=27)**	**Univariate F**	***p***
Disease				
Total thoughts	5.00 (2.94)	4.93 (2.96)	0.01	0.93
Favourable thoughts	2.82 (2.78)	2.56 (1.72)	0.24	0.63
Unfavourable thoughts	1.57 (1.62)	1.74 (1.70)	0.14	0.71
Accurate recall	4.26 (1.22)	4.56 (1.26)	0.34	0.56
Psychological Health*	**Loss-framed (n=29)**	**Gain-framed (n=29)**	**Univariate F**	***p***
Total thoughts	5.55 (2.47)	4.03 (2.37)	5.7	0.02
Favourable thoughts	3.76 (2.46)	2.59 (1.68)	4.49	0.04
Unfavourable thoughts	1.45 (1.59)	0.97 (1.43)	1.48	0.23
Accurate recall	4.03 (0.91)	3.59 (0.91)	3.55	0.07

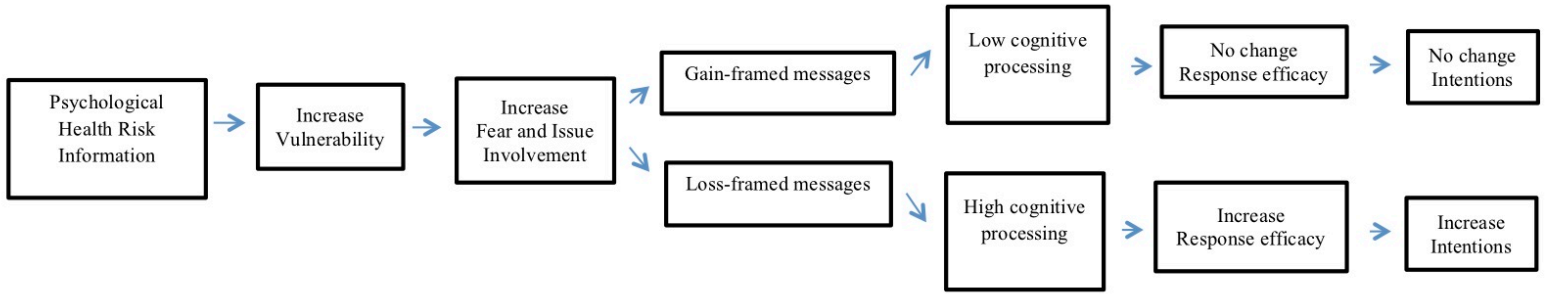
Note. * significant multivariate effect for condition Wilks' Lambda p=.05.

Figure 1. *Flow Diagram of Randomization and Data Collection Procedures*



Note. Data collection procedures were repeated for risk information and LTPA messages targeting the second health topic (i.e., disease or psychological health problems). However, randomization did not change and participants remained in their original conditions for the second round of data collection. Measures employed at a given data collection time point are italicized and in parentheses.

Figure 2. *Schematic for EPPM-based Explanation*



CHAPTER 4

I spy with my little eye: A persuasive message?

Abstract

Purpose: The primary purpose was to examine the relative attention – operationalized as dwell time on message content – given to gain- versus loss-framed LTPA response efficacy messages following exposure to health risk information. Guided by EPPM (Witte, 1992), the secondary purpose was to examine the relationship between dwell time and message elaboration, perceived risk, personal relevance, and fear arousal. **Method:** Baseline measures of perceived risk for inactivity-related disease and health problems was measured among 77 undergraduate students. Participants read population-specific health risk information from a computer monitor while wearing a head-mounted eye tracker, which measured participants' dwell time on message content. Perceived risk was then reassessed. Next, participants read LTPA response efficacy messages while the eye tracker measured dwell time on message content. Immediately following message exposure, elaboration (i.e., thought listing and recall), fear arousal, and personal relevance were measured. **Results:** Dwell time on gain-framed messages was significantly greater than loss-framed. However, dwell time was not significantly related to message elaboration, fear arousal, or personal relevance. Fear arousal was significantly related to message elaboration and personal relevance. **Conclusion:** Gain-framed messages may evoke greater levels of attention than loss-famed messages. However, attention alone may be insufficient for evoking message elaboration.

Health behaviour change messages should include health risk information as well as information about the efficacy of the response behaviour (Witte, 1992). In order to maximize the effectiveness of health messages, it is important to determine optimal strategies for presenting these types of information. Framing has been recommended as a strategy for developing persuasive communications to convey the efficacy of leisure time physical activity (LTPA) for promoting health and well-being (Latimer, Brawley, & Bassett, 2010). Gain-framed messages emphasize the benefits of regularly engaging in LTPA, whereas loss-framed messages emphasize the risks of not regularly engaging in LTPA. Although superficially the difference between these messages is subtle, there is conclusive evidence that people respond differently depending on how the efficacy information is framed (Rothman & Salovey, 1997).

Little is known about the mechanisms that account for the effects of message framing. Cognitive processing, specifically attention and elaboration, is one mechanism that has been suggested in the framing literature (Rothman & Updegraff, 2009). In order for messages to be persuasive they must be attended to and thought about. Thus, attention is a critical component of cognitive processing that is necessary for elaboration, and ultimately, persuasion. In addition to paying attention, the message recipient must sufficiently elaborate (i.e., think about and consider) the content of the message.

In a meta-analysis of message framing research targeting health detection (e.g., cancer screening), health prevention (e.g., LTPA), and other (e.g., pedestrian safety) behaviours, (O'Keefe & Jensen, 2008), the authors hypothesized that loss-framed messages would engender greater elaboration than gain-framed messages because of their fear-inducing effects; greater fear-arousal is associated with greater message elaboration (e.g., Meijnders, Midden, & Wilke, 2001; Slater, Karan, Rouner, & Walters, 2002). Contrary to hypothesis, however, greater

message elaboration -- indexed as message recall and message relevant thoughts -- was observed for gain-framed messages. When behaviour-type was included as a moderator, the gain-framed advantage for processing was significant for health prevention behaviours only. These findings are consistent with the message framing recommendations that gain-framed messages are better than loss-framed for promoting prevention-type behaviours (Latimer et al., 2010). Taken together, these results suggest that relative differences in cognitive processing of gain- and loss-framed messages may explain *why* framing effects occur. It is possible that gain- and loss-framed messages elicit different levels of attention and elaboration which, in turn, may account for differential responses to the two types of messages.

In study 2, however, we found that loss-framed messages resulted in greater elaboration than gain-framed messages in a sample of people with spinal cord injury (SCI). Drawing on the EPPM (Witte, 1992), we suggested that the presentation of health risk information prior to presenting the LTPA messages may have evoked feelings of vulnerability, fear, and a negative mindset among participants. This negative mindset may have been congruent with the negative wording of the loss-framed messages, leading to greater message elaboration, and thus, greater overall loss-framed message effects compared to the gain-framed messages. Indeed, the EPPM (Witte, 1992) is a useful framework for understanding cognitive processing when health risk information precedes a message advocating the efficacy of a behavioural strategy. According to EPPM, threat (i.e., perceived severity and vulnerability) "initiates and motivates message processing because the greater the threat, the greater the fear aroused, the more attention-getting the message and the more involving the message…If perceptions of threat are low, then people are not motivated to continue message processing" (Witte; p. 339). From this application of EPPM, it can be suggested that the presentation of health risk information preceding a

behavioural message may be an effective strategy to evoke vulnerability, fear-arousal, and a sense of issue involvement or personal relevance. In turn, these feelings may prompt greater elaboration of subsequent messages (Witte, 1992).

Such feelings may also motivate readers to pay greater attention to subsequent messages regarding risk-reduction strategies such as LTPA (Witte, 1992). Loss-framed LTPA messages may provide individuals with behavioural information that is congruent with the negative affect and mind set evoked by the risk information, thus engendering greater attention (cf. Lee & Aaker, 2004). Messages framed to be congruent with the recipient's cognitive characteristics are generally more effective than incongruently framed messages (e.g., Petty & Cacioppo, 1979; Sherman, Mann & Updegraff, 2006; Toll et al., 2008;Williams-Piehotta, Schneider, Pizarro, & Salovey, 2003) perhaps because they draw greater attention. Thus, after the presentation of health risk information, loss-framed messages may yield greater congruency than gain-framed messages, and consequently prompt greater attention.

The purpose of the current study was to examine the generalizability of the Study 2 findings of greater cognitive processing of loss-framed versus gain-framed messages among people with SCI, by examining cognitive processing in a university-based sample. In particular, we looked at differences in attention paid to the two types of messages. Attention is an early stage of cognitive processing (Greenwald & Leavitt, 1984) during which the information recipient has contact with the stimulus (i.e., message information; Smit, Neijens, Stuurman, 2006). During the attention phase of cognitive processing, the pupil dilates and the lens focuses as the information recipient dwells on the message content (Franzen, 1994, p.30). Dwell time (i.e., the amount of time one's eyes are fixated on the message content) during message exposure is an objective, biometric indicator of attention. Greater dwell time is presumed to be indicative of greater cognitive

processing; cognitive processing will occur as long as one is dwelling on the message (Krugman, Fox, Fletcher, Fischer, & Rojas, 1994).

In the extant messaging literature, attention and elaboration have often been treated as identical constructs. However, elaboration is the final stage of cognitive processing during which a) the recipient thinks about the information within the context of his or her existing knowledge structures, b) information is stored in memory, and c) information is accepted or rejected (Greenwald & Leavitt, 1984). Memory for message content and the number of message-related thoughts generated are indicative of message elaboration (see O'Keefe & Jensen). More accurate recall of the message content (Keller & Block, 1996) and more message-relevant thoughts (Cacioppo & Petty, 1981) indicate greater cognitive processing. Attention and elaboration are possibly related, but likely distinct aspects of cognitive processing (see Greenwald & Leavitt, 1984).

It is important to distinguish between attention and elaboration for at least two reasons. First, the existent messaging research has focused almost exclusively on the *elaboration* component of cognitive processing. The role of attention in the cognitive processing of framed messages has been virtually ignored. The few studies that have considered the role of attention have actually used measures of message elaboration to operationalize the attention construct. For instance, message recall has been treated as a measure of both attention (e.g., Higgins & Tykocinski, 1992) and message elaboration (e.g., Meyers-Levy & Maheswaran, 2004). This methodological assumption that attention and message elaboration are synonymous is likely incorrect. Attention is a necessary process for elaboration, and thus overall cognitive processing to occur (Greenwald & Leavitt, 1984), however, it is possible that attention may occur without elaboration. By overlooking the attention phase of cognitive processing, or considering attention and elaboration

to be the same processes, we may miss opportunities to better understand cognitive processes underlying framing effects (e.g., does framing influence attention, elaboration, or both).

We are unaware of any research that has examined a) the relative attention given to gain- and loss-framed LTPA messages preceded by risk information, or b) the relationship between attention to and elaboration of framed LTPA messages delivered in the context of a health message. Based on our Study 2 findings, we hypothesized that following the presentation of health risk information, greater attention to LTPA messages would be observed for participants exposed to loss- versus gain-framed messages. It was also hypothesized that attention – operationalized as dwell time on LTPA messages – would be positively correlated with message elaboration. Further, guided by EPPM (Witte, 1992), we hypothesized that dwell time on LTPA messages would be positively correlated with vulnerability, fear arousal, and personal relevance.

