Predicting Pain Catastrophizing and Hypervigilance Among Endurance Athletes: The Interactive Roles of Perfectionism and Sport Pain Ethic Endorsement

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Sport has been described as a "culture of risk" (Nixon, 1993, p. 188). As an example, the experience of pain is an integral component of training and competing in many sports, including endurance sports (Fitzgerald, 2015; Roebuck et al., 2018; Simpson et al., 2014). Factors which may influence this experience include the culture of sport (Hainline et al., 2017; Reardon et al., 2019) and personality, especially dispositions common in high-intensity sport, such as perfectionism or high-achieving personalities (Weise-Bjornstal, 2010, p. 105). From a cognitive-behavioural perspective (Zinsser et al., 2010), how athletes think about their inevitable experiences with pain should influence the degree to which their subsequent feelings and behaviour are (mal)adaptive and (dys)functional. This has clearly played out in research on chronic pain where higher levels of catastrophizing about pain are associated with higher levels of disability, depression, and anxiety (Mehta et al., 2016; Rice et al., 2016). Similarly, individuals with chronic pain who are hypervigilant to pain risk falling victim to "a vicious cycle of more restriction of physical activity, more disability, [and] frustration" (Goubert et al., 2004a, p. 392; Vlaeyen & Linton, 2000). There has been little investigation into the way athletes think about pain to date (Assa et al., 2018; Roebuck et al., 2018). Adding research to the literature concerning these variables would be valuable given that, as athletes strive for ever-increasing standards and progress through competition levels, their experiences with pain become more salient (Coakley, 2007). The general purpose of the present study was to address this need by examining how personal and cultural factors interact to explain pain catastrophizing and pain hypervigilance among endurance athletes.

Fear-Avoidance Model

There are few models which help explain the way athletes think about pain and the associated outcomes. A model from the study of chronic pain, The Fear-Avoidance Model of Pain (presented in Figure 1), addresses such relationships (Crombez et al., 2012; Dover & Amar, 2015; Vlaeyen & Linton, 2000, 2012). Known as a highly "influential model" (p. 4) in chronic pain populations, the Fear-Avoidance Model captures how people place meaning on pain and how such thought processes may lead to positive or negative long-term consequences, including the experience of chronic pain (Crombez et al., 2012). This model has been used to help understand the pain-related cognitions of athletes on a few occasions to date, having been used as a foundation to explore differences in pain tolerance between ultrarunners and controls (Roebuck et al., 2018) and to explore the cognitive processes and emotions toward pain experienced in sport by rugby players (Bardel et al., 2013).

One of the main ideas in the Fear-Avoidance Model is that thinking about pain in a persistent and perseverative way can foster the growth of pain-related fear and functional disability (Vlaeyen & Linton, 2000, 2012). The model recognizes that there are two possible pathways of thinking following a pain episode. On the first pathway, individuals may be considered confronters if they perceive or appraise pain as being non-catastrophic or a nuisance. Following the experience of pain, confronters will have no fear, confront pain, and work toward recovery in their injured body part. On the second pathway, avoiders perceive or appraise pain as being catastrophic or highly threatening. Avoiders become hypervigilant for potentially painful movements, develop increasing pain-related fear and anxiety, and the threat of pain is magnified further—these negative feelings increase avoidance of any activity that may induce some pain. By refusing to test one's expectations of pain, excessive pain- or injury-related fear builds,

increasing the likelihood of future catastrophic expectations of pain and its negative consequences, thus fueling avoidance of such activities (Crombez et al., 2012). If these are kept up chronically, avoiders are vulnerable to developing depression, disuse syndrome, and disability in the injured body part.

Two central constructs in the Fear-Avoidance Model are pain catastrophizing and pain hypervigilance. Pain catastrophizing starts the avoider pathway and is considered one of the most important predictors of the pain experience (Crombez et al., 2012; Flink et al., 2013; Sullivan, Thorn, et al., 2001). Pain hypervigilance maintains pain, injury, and disability by fueling avoidance from daily activities and physical activity (Crombez et al., 2012). Both constructs are relevant within sport. Catastrophizing, for example, has been identified as one of the most pervasive forms of irrational and distorted thinking among athletes (Zissner et al., 2010). Meanwhile, pain hypervigilance has been identified as an important construct to consider in environments where there are competing attentional demands and where "attention to pain is irrelevant to the task at hand" (Crombez et al., 2005, p. 6). Sport may be such an environment, given that if an athlete's attention is focused on pain, then they may lose sight of stimuli that are more important in promoting their performance and wellbeing (Bardel et al., 2013). The following section provides a more in-depth description of these two influential constructs.