Method

Participants

Participants included male (n=23) and female (n=54) students from McMaster University, recruited through a) a database of volunteer participants from previous research, b) web and poster advertisements, and c) word-of-mouth in the university community. Individuals were eligible for study participation if they were a) at least 18 years of age, b) had self-reported 20/20 vision with or without a visual aid including glasses or uncoloured contact lenses, c) able to speak and read English, and d) not engaging in regular LTPA. Regular LTPA was defined as at least 30 minutes of moderate to heavy intensity LTPA on more than two days of the week[2]. It was important to include individuals who had not established regular LTPA because informational messages targeting perceived risks and outcome expectancies are more persuasive

[2] This definition of regular LTPA was used in order to ensure that the study participants were well below the recommended levels of LTPA for health and well-being benefits based on the Canadian Physical Activity Guidelines (Canadian Society for Exercise Psychology, 2011).

in the early stages of behaviour change (Schwarzer, 2008). In addition, eligible participants must have reported a family history of at least one of the following: heart disease, cancer, obesity, diabetes. A family history of inactivity-related disease was included as a requirement for participation in order to enhance the personal relevancy of the informational messages (Rothman, Bartels, Wlaschin, & Salovey, 2006). Additional demographic characteristics are summarized in Table 1.

Materials

Health Risk Information. Participants read risk information regarding a) inactivity-related disease (i.e., cardiovascular disease [CVD], diabetes, obesity, cancer), and b) student-relevant health concerns (i.e., common colds, weight gain, and stress). The information described each health problem and provided facts and statistics about the risk among the student or young adult population. Two examples are: "Overweight and Obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. Among Canadians aged 18 or older: 23.1% are obese and 36.1%, are overweight" and "University students are at an increased risk for the common cold. In a study of 3000 undergraduate students; 4263 classes were missed due to the common cold." Risk information was not framed.

Framed LTPA Messages. Participants viewed framed messages describing the relationship between each health problem presented in the health risk information section and LTPA. Each participant read a series of exclusively gain- *or* loss-framed messages. Gain-framed messages outlined the *benefits* of engaging in regular LTPA while loss-framed messages outlined the *risks* of not engaging in regular LTPA. For each health problem, a series of framed messages included: a) facts about benefits (gain-framed) or risks (loss-framed) of LTPA/inactivity, and b) summary statements about research evidence regarding LTPA. All aspects of the material were

consistently gain-framed or loss-framed. For example, the messages targeting obesity were: "If you engage in regular LTPA you may reduce your risk of gaining weight during university" (i.e., gain-framed) or "If you do not engage in regular LTPA you may increase your risk of gaining weight during university" (i.e., loss-framed).

Apparatus

Eye Tracker. The Eyelink II,® a head-mounted video-based eye tracker, was used to capture digitally the participants' eye movements while they were reading from a computer monitor. The Eye link II digitally tracks the participant's pupil movements and the light reflecting off the cornea. The head-mounted device has two cameras, which allowed for binocular tracking of participants' eye movements while they read the risk information and LTPA messages.

Measures

Vulnerability. At baseline, participants responded to the following six items on 7-point scales*:* "My chances of developing a) CVD, b) obesity, c) diabetes, d) cancer, e) a common cold, f) stress, and g) poor study habits in the future are" (-3 *not at all strong* to +3 *very strong*), and "I am unlikely to develop [CVD, obesity, etc.] in the future" (-3 *strongly disagree* to +3 *strongly agree*; reverse scored). These identical six items were presented preceded by the statement "keeping in mind the information you just read" following the risk information. The items were averaged for an overall vulnerability score at baseline (Cronbach's $\alpha = .69$) and post-risk information (Cronbach's $\alpha = .88$). The measure was adapted from Milne (2002) to address perceived risk of inactivity-related health problems.

Fear arousal. For each set of messages (i.e., chronic disease and psychological health problems), participants responded to four items assessing fear arousal. The items were presented in the following statement: "Indicate the degree to which the information you just read made you

feel very afraid/very unafraid, relaxed/tense, calm/agitated, and restful/excited. Each item was assessed on a 7-point bipolar scale. The four items were averaged for a composite fear arousal score (Keller & Block, 1996; Cronbach's $\alpha = .78$).

Attention. Dwell time per word (milliseconds) for a) risk information and b) LTPA messages was calculated using a software program based on data from the Eyelink II® eye tracker. Dwell time on risk information for each health problem was calculated based on the average time spent dwelling on each word in the risk information statements. Dwell time on the LTPA messages for each health problem was calculated based on the average time spent dwelling on key context words (i.e., those words which accounted for the differences between the gain- and loss-framed messages). For example, within the following gain-framed message, the words in bold font were the key context words included in the calculation of overall dwell time: "By **participating** in regular LTPA you will **reduce** your risk of heart disease and stroke." Total dwell time across each health topic (e.g., obesity, heart disease, stress) was averaged to form two composite scores: a) dwell time per word on risk information (Cronbach's $\alpha = .96$), and b) dwell time per word on LTPA messages (Cronbach's $\alpha = .84$).

Elaboration. Two measures of elaboration were assessed. First, immediately following message exposure, participants listed thoughts they had during message viewing. Two independent scorers coded each thought as unfavourable (i.e., described undesirable attributes or negative associations of the messages), favourable (i.e., described desirable attributes or positive associations of the messages), or neutral/irrelevant (i.e., without affect toward messages or unrelated). Interrater reliability was high ($\kappa > 0.90$, $p < .0.001$; Landis & Koch, 1977). Any coding discrepancies were resolved between the two scorers through discussion. The following scores

were calculated for each participant's thoughts: a) total, b) favourable, and c) unfavourable. Higher scores on each are considered indicative of greater elaboration (Cacioppo & Petty, 1981).

Second, memory for message content was evaluated (i.e., message recall) as an additional indicator of elaboration. Message recall is commonly employed as a measure of message elaboration (see O`Keefe & Jensen, 2008). Participants read six statements and indicated if each was or was not included verbatim in the LTPA messages. A total recall score was calculated by summing the number of correctly identified statements. This particular message recall measurement strategy was adopted from previous message framing research (Block & Keller, 1995).

Personal Relevance. Participants were asked to evaluate the personal relevance of the risk information and LTPA messages. Each of the following items was rated on a 7-point scale: 1) How much did the information apply to your life?" (1 *applied very little* to 7 *applied very much*) and 2) "How personally relevant did you find the information?" (1 *not at all personally relevant* to 7 *very personally* relevant). The two items were averaged for a composite score of message evaluation. The items were highly correlated (Pearson's $r = .81$, $p < .001$).

Procedure

Following recruitment and screening, each participant attended a one-hour testing session at a McMaster University laboratory. After giving informed consent, demographic variables (e.g., family history of disease, age) and the baseline vulnerability questionnaire were completed through electronic survey. Once baseline measures were complete, participants sat in front of a specialized computer monitor where the Eye-link II® equipment then was set up and calibrated. Participants first viewed the health risk information targeting each health problem. The order of presentation of health risk information statements was randomized across participants by the

Eyelink II® software program. Information regarding each individual health problem was presented on a separate screen. After reading all of the health risk information, vulnerability was re-assessed. Using a random numbers table, participants were then randomized to view either gain-framed or loss-framed LTPA messages. The Eyelink II® then was recalibrated. Messages regarding the benefits (i.e., gain-framed) or risks (i.e., loss-framed) of LTPA/inactivity in relation to each health problem were presented one statement at a time. The presentation of the messages was self-paced such that participants pressed any key on the computer keyboard in order to move to the next screen (i.e., message). As participants viewed each screen, the Eyelink II collected dwell time data. Immediately after viewing the final framed LTPA message, participants completed the thought listing and recall measures of elaboration. Next, participants completed electronic questionnaires measuring fear arousal and personal relevance. All procedures were approved by the McMaster University Research Ethics Board.

Statistical Analysis Approach

Prior to analyses, data were inspected for outliers. Sample sizes vary across analyses as a result of missing data and removal of statistical outliers (i.e., values >3.29 standard deviations from the mean; Tabachnick & Fidell, 2001). The statistical assumptions of each analysis were tested and satisfied (Kleinbaum, Kupper, Nizam, & Muller, 2008).

Dwell time on risk information, post-risk information vulnerability, fear arousal, personal relevance, and sex were examined as covariates of dwell time on framed LTPA messages. Dwell time on risk information may be related to dwell time on LTPA messages as a result of individual differences in variables related to dwell time in general (e.g., reading speed, need for cognition). Also, consistent with EPPM, vulnerability or fear aroused by the risk information may impact motivation to cognitively process subsequent messages (Witte, 1992). Previous

research has also found sex differences in cognitive processing (Jones, Stanaland, & Gelb, 1998) and information viewing behaviours (Pan et al., 2004). Possible covariates were considered by computing a one-way ANOVA to test for sex differences and Pearson's correlations were computed among the continuous variables. A chi-square analysis was calculated to check for differences in the ratio of male to female participants in each condition. ANOVAs were also calculated to check for group differences in baseline vulnerability, fear arousal, and personal relevance.

Participants' exposure to the health risk information was expected to result in an increase in vulnerability. This assumption was based on the effects of the health risk information in Study 2. It was important that participants' vulnerability was enhanced by the health risk information given the assumptions of the EPPM framework (Witte, 1992). In order to test the success of the health risk information manipulation on participants' vulnerability in the current study, a paired-samples *t*-test was calculated to determine differences between baseline and post-risk information vulnerability.

In order to test hypothesis one, an ANCOVA was calculated to examine group differences in dwell time on framed LTPA messages while controlling for covariates. To test hypothesis two, Pearson's correlations were calculated to explore the relationship between dwell time, message recall, message-relevant thoughts, fear arousal, vulnerability, and personal relevance.

Results

Preliminary Analyses and Descriptive Statistics

Testing for Potential Covariates and Group Differences. All correlations are shown in Table 2. Dwell time on risk information was the only potential covariate significantly related to dwell time on framed LTPA messages ($r = .53$, $p < .001$), and was treated as a covariate in

subsequent analyses. Dwell time on framed LTPA messages did not significantly differ between men ($\bar{x}$ = 256.93ms/word) and women ($\bar{x}$ = 230.04ms/word; $F(1,71) = 2.02$, $p = .16$). Vulnerability, fear arousal, personal relevance, and sex did not significantly differ between the gain-framed and loss-framed conditions (see Table 3).

Change in Vulnerability. Vulnerability increased significantly from baseline to post-risk information ($t = -4.67$, $p < .001$). Thus, manipulation of vulnerability was successful and we could proceed to test for differences in dwell time on framed LTPA messages following health risk information under the assumption that participants had enhanced vulnerability.

Hypothesis Testing

Hypothesis One: Greater dwell time on LTPA messages will be observed for the loss-framed compared to gain-framed condition. Table 4 displays the results of an ANCOVA calculated with dwell time on LTPA messages as the dependent variable and condition (i.e., gain- or loss-framed) as the independent variable. Dwell time on risk information was included as a covariate. As hypothesized, dwell time on LTPA messages differed by frame ($F(1,67) = 6.93$, $p = .01$; $\eta_p^2 = .10$). However, contrary to hypothesis, greater dwell time was observed in the gain-framed condition ($\bar{x}$ = 261.81ms/word) compared to the loss-framed condition ($\bar{x}$ = 219.69ms/word).

Hypothesis Two: Dwell time on framed LTPA messages will be positively correlated with message elaboration, post-risk information vulnerability, fear arousal, and personal relevance. Contrary to hypothesis, dwell time on LTPA messages was not significantly correlated with indicators of message elaboration (i.e., recall and message-relevant thoughts), vulnerability, fear arousal, or personal relevance (see Table 2). Given the EPPM (Witte, 1992) framework, it is noteworthy that fear arousal was related to the number of total ($r = .24$, $p = .04$)

and unfavourable (r = .23, p =.04) thoughts generated, as well as accurate recall (r = .37, p =.001) and personal relevance (r = .27, p =.02). Further, post-risk information vulnerability was significantly related to the number of total thoughts (r = .29, p = .01) generated following message exposure.

Discussion

The primary purpose of the current study was to compare attention paid to gain- versus loss-framed leisure time physical activity (LTPA) messages following the presentation of risk information regarding inactivity-related health problems. The study also examined attention in relation to message elaboration, vulnerability, fear arousal, and personal relevance. Contrary to hypothesis, attention -- operationalized as dwell time on LTPA messages -- to LTPA messages was greater for gain- versus loss-framed messages. Dwell time on LTPA messages was not significantly related to message elaboration, vulnerability, fear arousal, or personal relevance.

Dwell Time on Gain- versus Loss-Framed Messages

Following exposure to risk information, participants spent more time dwelling on gain-framed LTPA messages (i.e., emphasizing the benefits of LTPA) compared to contextually identical loss-framed messages (i.e., emphasizing the risks of inactivity). Although this finding is contrary to the hypothesis driven by the results of Study 2, it is consistent with meta-analytic findings that gain-framed messages targeting health prevention behaviours engender greater cognitive processing than loss-framed messages (O'Keefe & Jensen, 2008). Despite methodological differences between the current study and the studies included in the meta-analysis, the explanations for the previous studies' findings may extend to the current findings.

Specifically, it has been suggested that gain-framed messages may seem more optimistic and instilled with positive affect, which may lead individuals to process them more closely than loss-

framed messages (O'Keefe & Jensen, 2008). Alternatively, the pessimistic and negative affect associated with loss-framed messages may evoke reactance for some individuals. Loss-framed messages may also be interpreted as hectoring in tone and unpleasant to process (O'Keefe and Jensen). Similarly, some individuals may find loss-framed messages more awkward or less natural than gain-framed messages (Gamliel, 2007), and consequently readers may be less inclined to process the message content. These explanations may explain why participants in the current study spent less time dwelling on the loss-framed messages and more time dwelling on the gain-framed messages.

Although these explanations are plausible, one might question their application within the current study design. Recall that participants read health risk information prior to reading the framed LTPA messages. Within the framework of the extended parallel process model (EPPM; Witte, 1992), it was expected that the health risk information would evoke vulnerability, fear, and personal relevance, which would increase motivation to process subsequent framed LTPA messages. Further, it was hypothesized that the negative cognitions and affect evoked by the health risk information would result in a mindset that was more congruent with the processing of loss-framed than gain-framed messages. Although an increase in vulnerability was observed following health risk information exposure, perhaps participants did not experience adequate vulnerability, fear, or personal relevance to elicit a mindset sufficiently negative to induce congruency with the loss-framed messages. Indeed, it is difficult to evoke high levels of vulnerability among relatively healthy, young adults (Courneya & Hellsten, 2001). Despite reading the health risk information, participants may have maintained an overall neutral or positive mindset, which may have been incongruent with processing loss-framed messages. There may be a threshold of vulnerability or fear that must be surpassed in order to create

congruency between one's mindset and the processing of loss-framed messages. It has been suggested that when individuals do not feel sufficiently vulnerable or threatened, gain-framed appeals should be more persuasive than loss-framed (Lee & Aaker, 2004). In the current study, congruency between the participants' mindset and gain-framed messages, reactance to the loss-framed messages, and superior optimism and fluency of the gain-framed messages, may explain the greater dwell time on the gain-framed messages.

Dwell Time on LTPA Messages, Message Elaboration, Vulnerability, Fear, and Personal Relevance

Dwell time on framed LTPA messages was not significantly related to message recall or message-relevant thoughts. This was unexpected given the assumptions of previous research that dwell time, message recall, and message-relevant thoughts are measures of the same cognitive processes (e.g., Krugman et al., 1994). This was also unexpected given the notion that attention is a necessary process preceding message elaboration (Greenwald & Leavitt, 1984). The lack of significant correlations between the measures in the current study suggests that dwell time, recall, and message-relevant thoughts are three independent aspects of cognitive processing. The results of the current study indicate that a message recipient can dwell on a message without necessarily generating message-relevant thoughts or accurately recalling the message content. For example, if an individual sufficiently dwells on message content but does not comprehend the content, or immediately rejects the content with little thought or scrutiny, he or she may not necessarily generate a lot of message-relevant thoughts or accurately recall the content (see Greenwald & Leavitt, 1984). Likewise, some individuals may generate message-relevant thoughts and accurately recall message content with relatively little time spent dwelling on the message content. For example, if the message recipient is familiar with the content of the

messages (e.g., he or she has seen information about health and LTPA before), a relatively brief amount of time dwelling on the message content may be sufficient to generate high levels of message-relevant thoughts or message recall. Indeed, exposure to information that is familiar results in decreased attention elicited by the information (see Greenwald & Leavitt, 1984).

Similarly, dwell time on LTPA messages was not significantly related to vulnerability, fear arousal, or personal relevance. These null findings were unexpected considering the EPPM (Witte, 1992) driven hypothesis that higher levels of vulnerability, fear arousal, and personal relevance would motivate cognitive processing of subsequent LTPA messages, which would be demonstrated by longer durations of dwell time on the messages. Although the dwell time data do not support the EPPM hypothesis, fear arousal was positively related to personal relevance, the number of message-relevant thoughts generated, and message recall.

The positive relationship between personal relevance and fear arousal suggests that higher levels of fear were observed among those who felt the messages were more personally meaningful compared to those who did not find them as personally relevant. Although personal relevance was not related to the attention committed to the LTPA messages, it may have impacted the message recipients' affective responses. Unfortunately, the order of measure administration does allow us to confirm the directionality of this relationship.

The positive relationship between fear arousal and message recall, as well as message-relevant thoughts, suggests that fear arousal may indeed be related to cognitive processing of LTPA messages. Although it was hypothesized that fear arousal would be related to the *attention* committed to the messages (i.e., dwell time on LTPA messages), fear arousal may have only influenced the *elaboration* aspect of cognitive processing (i.e., message recall and message relevant thoughts). Previous research has also found a positive relationship between fear arousal

and message elaboration (Slater et al., 2002). Regardless of the amount of time an individual dwells on a message, it may be the affective response (i.e., fear) that motivates further elaboration of the message content. This explanation is theoretically consistent as fear is the driving force behind message elaboration according to EPPM. Indeed, regardless of dwell time, the greater the fear evoked by the risk information, the greater the motivation to elaborate subsequent messages (Witte, 1992).

Practical Implications

Gain-framed LTPA messages evoked greater attention, as indicated by dwell time, compared to loss-framed messages. If designing LTPA messages with the sole purpose of attracting message recipients' attention, the exclusive use of gain-framed messages would be recommended. However, the data suggest that simply drawing recipients' attention may not be sufficient to evoke subsequent message elaboration or affective responses. Obviously some attention to the message content is necessary, however our finding suggests attention is unrelated to other aspects of cognitive processing -- particularly message elaboration – that is critical for message persuasion. The data suggest that fear arousal is a driving force behind message elaboration. Health risk information coupled with LTPA messages may need to evoke a sufficient level of fear to induce elaboration and be effectively persuasive. Rather than design framed messages which are solely attention-grabbing, health risk information and LTPA messages should be designed to target affective and fear responses. Further, ensuring that health risk information and LTPA messages are perceived as personally relevant may also elicit fear arousal. These strategies may promote message elaboration.

Despite the differences in dwell time, there were no differences in fear arousal or message elaboration following the gain-framed messages compared to the loss-framed. This finding

suggests that loss-framed messages may evoke the same fear response and message elaboration as gain-framed messages despite relatively less dwell time on the message content. Although individuals may prefer dwelling on gain-framed message content, the fear response for loss-framed messages is similar. In a real world context where people may be spending limited time dwelling on message content (e.g., flipping through magazine or brochure at doctor's office), the relatively quick fear arousal by the loss-framed message may be beneficial in persuading message elaboration.

Theoretical and Research Implications

The EPPM (Witte, 1992) may be an appropriate model for examining the use of health risk information in combination with framed LTPA messages. Although the relatively greater attention to gain- versus loss-framed messages was not expected based on the EPPM's tenets, there is reason to believe that this finding may have been the result of the participants' mindset being incongruent with dwelling on loss-framed messages. Indeed, if the participants were not feeling sufficiently vulnerable or threatened following exposure to the health risk information, EPPM would predict limited motivation to cognitively processing subsequent LTPA messages. Under circumstances of reduced vulnerability or threat, gain-framed messages may engender greater attention than loss-framed because of the optimistic content (O'Keefe & Jensen, 2008) and relative ease of processing (Block & Keller, 1995). Further, the positive correlation between fear arousal and message elaboration (i.e., message recall and message-relevant thoughts) supports EPPM. Consistent with EPPM, greater fear arousal may have motivated greater message elaboration. Thus, the EPPM may be better suited to understanding *elaboration of* rather than *attention to* framed LTPA messages.

Indeed, the findings of the current study suggest that attention paid to the message (i.e., dwell time) and message elaboration (i.e., recall of message content and message-relevant thoughts) are two independent phases of cognitive processing. The terms 'attention' and 'elaboration' should not be used interchangeably in future messaging research as they have in the past. Indeed, the interchangeable use of various terms can only complicate our understanding of cognitive processing as a possible mechanism of framing effects. Each construct may be an important component of cognitive processing. However, future research must tease apart the separate role of dwelling on message content, accurately recalling message content, and generating message-relevant thoughts. Certainly, these indicators are not identical components of cognitive processing in relation to framed LTPA messages.

Strengths, Limitations, and Future Directions

The current study has important practical and theoretical implications. However, there are limitations which warrant mention. First, the ordering of administration of the study measures limits our understanding of the direction of the relationship between fear and message elaboration. Although the EPPM (Witte, 1992) framework suggests that fear arousal motivates message elaboration, it is possible that greater message elaboration resulted in greater fear arousal. Second, the primary purpose of the current study was to explore cognitive processing as a possible mechanism of framing effects within the framework of EPPM. However, our understanding of the mechanistic role of both attention and elaboration would be enhanced through the inclusion of a measure of message persuasiveness (e.g., cognition change, behaviour change, message acceptance). Third, the generalizability of the findings outside of the university student population is unknown. When applying the EPPM to understand LTPA message framing, there may be unique aspects of the university student population which require consideration.

For example, young adults may be optimistically biased about their risk for health problems (see Arnett, 2000), which may influence the amount of vulnerability or threat that can be evoked by health risk information. Although the study was strategically designed to target individuals with issue involvement (i.e., family history of inactivity-related disease and currently inactive), it is possible that the effects of the risk information on vulnerability may have been buffered in this population.

There are also numerous strengths of the current study. First, the exploration of cognitive processing in relation to framing effects is important given the need for research to examine framing mechanisms (Rothman & Updegraff, 2009). Second, the focus on the attention component of cognitive processing and the use of eye tracking technology was a novel approach which provided a biometric measure of attention. This innovative measure allowed for the distinction of attention and message elaboration as two separate aspects of cognitive processing. This finding is important in light of the inappropriate use of these concepts interchangeably in previous research.

Conclusion

Although greater attention was observed for gain- versus loss-framed LTPA messages, attention was not related to message elaboration, vulnerability, fear, or personal relevance evoked by the health risk information. Fear arousal was, however, positively related to indicators of message elaboration. Attention alone may be insufficient for evoking message elaboration rather, a fear response may be necessary. Future research should continue to examine cognitive processing as a possible mechanism to explain message framing effects and seek to understand the relative greater attention given to gain-framed messages in the current study. However,

attention and message elaboration must be considered two separate aspects of cognitive processing.

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Table 1

Participant Characteristics

Variable	N=77
Sex	
Male	23 (30%)
Female	54 (70%)
Age (yr)	23.04 ± 7.40
Family History of Disease	
Diabetes	41 (53.3%)
Heart Disease	35 (45.5%)
Cancer	38 (49.4%)
Obesity	17 (22.1%)

Table 2

Descriptives and Correlations; Dwell Time, Thoughts, Recall, Relevance, Vulnerability, & Fear Arousal

	1	2	3	4	5	6	7	8
1. Dwell LTPA	238.38 (73.91)							
2. Total Thoughts	-.05	6.34 (2.88)						
3. Favourable Thoughts	.05	.63**	2.52 (1.80)					
4. Unfavourable Thoughts	-.10	.63**	.07	2.92 (1.99)				
5. Recall	-.05	.14	.13	.17	6.0 (1.46)			
6. Relevance	-.01	.07	.11	.11	.12	5.45 (1.27)		
7. Vulnerability	-.09	.29**	.19	-.09	.01	-.04	4.79 (1.03)	
8. Fear Arousal	-.02	.24*	.10	.23*	.37**	.27*	-.06	4.16 (.90)

Note. Sample means (standard deviations) are shown on the diagonal. Vulnerability = post risk information vulnerability

**p<.01, *p<.05.

Table 3

Group Differences for Vulnerability, Fear-Arousal, Personal Relevance

	Gain-Framed (n=37) $\bar{x}$ (SD)	Loss-Framed (n=38) $\bar{x}$ (SD)
Baseline Vulnerability	4.42 (0.64)	4.26 (0.88)
Post-Vulnerability	4.83 (1.12)	4.76 (0.95)
Fear Arousal	4.05 (0.91)	4.28 (0.90)
Personal Relevance	5.43 (1.27)	5.47 (1.17)

Note. Post-vulnerability = post-risk information vulnerability. No significant between-group differences. Scale range for each variable was 1-7.

Table 4

ANCOVA Comparing Dwell Time of LTPA Messages by Message-Frame

	Dwell time LTPA messages $\bar{x}$ (SD)	*F*	*p*	*Partial eta*^{2}
Condition		6.93	0.01	0.10
Gain Framed (n=33)	261.81 (11.13)			
Loss Framed (n=35)	219.69 (10.79)			
Covariate				
Dwell time risk info		16.12	<0.001	0.20

*Note. Units for dwell time scores are millisecond per word.

CHAPTER 5

General Discussion

The primary purpose of this dissertation was to examine the use of health risk communications as a strategy to change risk perceptions and motivate leisure time physical activity (LTPA) among people with spinal cord injury (SCI). The secondary purpose was to explore cognitive processing of framed LTPA messages that are prefaced by health risk information. Three separate studies were undertaken and together contribute valuable information to our understanding of health risk communication strategies in general, as well as specifically within the SCI population. Further, the studies contribute to our understanding of cognitive processing as it relates to framed LTPA messages. The theoretical, practical, and research implications of the dissertation are discussed in this final chapter.

7.0 CONTRIBUTIONS TO UNDERSTANDING THE USE OF HEALTH RISK COMMUNTICATIONS IN GENERAL

Health risk communications have often proven effective for changing health risk perceptions (Gerrard, Gibbons, & Reis-Bergan, 1999). However, changes in risk perceptions have not always translated into positive changes in health behaviours such as LTPA (e.g., Milne, Orbell, & Sheeran, 2002). This dissertation has made significant contributions to the advancement of knowledge regarding two strategies to enhance the effectiveness of health risk communications: 1) the use of individualized health risk information, and 2) the use of accompanying framed LTPA messages. Furthermore, this dissertation has made significant contributions to our understanding of cognitive processing in relation to framed LTPA messages.

7.1 The Use of Individualized Health Risk Information

The results of Study 1 indicate that the presentation of individualized health risk information is a useful strategy for enhancing perceptions of risk for inactivity-related disease. This study advances our knowledge regarding pragmatic approaches to changing perceptions of disease risk, which are often underestimated, and thus can thwart motivation to engage in risk-

reducing behaviours (Weinstein, 1989). Further, this study demonstrates objective risk status as a moderator of the effects of individualized health risk information. The provision of individualized health risk information may be particularly effective among individuals who are at risk for disease based on an objective health risk appraisal (i.e., assessment of physiological indicators of disease risk). Health care practitioners may find it advantageous to share results of individualized health assessments with their patients as a risk communication strategy. In particular, sharing results with patients who are at risk based on the assessment criteria (e.g., a patient with a BMI above the healthy limit) may prove especially beneficial for changing perceptions of disease risk.

The results of Study 1 also contribute to our understanding regarding the relationship between health risk perceptions and LTPA. In some instances, changes in perceived risk for inactivity-related disease positively predicted subsequent changes in LTPA. It is postulated that many participants were aware of the risk-reducing effects of LTPA and thus increased LTPA as a strategy to reduce risk following exposure to the health risk information. This pattern of findings is consistent with protection motivation theory (PMT; Rogers, 1983) in that vulnerability or perceived risk is a predictor of protection motivation, or behavioural intentions, which directly predict behaviour (Ajzen, 1991). Indeed, in some instances the presentation of health risk information may motivate LTPA.

However, in some cases, changes in perceived risk for inactivity-related disease were *negatively* related to changes in LTPA. The absence of subsequent LTPA efficacy messages in Study 1 was strategic in order to isolate the effects of individualized risk information. However, the study design may have inadvertently mimicked many real-world situations where an individual is presented with health risk information without receiving subsequent behavioural

recommendations. For example, a physician may tell a patient that his or her body weight or blood pressure is above the healthy values, yet the physician may not always give behavioural advice regarding LTPA's efficacy to reduce risk (e.g., circumstances where a pharmacological treatment is recommend). When perceived risk is enhanced by health risk information, but behavioural advice regarding LTPA is absent, the patient may actually reduce his or her participation in LTPA because of denial, fear, or behavioural reactance (for a review see Norman, Boer, & Seydel, 2005). Indeed, if the enhanced perceptions of risk evoke a sense of fear or anxiety, the individual may respond with maladaptive, avoidance, or denial behaviours in order to reduce the unpleasant affect (Witte, 1992). This explanation is consistent with the extended parallel process model (EPPM; Witte, 1992); EPPM states that maladaptive responses to risk communications can be expected in the absence of behavioural recommendations, or when the recommended behaviour is not perceived to be efficacious in reducing risk (Witte, 1992). By highlighting the possible dangers of providing individualized health risk information without subsequent information regarding a recommended response to reduce risk (e.g., messages promoting regular LTPA), Study 1 has made an important contribution to health risk communication research. To the best of our knowledge, Study 1 is among the first experiments to examine this issue in LTPA health communication research.

7.2 The Use of Framed Leisure Time Physical Activity Messages

If risk information is accompanied by persuasive messages promoting LTPA as an effective means to reduce risk, individuals may increase LTPA (Kreuter & Strecher, 1996). Studies 2 and 3 extend the health risk communication research by advancing our knowledge regarding the effects of supplementing health risk information with framed messages promoting LTPA. An important limitation of previous message framing and LTPA research is the lack of a theoretical

framework for designing framed messages. A theoretical framework is critical for understanding and predicting LTPA, as well as designing LTPA-enhancing interventions (Baranowski, Anderson, & Carmack, 1998). Thus, a significant contribution of Studies 2 and 3 is the use of PMT (Rogers, 1983) to guide the development of the messages used in these experiments.

The results of Study 2 suggest that loss-framed messages targeting a key construct of PMT -- LTPA response efficacy (i.e., an individual's belief that LTPA can effectively reduce inactivity-related disease risk) -- may be more effective than gain-framed messages for changing LTPA response efficacy beliefs and LTPA intentions. This finding is inconsistent with previous LTPA message framing research which has found that, in general, gain-framed LTPA messages are more effective than loss-framed (see Latimer, Brawley, & Bassett, 2010). However, the discrepancy between Study 2 and previous research results highlights an important methodological distinction of Study 2. Unlike other LTPA message framing studies, the framed LTPA messages in Study 2 were presented following exposure to health risk information. We believe that the loss-framed advantage observed in Study 2 was a result of a congruency between the potentially negative mindset evoked by the risk information and the negatively worded nature of the loss-framed LTPA messages. Although it has been suggested that there is sufficient evidence to cautiously recommend the exclusive use of gain-framed messages to promote LTPA (Latimer et al., 2010), these results suggest that gain-framed LTPA messages may not always be most effective. This finding is an important contribution to the LTPA message framing literature.

A second key limitation of previous message framing research is the lack of research and understanding of the mechanisms underlying framing effects. By gaining an understanding of framing mechanisms, we can determine the conditions when a message is most likely to

influence the adoption of health behaviours such as LTPA (Brinol & Petty, 2006). For example, an improved understanding of message framing effects could help to explain why gain-framed LTPA messages are generally more persuasive than loss-framed, yet loss-framed LTPA messages may be more persuasive following exposure to risk information. Studies 2 and 3 make significant contributions to our understanding of cognitive processing as a possible mechanism of LTPA message framing effects.

Specifically, in Study 2, greater message elaboration – a cognitive process operationalized as message recall and message-relevant thoughts -- was observed for loss- versus gain-framed LTPA messages targeting psychological health benefits that were presented after exposure to risk information. Loss-framed messages also had stronger effects on LTPA response efficacy and LTPA intentions. These effects may have been due to greater elaboration of the loss-framed messages compared to the gain-framed messages. This pattern of findings supports the notion that differences in the cognitive processing of gain- versus loss-framed messages may explain the framing effects observed in health-promotion messaging research (see O'Keefe & Jensen, 2008) and represents an important step towards understanding the mechanisms underlying message framing effects.

Study 3 is also the first known experiment to examine the attention phase of cognitive processing in relation to framed health behaviour messages and to do so using a biometric indicator of attention -- eye dwell time on message content. Significant differences in eye dwell time were found for gain- compared to loss-framed LTPA messages. Taken together, the results from Studies 2 and 3 suggest that attention and message elaboration are not equivalent for gain- and loss-framed LTPA messages.

A major limitation of previous messaging research is the assumption that attention and message elaboration are synonymous, or indistinguishable, aspects of cognitive processing. In fact, these terms have been used interchangeably throughout the cognitive processing and message framing literature. However, in Study 3, attention and message elaboration were not significantly correlated. Accordingly, a notable contribution of this dissertation is the determination that attention and message elaboration are indeed two distinct aspects of cognitive processing, which will be useful knowledge in the design of future research exploring cognitive processing of framed messages.

8.0 CONTRIBUTIONS TO THEORY

An important contribution of the dissertation is the use of a theoretical framework to conduct health risk communication research and to examine the role of cognitive processing. Much of the previous risk communication research has been atheoretical. Studies 1 and 2 extend the research by examining the vulnerability (ie., perceived risk) and response efficacy constructs of protection motivation theory (PMT; Rogers, 1983) as important components of risk communications. LTPA researchers have raised questions regarding the relevance of perceived risk within PMT (see Plotnikoff & Trihn, 2010). However, our findings emphasize the importance of perceived risk for changing intentions and LTPA, specifically among people with SCI, who may be unaware of the increased risk for inactivity-related disease and psychological health problems that accompany SCI. Further, this research advances our knowledge regarding the importance of response efficacy, when PMT is used as a framework for developing risk communications. Response efficacy is a critical component of health risk communication strategies (Witte, 1992). Our research has shown that PMT (Rogers, 1983) is a suitable theoretical framework for designing health risk communication interventions, especially for people with SCI. Further, this research

contributes to research regarding perceived risk and response efficacy as salient constructs within PMT.

Two limitations of applying PMT (Rogers, 1983) to health risk communications research are highlighted in the dissertation. First, PMT does not provide an explanation for maladaptive responses to an increase in perceived risk for health problems (as observed in Study 1). Second, when examining framed LTPA messages as a strategy to enhance the effectiveness of health risk information, PMT does not provide insight regarding possible mechanisms of framing effects. Accordingly, we extended our theoretical examination of health risk communications and LTPA to include the extended parallel process model (EPPM; Witte, 1992). EPPM explains that maladaptive responses to health risk communication can be expected in the absence of LTPA response efficacy messages (Witte, 1992). EPPM also explains that perceived risk evoked by health risk information can motivate cognitive processing of subsequent messages, and in turn, cognitive processing can determine the effectiveness of the message. The application of EPPM to Study 2 has advanced our knowledge regarding the use of health risk information to change LTPA behaviour. Further, the application of EPPM to Study 3 has provided a theoretical framework for examining cognitive processing in relation to framed LTPA messages. An important contribution of the current work is the determination of PMT and EPPM as appropriate frameworks for developing future health risk communications to change LTPA and future health risk communication research.

9.0 CONTRIBUTIONS TO IMPROVING HEALTH RISK COMMUNICATION DELIVERY TO PEOPLE WITH SPINAL CORD INJURY

Given the increased risk for inactivity-related disease and psychological health problems (e.g., Nash, 2005; Hammell, Miller, Forwell, Forman, & Jacobsen, 2009), and the exceptionally

low LTPA participation rates following SCI (Martin Ginis et al., 2010), initiatives to increase LTPA are invaluable. This dissertation has significantly advanced our knowledge regarding the use of health risk communications as a strategy to enhance LTPA among people with SCI. Study 1 is the first known published study to test the effects of individualized health risk information on risk perceptions and LTPA among people with SCI, and Study 2 is the first to test the effects of health risk information accompanied by framed LTPA messages.

9.1 Pragmatic Contributions

An important contribution of this work is the advancement of knowledge regarding the use of health risk information as a suitable intervention for changing perceptions of risk for inactivity-related disease and psychological health problems. Both individualized (Study 1) and generalized (i.e., population-specific) risk information (Study 2) were effective for changing perceptions of risk and are recommended for use. However, response efficacy messages are critical given that health risk information alone may evoke maladaptive responses (e.g., Study 1; Witte, 1992) and many people with SCI may be unaware of the risk-reducing benefits of LTPA (e.g., Rimmer, Rubin, & Braddock, 2000). When supplementing health risk information with LTPA messages for people with SCI, it is recommended that the messages be loss-framed. This is an important finding and recommendation to highlight given the previous assumption that all LTPA messages might benefit from being gain-framed (e.g., see Latimer et al., 2010).

10.0 DIRECTIONS FOR FUTURE RESEARCH

The findings from this dissertation provide numerous directions for future research. One direction would be to continue to apply PMT (Rogers, 1983) and EPPM (Witte, 1992) to study risk communication and LTPA messages, while expanding to focus on all of the theories' constructs. For example, although this dissertation focused on vulnerability, health risk

information could also target perceptions of the severity of inactivity-related disease and psychological health problems following SCI, while framed LTPA messages could also aim to enhance self-efficacy. Another direction would be to further examine the relationship between fear and cognitive processing. Consistent with EPPM (Witte, 1992) and the findings of Study 3, fear may be a critical component for understanding message effects. Additionally, experimental research to create conditions of high and low perceived risk could be useful in understanding the impact of perceived risk on the processing of subsequent LTPA messages. It is possible that the high risk condition would demonstrate greater levels of fear and cognitive processing of LTPA messages compared to the low risk condition. Given the contributions of the dissertation regarding the relationship between message elaboration and message framing effects, future research should experimentally test message elaboration as a mechanism of message framing. Finally, Studies 1 and 2 should be replicated in populations other than people with SCI. Future research that extends the findings of this dissertation to other populations can continue to contribute to our knowledge of health risk communications as a strategy to change LTPA.

11.0 CONCLUSION

This series of studies has expanded our understanding of health risk information as a strategy to change risk perceptions and LTPA. The importance of accompanying health risk information with LTPA messages was also demonstrated. Among people with SCI, loss-framed LTPA messages may be more effective than gain-framed messages for changing LTPA beliefs and intentions after presenting health risk information. It is anticipated that these findings will be an important catalyst for improving the study and delivery of LTPA-enhancing health risk communications to the SCI and general populations.

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Appendix A:

Study 1 Materials

Appendix A.1	Perceived Disease Risk Measures
Appendix A. 2	Sample Participant Objective Risk Letter including Objective Risk Guidelines
Appendix A. 3	PARA-SCI Short Version

Appendix A. 1 – Perceived Disease Risk Measures

Baseline Instructions – Please answer the following questions:

1. What is the likelihood that ***you*** will develop *heart disease* in your lifetime?

2. What is the likelihood that ***you*** will develop *diabetes* in your lifetime?

3. What is the likelihood that ***you*** will develop *obesity* in your lifetime?

-3	-2	-1	0	+1	+2	+3
Very Unlikely	*Somewhat Unlikely*	*A little Unlikely*	*Neither unlikely nor likely*	*A little Likely*	*Somewhat Likely*	*Very Likely*

Post-Information Instructions - Keep in mind your own personal objective risk information as you answer the following questions:

1. What is the likelihood that ***you*** will develop *heart disease* in your lifetime?

2. What is the likelihood that ***you*** will develop *diabetes* in your lifetime?

3. What is the likelihood that ***you*** will develop *obesity* in your lifetime?

-3	-2	-1	0	+1	+2	+3
Very Unlikely	*Somewhat Unlikely*	*A little Unlikely*	*Neither unlikely nor likely*	*A little Likely*	*Somewhat Likely*	*Very Likely*

Appendix A. 2 – Sample Participant Objective Risk Letter including Objective Risk Guidelines

YOUR INDIVIDUAL RESULTS

	Your Results	Able Bodied Average	Reference Range
BMI (kg/m^2)	29.8	25.5	see below
Weight (kg)	97.1	-	-
Waist circumference (cm)	107.2	90.9	<102 cm
Glucose (mmol/L)	4.7	5.0	3.8-6.0
Insulin (pmol/L)	56	59	43-194
Total cholesterol (mmol/L)	2.97	5.0	< 5.2
HDL "good" cholesterol	1.79	1.5	> 1.0, >1.3 (W)
LDL "bad" cholesterol	0.85	2.8	< 3.4
Triglycerides (mmol/L)	0.72	1.5	< 1.7
C-reactive protein (mg/L)	1.5	1.6	< 3.0

BMI – Body Mass Index is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in able-bodied adults (we currently working on lowering the cut-offs for persons with SCI)

Classification	Obesity Class	BMI (kg/m^2) cut-off points
Underweight		< 18.5
Normal Weight		18.5 – 24.9
Overweight		25.0 – 29.9
Obesity	I	30.0 – 34.9
	II	35.0 – 39.9
Extreme obesity	III	> 40.0

Insulin resistance – a relative measure of how resistant your body is to action of insulin, with 1.0 as "normal". Insulin resistance can increase your risk for diabetes.

C-reactive protein – a marker of inflammation related to cardiovascular risk

0-1 low risk
1-3 average risk
3-10 increased risk for cardiovascular disease
>10 active infection (not related to cardiovascular disease risk)

Appendix A. 3 - PARA-SCI-Short Version

I am going to ask you about the time you spent engaging in mild, moderate, and heavy intensity LTPA in the last **7 days**. Recall that Leisure Time Physical Activity (LTPA) is physical activity that you **choose** to do during your **free time**, such as exercising, playing sports, gardening, and taking the dog for a walk (necessary physical activities such as physiotherapy, grocery shopping, pushing/wheeling for transportation are not considered LTPA).

1. Keep in mind that **mild intensity LTPA** requires very light physical effort. Mild intensity activities make you feel like you are working a little bit, but you can keep doing them for a long time without getting tired.

   During the last 7 days, on **how many days** did you do mild intensity LTPA?

   On those days, **how many minutes** did you usually spend doing mild intensity LTPA?

2. Recall that **moderate intensity LTPA** requires some physical effort. Moderate intensity activities make you feel like you are working somewhat hard, but you can keep doing them for a while without getting tired.

   During the last 7 days, on **how many days** did you do moderate intensity LTPA?

   On those days, **how many minutes** did you usually spend doing moderate intensity LTPA?

3. Remember, **heavy intensity LTPA** requires a lot of physical effort. Heavy intensity activities make you feel like you are working really hard, almost at your maximum. You cannot do these activities for very long without getting tired. These activities may be exhausting.

   During the last 7 days, on **how many days** did you do heavy intensity LTPA?

   On those days, **how many minutes** did you usually spend doing heavy intensity LTPA?

Appendix B

Study 2 Materials

Appendix B. 1 - Health Risk Information

Disease Risk Information:

Cardiovascular Disease:

CVD refers to disease of the heart and blood vessels. CVD can result in heart attack or stroke caused by blockages to the heart or brain.

- CVD is a major cause of death in people with SCI
- CVD risk is greater among people with SCI compared to the general population
- Among Canadians under the age of 65:
    - 7.6% of men and 5.5% of women with disabilities report CVD compared to just1.6% and 1.1% of men and women without disabilities.

Overweight & Obesity:

Overweight and Obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer.

- Compared to the general population, people with SCI are more susceptible to obesity
- People with SCI have higher percentages of fat mass compared to able bodied people
- Age-related muscle loss and fat gains are accelerated among people with SCI
- Up to 60% of people with SCI are overweight or obese

Type 2 Diabetes

Type 2 Diabetes is a disease that occurs when the body cannot effectively use the insulin it produces (i.e., insulin resistance). Raised blood sugar is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels. Over time type 2 diabetes can lead to blindness, kidney failure, and increased risk of cardiovascular disease and stroke.

- Insulin resistance occurs in a high percentage of individuals with SCI
- As many as 50% of people with SCI live with insulin resistance
- Among Canadians under the age of 65:
    - 6.4% and 5.2% of disabled men and women report that they had diabetes, compared to just 2.1% and 1.8% of men and women without disabilities

Psychological Health Risk Information:

Depression:

Depression is a common mental disorder characterized by sadness, loss of interest in activities and decreased energy. Depression is differentiated from normal mood changes by its severity, symptoms and duration.

- Depression is more prevalent among people with SCI vs. the general population
- More than 20% of people with SCI report depression compared to 5% of general population

Pain:

Many individual describe pain as burning, cramping, aching, stabbing, tingling, tight, or nagging. The most common sites of pain for people with SCI include the back, hips, buttocks, legs and feet.

- Up to 80% of individuals with SCI report chronic pain
- Many individuals with SCI experience pain that interferes with daily activities.
- Many people with SCI are unable to manage pain through medical interventions

Fatigue:

Fatigue refers to a pervasive sense of tiredness or lack of energy that is not exclusively related to exertion. Many individuals describe fatigue as an *overwhelming sense of tiredness, feeling completely worn out,* or *a full body sense of exhaustion.* This type of fatigue may be prolonged and may interfere with daily living.

- Fatigue is a common and debilitating problem for many individuals with SCI
- Up to 65% of individuals with SCI experience sufficient fatigue to interfere with their physical functioning and quality of life
- Many individuals with SCI who suffer from fatigue are not aware of any solutions

Appendix B. 2 – Framed LTPA Messages

Gain-Framed Disease LTPA Messages:

Cardiovascular Disease:

Protect your Heart!
Add Leisure Time Physical Activity to Your day!

"When I exercise regularly, I notice that everyday things are easier. I can wheel further without getting tired. It is also easier for me to wheel up ramps and hills without getting out of breath."
38 year old man (Quadripleiga), MacWheelers Member

"Cardiovascular improvements are consistently seen as a result of a physically active lifestyle."
Dr. Audrey Hicks, Researcher & MacWheelers SCI exercise program director

"Routine participation in endurance exercise is a good way to prevent heart disease."
Dr. Cathy Craven, Physician

By adding 10 minute bouts of regular leisure time physical activity you will …

- Reduce your risk of heart attack and stroke
- Manage your blood pressure
- Strengthen your heart
- Improve your cardiovascular endurance for daily activities

Research shows...

- People with SCI who engage in regular leisure time physical activity are less likely to have a heart attack or stroke than people who are inactive
- People who participate in aerobic activities such as wheeling, arm ergometry, and swimming are more likely to improved their cardiovascular fitness

Overweight & Obesity:

Maintain a healthy body weight!
Engage in regular physical activity during your free time.

"Since I have started exercising I have lost 20 pounds. When I exercise regularly I have an easier time maintaining my weight."

49 year old man (Paraplegia)

"I have seen numerous individuals gain weight following a SCI, which significantly increases their risk for the many health complications associated with overweight and obesity. Being physically active makes it much easier for people to maintain a healthy weight following SCI."

Dr. Audrey Hicks, Researcher & MacWheelers SCI exercise program director

"A lot of individulas with SCI are concerned that they are overweight or obese. You will increase your chances of losing weight and maintaining a healthy body weight if you have a healthy diet and active lifestyle."

Dr. Patrick Potter, Physician

If you engage in regular leisure time physical activity, you may…

- Reduce your risk of becoming overweight or obese
- Help reduce body fat while maintaining muscle mass
- Increase your daily energy expenditure
- Improve your chances of losing weight or maintaining a healthy body weight

Research shows...

- You will be more successful in losing weight if you add regular leisure time physical activity to your lifestyle compared to following a healthy diet alone.
- You are less likely to become overweight or obese if you engage in physical activity during your free time.

Type 2 Diabetes:

Leisure time physical activity reduces your risk of type 2 diabetes!

"As an individual with SCI, I know that the risk of type 2 diabetes is very real. I need to do everything I can to protect myself. My doctor has told me that regular exercise is the best way."

38 year old man (Quadriplegia), MacWheelers Participant

"I tell my patients they must be phyiscally active on a regular basis to reduce their risk of type 2 diabetes. This is a major health concern for the SCI population. I cannot emphasize it enough! Physical activity is essential!"

Dr. Patrick Potter, Physician

"The research evidence is clear. Exercise is an excellent preventative measure for reducing the risk of type 2 diabetes. Further, exercise is a successful treatment modality for individuals who already have type 2 diabetes."

Dr. Kathleen Martin Ginis, Researcher

If you choose to add regular leisure time physical activity to your day -

You can …

- Reduce your risk of developing type 2 diabetes
- Help manage your type 2 diabetes or insulin resistance if you have already been diagnosed
- Improve your body's ability to use insulin and carbohydrates

Research shows...

- Active individuals are less likely to develop type 2 diabetes than inactive individuals
- Resistance activities such as weight lifting or *Theraband* exercises can improve carbohydrate tolerance and insulin resistance

Loss-Framed Disease LTPA Messages:

Cardiovascular Disease:

If you don't add leisure time physical activity to your day
You miss out on a chance to protect your Heart!

"When I don't exercise regularly, I notice that everyday things are more difficult. I can't wheel as far without getting tired. It is also difficult for me to wheel up ramps and hills without getting out of breath."

38 year old man(*Quadriplegia*), MacWheelers Member

"Cardiovascular deterioratations are consistently seen as a result of a sedentary lifestyle."

Dr. Audrey Hicks Researcher, MacWheelers SCI exercise program director

"If people with SCI do not routinely participate in endurance exercise, they are missing out on a good way to prevent heart disease."

Dr. Cathy Craven, Physician

By NOT participating in 10 minute bouts of regular leisure time physical activity you will …

- Increase your risk of heart attack and stroke
- Reduce your chances of managing your blood pressure
- Miss an opportunity to strengthen your heart
- Be less likely to improve your cardiovascular endurance for daily activities

Research shows...

- People with SCI who do not engage in regular leisure time physical activity are more likely to have a heart attack or stroke than active people
- People who do not participate in aerobic activities such as wheeling, arm ergometry, and swimming are less likely to improved their cardiovascular fitness

Overweight & Obesity:

You may have a difficult time maintaining a healthy body weight if you do not engage in regular physical activity during your free time.

"Before I started exerciseing I gained 20 pounds. When I don't exercise regularly I have a had time maintaining my weight."

49 year old man (*Paraplegia*)

"I have seen numerous individuals gain weight following a SCI which significanlty increases their risk for many health complications associated with overweight and obesity. Being inactive makes it really difficult for people with SCI to reduce the risk of overweight or obesity."

Dr. Audrey Hicks, Researcher & MacWheelers SCI exercise program director

"A lot of individual with SCI are concerned that they are overweight or obese. You do not decrease your chances of losing weight and maintaining a healthy body weight if you have an unhealthy diet and inactive lifestyle."

Dr. Patrick Potter, Physician

If you do NOT engage in regular leisure time physical activity, you may NOT…

- Reduce your risk of becoming overweight or obese
- Help reduce body fat while maintaining muscle mass
- Increase your daily energy expenditure
- Improve your chances of losing weight or maintaining a healthy body weight

Research shows...

- Despite following a healthy diet, you may not be successful in losing weight if you do not add regular leisure time physical activity to your lifestyle.
- You may become overweight or obese if you don't engage in physical activity during your free time.

Type 2 Diabetes:

Physical Inactivity Increases your Risk of Type 2 Diabetes!

"As an individual with SCI, I know that the risk of type 2 diabetes is very real. I need to do everything I can to protect myself. My doctor has told me that if I do not engage in regular exercise I am less likely to reduce my risk ."

38 year old man (Quadriplegia)

"I tell my patients if they are sedentary they will not reduce their risk of type 2 diabetes. This is a major health concern for the SCI population. I cannot emphasize it enough! Physical inactivity is dangerous!"

Dr.Patrick Potter, Physician

"The research evidence is clear. If you do not engage in regular exercise you miss out on an excellent preventative measure for reducing the risk of type 2 diabetes. By being inactive, indviduals who already have type 2 diabetes miss out on a successful treatment modality."

Dr. Kathleen Martin Ginis, Researcher

If you choose NOT to add regular leisure time physical activity to your day -

You will NOT…

- Reduce your risk of developing type 2 diabetes
- Help manage your type 2 diabetes or insulin resistance if you have already been diagnosed
- Improve your body's ability to use insulin and carbohydrates

Research shows...

- Inactive individuals are more likely to develop type 2 diabetes than active individuals
- You are less likely to improve carbohydrate tolerance and insulin resistance if you do not engage in resistance activities such as weight lifting or *Theraband* exercises

Gain-framed Psychological Health LTPA Messages:

Depression:

Get Active. Get Happy.

"Exercise lifts my mood and makes me feel better about myself."
31 year-old man, (Paraplegia)

"People who exercise regularly are generally happier."
Dr. Cathy Craven, Physician

"I've noticed people have an overall lifting of spirits. They just seem brighter and more outgoing. I've found that after people with SCI start exercising, they are generally more satisfied with themselves and less susceptible to depression."
Dr. Kathleen Martin Ginis, Researcher

"Those persons who participate on sports teams display a sense of better quality of life as a consequence of that participation."
Dr. Patrick Potter, Physician

Adding regular leisure time physical activity to your day will …

- Help to put you in a positive mood
- Give you a new outlook
- Reduce feelings of depression and stress
- Give you a feeling of accomplishment
- Make you happier

Research shows…

- People with SCI who do regular leisure time physical activities report fewer depressive symptoms than people who are inactive
- Lifting weights and doing aerobic activities such as wheeling can enhance your mood and improve your mental well-being.
- People who do physical activity regularly during their free time have greater body satisfaction and higher self-esteem than people who do not

Pain:

Take Action Against Pain!
Add leisure time physical activity to your day

"I have found that people with SCI are less susceptible to pain once they start an exercise program."

Dr. Kathleen Martin Ginis, Researcher

"I exercise regularly to help reduce the chances of developing things like joint pain and osteoporosis as I age with a SCI."

43 year-old woman, (Quadriplegia)

"Physical activity seems to allow my patients to forget about their pain at least temporarily while they are exercising. Importantly, it seems like, to some extent, the exercise makes them "tougher" and more resilient to the pain."

Dr. Keith Sequeira, Physician

"Patients who suffer from chronic pain and exercise regularly, report being distracted from their pain during and after exercise."

Dr. Cathy Craven, Physician

Adding leisure time physical activity to your day...

- May reduce your experience of pain
- Can help you manage your pain
- Can help you build strength to help you relieve pain
- May protect you against developing other painful secondary complications (ie. pressure sores and respiratory illness)

Research shows…

- People with spinal cord injury (SCI) who are active during their leisure time report less pain than people who are inactive
- Participating in regular leisure time physical activity helps to decrease pain
- Upper body strength activities protect against shoulder injuries

Fatigue:

Get Energized! Add Activity to Your Free Time!
Reduce fatigue, feel refreshed!

"If I am active, I can avoid feeling like a slug and getting irritable."
Chris Bourne (Paraplegia), Executive Director, Active Living Alliance

"Many people indicate that their energy levels are higher after exercising regularly. Individuals also find some Activities of Daily Living (e.g., transfers) require less physical effort since they have started exercising."
Dr. Kelly Arbour-Nicitopoulos, Researcher

"Yes, I have noticed improvements in individuals' energy as they become more active post SCI. They often describe feeling stronger, less tired and are more able to accomplish daily tasks. In addition, they seem to have less illnesses, infections and sick days."
Dr. Keith Sequeira, Physician

"I notice that my patients who are physically active report generally feeling better. They report having better energy levels and sleeping better."
Dr. Karen Smith, Physician

Adding 10 minutes of activity to your leisure time will…

- Energize you
- Decrease your of feelings tiredness
- Make you feel upbeat
- Help you feel refreshed!

Research shows…

- You will have more energy and less tension after being active than if you eat a sugary snack.
- You will increase your stamina for you daily activities if you are regularly active during your free time

Loss-Framed Psychological Health LTPA Messages

Depression:

By being inactive you are missing out on a chance to Get Happy!

"When I don't exercise I don't get that lift in my mood and that chance to feel better about myself."

31 year-old man *(paraplegia)*

"People who do not exercise regularly are generally less happy."

Dr. Cathy Craven, Physician

"I've noticed people who do not exercise miss out on the opportunity to have an overall lifting of spirits. I've found people with SCI who do not start exercising are generally less satisfied with themselves and more susceptible to depression."

Dr. Kathleen Martin Ginis, Researcher

"Those persons who do not participate on sports teams display a sense of poorer quality of life as a consequence."

Dr. Patrick Potter, Physician

By NOT adding regular leisure time physical activity to your day you may...

- Miss out on a chance to brighten your mood
- Decrease your chances of gaining a new outlook
- Experience feelings of depression and anxiety
- Be less likely to enjoy a feeling of accomplishment
- Miss an opportunity to feel happier

Research shows…

- People with SCI who are inactive report greater depressive symptoms than people who do regular leisure time physical activities.
- You are less likely to enhance your mood and improve your mental well-being if you do not engage in physical activities like lifting weights and aerobic activities such as wheeling.
- People who do not engage in regular leisure time physical activity have poorer body satisfaction and lower self-esteem than people who do.

Pain:

If you don't engage in regular leisure time physical activity, you may not decrease your pain!

"I have found that people with SCI are more susceptible to pain if they do not engage in an exercise program."

Dr. Kathleen Martin Ginis, Researcher

"If I do not exercise regularly, I will not help reduce my chances of developing things like joint pain and osteoporosis as I age with a SCI."

43 year-old woman (Quadriplegia)

"My patients who are physically inactive seem to miss out on a chance to forget about their pain at least temporarily while they are exercising. Importantly, it seems like, to some extent, not exercising makes them less resilient to the pain."

Dr. Keith Sequeira, Physician

"Patients who suffer from chronic pain and do NOT exercise regularly, do not reap the benefits of being distracted from their pain during and after exercise."

Dr. Cathy Craven, Physician

By NOT adding leisure time physical activity to your day you may...

- NOT reduce your experience of pain
- Miss out on an opportunity to manage your pain
- NOT build strength to help you relieve pain
- Develop other painful secondary complications (ie. pressure sores and respiratory illness)

Research shows…

- People with spinal cord injury (SCI) who are inactive during their leisure time report more pain than people who are active
- You may not decrease pain if you do not participate in regular leisure time physical activity
- If you do not engage in upper body strength activities you miss out on a chance to protect yourself against shoulder injuries

Fatigue

If you don't engage in physical activity during your free time, you miss out on a chance to feel more energetic!

"If I'm not active, I feel like a slug and I get irritable.
Chris Bourne (paraplegia), Executive Director, Active Living Alliance

"Many people indicate that their energy levels are lower when they do not exercise regularly. Individuals also find some Activities of Daily Living (e.g., transfers) require more physical effort if they do not exercise regularly."
Dr. Kelly Arbour-Nicitopoulos, Researcher

"Yes I have noticed decreases in individuals' energy levels as they become less active post SCI. Inactive individuals with SCI often describe feeling weaker, more tired and have greater difficulty accomplishing daily tasks. In addition, they seem to have more illnesses, infections and sick days."
Dr. Keith Sequeira, Physician

"I notice that my patients who are physically active report generally feeling better. They report having better energy levels and sleeping better."
Dr. Karen Smith, Physician

By NOT adding 10 minutes of activity to your leisure time you may…

- Miss out on an opportunity to feel energized
- Increase your of feelings tiredness
- Feel less upbeat
- Not enjoy a feeling refreshed!

Research shows…

- You will have less energy and more tension after being inactive
- You will not increase your stamina for you daily activities if you are not regularly active

Appendix B.3 - Vulnerability Measures

Disease Risk

Please circle the most appropriate response for each question.

1. My chances of developing *cardiovascular disease* in the future are...

1	2	3	4	5	6	7
Not at all strong						Very Strong

2. I am unlikely to develop *cardiovascular disease* in the future.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

3. My chances of developing *type 2 diabetes* in the future are...

1	2	3	4	5	6	7
Not at all strong						Very Strong

4. I am unlikely to develop *type 2 diabetes* in the future.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

5. My chances of developing *overweight or obesity* disease in the future are...

1	2	3	4	5	6	7
Not at all strong						Very Strong

6. I am unlikely to develop *overweight or obesity* in the future.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

Psychological Health Risk

Please circle the most appropriate response for each question.

1. My chances of developing *depression* in the future are...

1	2	3	4	5	6	7
Not at all strong						Very Strong

2. I am unlikely to develop *depression* in the future.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

3. My chances of developing *chronic pain* the future are...

1	2	3	4	5	6	7
Not at all strong						Very Strong

4. I am unlikely to develop *chronic pain* in the future.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

5. My chances of developing *fatigue* in the future are...

1	2	3	4	5	6	7
Not at all strong						Very Strong

6. I am unlikely to develop *fatigue* in the future.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

Appendix B. 4 - LTPA Response Efficacy Measures

Disease Risk LTPA Response Efficacy:

	Mild Activities	Moderate Activities	Heavy Activities
Exercise and Leisure	Gardening, stretching, tai chi, playing catch with kids	Brisk wheeling, dancing, hand-cycling, swimming, moderate strength training	Fast or sprint wheeling, strenuous weight training, wheelchair or body-weight supported treadmill
Sports	Fishing, bowling, sailing	Curling, golfing, baseball, skiing	Rugby, sledge-hockey, tennis, basketball

Above are some examples of mild, moderate and heavy intensity leisure time physical activities.

Regular physical activity refers to accumulating 30 minutes of *moderate to heavy* physical activity at least 4 days per week. You can add up your activities, 10 minutes at a time, to get that daily total. Keeping this definition of *regularly physical activity* in mind, please choose the most appropriate response for each question:

1. Regular physical activity will reduce my chances of having a heart attack or stroke.
   1 2 3 4 5
   Definitely Not Definitely Yes

2. Regular physical activity will increase my chances of developing type 2 diabetes.
   1 2 3 4 5
   Definitely Not Definitely Yes

3. Regular physical activity will help keep my body weight healthy.
   1 2 3 4 5
   Definitely Not Definitely Yes

4. Regular physical activity will improve my cardiovascular fitness.
   1 2 3 4 5
   Definitely Not Definitely Yes

5. Regular physical activity will increase my risk of obesity.
   1 2 3 4 5
   Definitely Not Definitely Yes

6. Regular physical activity will reduce my risk of type 2 diabetes.

1	2	3	4	5
Definitely Not				Definitely Yes

7. Regular physical activity will improve my chances of living longer.

1	2	3	4	5
Definitely Not				Definitely Yes

Psychological Health Risk LTPA Response Efficacy:

	Mild Activities	Moderate Activities	Heavy Activities
Exercise and Leisure	Gardening, stretching, tai chi, playing catch with kids	Brisk wheeling, dancing, hand-cycling, swimming, moderate strength training	Fast or sprint wheeling, strenuous weight training, wheelchair or body-weight supported treadmill
Sports	Fishing, bowling, sailing	Curling, golfing, baseball, skiing	Rugby, sledge-hockey, tennis, basketball

Above are some examples of mild, moderate and heavy leisure time physical activities:

Regular physical activity refers to accumulating 30 minutes of *moderate to heavy* physical activity at least 4 days per week. You can add up your activities, 10 minutes at a time, to get that daily total. Keeping this definition of *regularly physical activity* in mind, please choose the most appropriate response for each question.

1. Regular physical activity will reduce my chances of having chronic pain.
   1 2 3 4 5
   Definitely Not Definitely Yes

2. Regular physical activity will increase my chances of developing depression.
   1 2 3 4 5
   Definitely Not Definitely Yes

3. Regular physical activity will help manage fatigue.
   1 2 3 4 5
   Definitely Not Definitely Yes

4. Regular physical activity will improve my pain.
   1 2 3 4 5
   Definitely Not Definitely Yes

5. Regular physical activity will increase my risk of fatigue.

1	2	3	4	5
Definitely Not				Definitely Yes

6. Regular physical activity will reduce my risk of depression.

1	2	3	4	5
Definitely Not				Definitely Yes

7. Regular physical activity will improve my overall quality of life.

1	2	3	4	5
Definitely Not				Definitely Yes

Appendix B.5 – Intentions Measure

This next set of questions ask you about your intentions for increasing your participation in moderate to heavy intensity leisure time physical activity in the next two weeks. Specifically, we would like to know your intentions for increasing your physical activity to accumulate 30 minutes of moderate to heavy LTPA on at least four days per week. You can add up your activities, 10 minutes at a time, to get that daily total.

There are many ways to add activity to your day. Some people, choose to go for a wheel around the block after dinner, others join a sports team or an exercise program. Some people even do resistance training during the commercial breaks in a television show. Please keep these activities in mind as you respond to the next set of questions. You can indicate your answer by clicking on the number that best represents your response:

1. To what extent is the following statement true for you?

"During the next two weeks, I intend to accumulate 30 minutes of moderate to heavy intensity leisure time physical activity at least 4 days per week."

1	2	3	4	5	6	7
Definitely False						Definitely True

2. To what extent is the following statement likely?

"I will try to accumulate 30 minutes of moderate to heavy intensity leisure time physical activity at least 4 days per week over the next two weeks.

1	2	3	4	5	6	7
Very Unlikely						Very Likely

3. Over the next two weeks, how many days per week do you intend to accumulate 30 minutes of moderate to heavy intensity leisure time physical activity?

1	2	3	4	5	6	7
Day per week						Days per week

Appendix B. 6 – Cognitive Processing Measures

Thought Listing Exercise:

We are now interested in what you were thinking about while reading the messages. You might have had ideas that were favourable, opposed, or irrelevant to the messages. Any thoughts are fine: simply list what it was that you were thinking while reading the messages. Simply type the first idea you had in the first box, the second idea in the second box etc. Please put only one idea or thought in a box. You should try to record only those ideas that you were thinking *during* the time you were reading the messages. Ignore spelling, grammar, and punctuation. You will have 2.5 minutes to write your thought. We have deliberately provided more space than we think most people will need to insure that everyone would have plenty of room to write their thoughts. So don't worry if you don't fill every space. Just write down whatever your thoughts were during the messages. Please be completely honest and list all the thoughts you had.

*****Note. There were 12 boxes for each participant to fill.

Message Recall:

Disease:

Gain-Framed Recall:

Please select any sentence that was included verbatim (word for word) in the website you read:

Message	YES	NO
By adding 10 minute bouts of regular leisure time physical activity you will reduce your risk of heart attack and stroke.		
People who participate in aerobic activities such as wheeling, arm ergometry, and swimming are more likely to improve their cardiovascular fitness.		
By participating in regular leisure time physical activity you will increase your mobility.		
Regular physical exercise will help to improve your posture.		
Participating in regular physical activity will improve your circulation and reduce blood pooling and swelling in the legs.		
If you engage in regular leisure time physical activity, you may improve your chances of maintaining a healthy body weight.		

Disease:

Loss-Framed Recall

Please select any sentence that was included verbatim (word for word) in the website you read:

Message	YES	NO
By not participating in 10 minute bouts of regular leisure time physical activity you will increase your risk of heart attack and stroke.		
People who do not participate in aerobic activities such as wheeling, arm ergometry, and swimming are less likely to improve their cardiovascular fitness.		
By not participating in regular leisure time physical activity you will decrease your mobility.		
Not participating in regular physical exercise will worsen your posture.		
Not participating in regular physical activity will decrease your circulation and reduce blood pooling and swelling in the legs.		
If you do not engage in regular leisure time physical activity you may not improve your chances of losing weight or maintaining a healthy body weight.		

Psychological Health:
Gain-Framed Recall

Please select any sentence that was included verbatim (word for word) in the website you read:

Message	YES	NO
Adding regular leisure time physical activity to your day will make you happier.		
By participating in physical activity you will reduce the likelihood of developing psychiatric diseases.		
Adding leisure time physical activity to your day can help you manage your pain.		
Participating in physical activity will help you cope with daily challenges better.		
Participating in physical activity will help to decrease your overall level of stress.		
You will increase your stamina for your daily activities if you are regularly active during your free time.		

Psychological Health:
Loss-Framed Recall

Please select any sentence that was included verbatim (word for word) in the website you read:

Message	YES	NO
By not adding regular leisure time physical activity to your day you may miss an opportunity to feel happier.		
By not participating in physical activity you will increase the likelihood of developing psychiatric diseases.		
By not adding leisure time physical activity to your day you may miss out on an opportunity to manage your pain.		
Not participating in physical activity makes coping with your daily activities more difficult.		
By not participating in physical activity you will increase your overall level of stress.		
You will not increase your stamina for your daily activities if you are not regularly active.		

Appendix C:

Study 3 Materials

Appendix C.1 – Health Risk Information

Cardiovascular Disease (CVD)

- Every 7 minutes in Canada, someone dies from heart disease or stroke
- CVD is a leading cause of death in Canada
- Many young adults already have risk factors for CVD

Overweight & Obesity

- The percentage of Canadians who are overweight or obese has risen dramatically in recent years especially among young adults
- Many individuals gain weight and body fat while attending university
- Among Canadians aged 18 or older: 23.1% are obese and 36.1%, are overweight

Type 2 Diabetes

- Diabetes is the seventh leading cause of death in Canada
- Over 50,000 young adults in Canada have diabetes
- Diabetes is a common condition and it's frequency is dramatically rising all over the world

Common Cold

- University students are at an increased risk for the common cold
- 9/10 students report having at least 1 common cold over the fall/winter semester
- Among 3000 undergraduate students surveyed; 4263 classes were missed in one semester due to the common cold

Stress

- Many undergraduate students report feeling stress as a result of academic pressures, financial problems, and relationship strains
- By the end of first-year university, 44% of undergraduate students report feeling stressed and overwhelmed
- Stress contributes to approximately 80% of all illnesses and disease

Study Habits

- The development of effective study habits is essential to academic success for undergraduate students.
- Many undergraduate students do not have adequate study habits and often rely on ineffective study habits.
- Undergraduate students often have not developed adequate study habits

Appendix C. 2 – Framed LTPA Efficacy Messages

Gain-Framed Messages:

Cardiovascular Disease:

By participating in 10 minute bouts of regular leisure time physical activity you will …

- Reduce your risk of heart attack and stroke
- Increase your chances of managing your blood pressure
- Take an opportunity to strengthen your heart

Research shows...

- People who participate in aerobic activities such as jogging, basketball, and swimming are more likely to improve their cardiovascular fitness

Overweight & Obesity:

If you engage in regular leisure time physical activity, you may…

- Reduce your risk of gaining weight during university
- Help reduce body fat while maintaining muscle mass
- Improve your chances of losing weight or maintaining a healthy body weight

Research shows...

- You are less likely to become overweight or obese if you engage in physical activity during your free time.

Type 2 Diabetes:

If you add regular leisure time physical activity to your day -

You may …

- Reduce your risk of developing type 2 diabetes
- Keep your blood sugar in check
- Improve your body's ability to use insulin and carbohydrates

Research shows...

- Active people are less likely to develop type 2 diabetes than inactive people.

Cancer:

By engaging in regular leisure time physical activity…

You will:

- Prevent 35% of all cancers
- Achieve and maintain a healthy weight; People who are a healthy weight are at less risk for cancer
- Help protect yourself from many cancers

Research Shows:

- High levels of physical activity are associated with low levels of cancers

The Common Cold:

If you engage in regular leisure time physical activity:

You may:

- Reduce your risk of catching a common cold
- Have more quality sleep and less sleep disturbances, which increases your resistance to the common cold
- Be less likely to catch a cold when you are faced with high stress periods like exams

Research shows:

- Higher levels of physical activity are associated with lower incidence of the common cold among undergraduate students.

Study Habits:

Adding regular leisure time physical activity to your day can:

- Improve your study habits
- Result in more quality sleep and less sleep disturbances, which can improve your study habits and academic performance
- Be beneficial to your academic studying

Research shows:

Undergraduate students who are regularly active have better study habits and academic performance than students who are regularly inactive.

Stress:

By engaging in regular leisure time physical activity;

You may:

- Succeed with managing school-related stress
- Feel a reduction in stress-related emotions such as anxiety
- Reduce the likelihood of feeling overwhelmed by stress

Research shows:

- Being physically active makes it easier for university students to cope with stress especially during academic demanding times.

Appendix C. 3 – Vulnerability Measure

1. My chances of developing *cardiovascular disease* in the future are...

1 2 3 4 5 6 7

Not at all strong Very Strong

2. I am unlikely to develop *cardiovascular disease* in the future.

1 2 3 4 5 6 7

Strongly Disagree Strongly Agree

3. My chances of developing *type 2 diabetes* in the future are...

1 2 3 4 5 6 7

Not at all strong Very Strong

4. I am unlikely to develop *type 2 diabetes* in the future.

1 2 3 4 5 6 7

Strongly Disagree Strongly Agree

5. My chances of catching a *common cold* in the future are…

1 2 3 4 5 6 7

Not at all strong Very Strong

6. I am unlikely to catch a *common cold* in the future.

1 2 3 4 5 6 7

Strongly Disagree Strongly Agree

7. My chances of developing *overweight or obesity* disease in the future are...

1 2 3 4 5 6 7

Not at all strong Very Strong

8. I am unlikely to develop *overweight or obesity* in the future.

1 2 3 4 5 6 7

Strongly Disagree Strongly Agree

9. My chances of facing *stress* in the future are…

1 2 3 4 5 6 7

Not at all strong Very Strong

10. I am unlikely to face *stress* in the future.

1 2 3 4 5 6 7

Strongly Disagree Strongly Agree

11. My chances of developing *cancer* in the future are…

1 2 3 4 5 6 7

Not at all strong Very Strong

12. I am unlikely to develop *cancer* in the future.

1 2 3 4 5 6 7

Strongly Disagree Strongly Agree

13. My chances of developing *poor study habits* in the future are…

1 2 3 4 5 6 7

Not at all strong Very Strong

14. I am unlikely to develop *poor study habits* in the future.

1 2 3 4 5 6 7

Strongly Disagree Strongly Agree

Appendix C. 4 – Fear Arousal Measure

Indicate the degree to which the information you just read made you feel:

1	2	3	4	5	6	7
Very Unafraid						*Very Afraid*

1	2	3	4	5	6	7
Relaxed						*Tense*

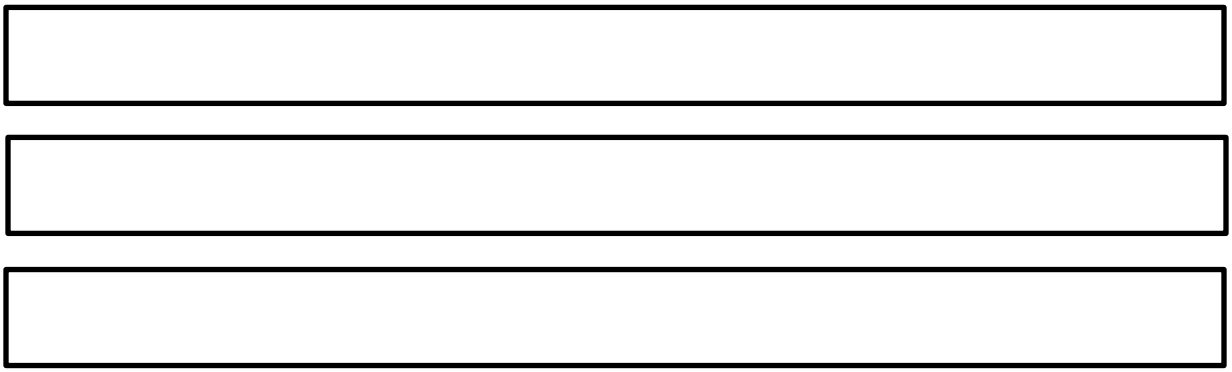
1	2	3	4	5	6	7
Calm						*Agitated*

1	2	3	4	5	6	7
Restful						***Excited***

Appendix C. 5 – Message Elaboration Measures

Thought Listing Exercise:

We are now interested in what you were thinking about while reading the messages. You might have had ideas that were favourable, opposed, or irrelevant to the messages. Any thoughts are fine: simply list what it was that you were thinking while reading the messages. Simply type the first idea you had in the first box, the second idea in the second box etc. Please put only one idea or thought in a box. You should try to record only those ideas that you were thinking *during* the time you were reading the messages. Ignore spelling, grammar, and punctuation. You will have 2.5 minutes to write your thought. We have deliberately provided more space than we think most people will need to insure that everyone would have plenty of room to write their thoughts. So don't worry if you don't fill every space. Just write down whatever your thoughts were during the messages. Please be completely honest and list all the thoughts you had.



*****Note. There were 12 boxes for each participant to fill.

Message Recall:

Gain-Framed:

Please indicate whether or not each sentence was included verbatim (word for word) in the website you read:

Message	YES	NO
By adding 10 minute bouts of regular leisure time physical activity you will reduce your risk of heart attack and stroke.		
People who participate in aerobic activities such as jogging, swimming, and basketball are more likely to improve their cardiovascular fitness.		
If you engage in regular leisure time physical activity you will improve your grades.		
If you engage in regular leisure time physical activity, you may improve your chances of losing weight or maintaining a healthy body weight.		
Regular physical activity will improve the quality of your diet.		
Participating in regular physical activity will help you feel better about yourself.		
Undergraduate students who are regularly active have better study habits and academic performance than students who are regularly inactive.		
By participating in regular leisure time physical activity you will have a chance to improve your mood.		

Loss-Framed:

Please indicate whether or not each sentence was included verbatim (word for word) in the website you read:

Message	YES	NO
By not participating in 10 minute bouts of regular leisure time physical activity you will increase your risk of heart attack and stroke.		
People who do not participate in aerobic activities such as jogging, swimming, and basketball are less likely to improve their cardiovascular fitness.		
If you do not engage in regular leisure time physical activity you will not improve your grades.		
If you do not engage in regular leisure time physical activity, you may not improve your chances of losing weight or maintaining a healthy body weight.		
Regular physical inactivity will reduce the quality of your diet.		
Not participating in regular physical activity may make you feel worse about yourself.		
Undergraduate students who are regularly inactive have poorer study habits and academic performance than students who are regularly active.		
By not participating in regular leisure time physical activity you miss out on a chance to improve your mood.		

Appendix C. 6 – Personal Relevance Measure

1. How much did the information apply to your life?

1	2	3	4	5	6	7
Applied very little						*Applied very much*

2. How personally relevant did you find the information?

1	2	3	4	5	6	7
Not at all personally relevant						*Very personally relevant*