Pain Catastrophizing and Pain Hypervigilance

Pain catastrophizing is conceptualized as a primary appraisal process with an exaggerated and negative focus on pain sensations (Sullivan, Thorn, et al., 2001; Sullivan, Tripp, et al., 2000). When people catastrophize about pain, whether it is currently being experienced or anticipated, a person may perceive themselves as incapable of effectively coping with a painful situation (Sullivan, Tripp, et al., 2000, p. 153; see also Sullivan et al., 1995; Sullivan, Thorn, et al., 2001).

Sullivan and colleagues (1995) conceptualized this integrated construct as encompassing three related aspects, where a person: magnifies or exaggerates the threat of pain sensations; experiences negative, repetitive, and intrusive thoughts that are difficult to disengage from; and where such thoughts reinforce feelings of helplessness to effectively address pain. In some instances, pain catastrophizing has been considered adaptive in the short term because it protects the individual from exacerbating the immediate injury. In the long-term, pain catastrophizing is considered maladaptive, dysfunctional, and debilitating because, in chronic pain populations, it is associated with greater reliance on healthcare services (Mehta et al., 2016; Rice et al., 2016), heightened pain reports and emotional distress (Sullivan, 2009), and may result in increased levels of physical deconditioning, and chronic and functional disability (Sullivan et al., 2002; Vlaeyen & Linton, 2000, 2012). A much smaller amount of research has been devoted to examining pain catastrophizing among athletes (Assa et al., 2018), although in the few studies that have been conducted, similar outcomes have emerged. For example, among samples of athletes, pain catastrophizing has been associated with negative cognitive patterns (e.g., pain-related anxiety, pain hypervigilance, and depression; Mannes et al., 2020; Roebuck et al., 2018), increased pain perception (Sullivan, Tripp, et al., 2000), and reduced physical output (Deroche et al., 2011; Tripp et al., 2007).

Pain hypervigilance is characterized by one's excessive readiness or tendency to attend to pain sensations and/or information over other environmental information (Crombez et al., 2007). It is assumed to be maintained by the immediate threat value of pain (Crombez et al., 2012; Schoth et al., 2012), and as evidence suggests, informed by pain-related fear and catastrophic thinking (Goubert et al., 2004a). One perspective on pain hypervigilance recognizes two attentional processes: (1) facilitated detection of pain, such that a person becomes attentionally

primed for pain stimuli over others (Bardel et al., 2013); and (2) difficulty disengaging from painful stimuli, such that a person experiences difficulty transferring attention toward a new stimulus when allocation of attention has already been assigned to an existing painful stimulus (Bardel et al., 2013). Crombez and colleagues (2012) propose that one's physical and mental capabilities may suffer if there is a lack of testing expectations of pain or pursuing valued activities, and if they experience more social isolation, which all fuel affective distress. If used to monitor the effectiveness of current pain management strategies, pain hypervigilance may also increase cognitive perseveration (i.e., rumination) if the solution to pain is not immediately available, questioning one's self-efficacy in managing pain (Crombez et al., 2005). A growing body of research among chronic pain populations supports the negative, maladaptive, and dysfunctional nature of prolonged pain hypervigilance (Van Ryckeghem et al., 2018). For example, higher levels of hypervigilance have been associated with the maintenance of pain and injury (Todd et al., 2018; Van Damme et al., 2004), increased emotional distress (Roelofs et al., 2003; Todd et al., 2018), and more physician visits due to pain (Roelofs et al., 2003). There appears to be limited research on the possible pain-related psychological factors in athletes (Bardel et al., 2013; Roebuck et al., 2018), though in the few studies that have been conducted, similar outcomes are supported. Heightened levels of pain hypervigilance have been associated with high pain-related anxiety (Bardel et al., 2013) and reduced physical output (Deroche et al., 2011).

Given the negative outcomes of pain catastrophizing and hypervigilance, it would be valuable to identify predictors which are meaningful or relevant in sport. According to the Fear-Avoidance Model, personality influences whether one confronts or avoids pain and, as a result, partially explains one's tendencies toward pain catastrophizing and pain hypervigilance

(Crombez et al., 2012; Vlaeyen & Linton, 2000). This model originated out of the treatment of phobias, panic disorders, and anxiety disorders. Accordingly, personality traits associated with psychopathology and anxiety have been highlighted as meaningful predictors of pain catastrophizing and pain hypervigilance (Crombez et al., 2012; Goubert et al., 2004a). As demonstrated by research conducted within and outside of sport, perfectionism represents such a personality trait (Affrunti & Woodruff-Borden, 2018; Limburg et al., 2017; Stoeber et al., 2018).

Perfectionism is also meaningful, important, and salient within sport. In high performance sport contexts, the pursuit of perfect performance is often encouraged and even revered (Hill et al., 2018). Perhaps this is because, as Flett and Hewitt (2005) argue, success in many sports requires error-free or perfect performance. As such, it is not surprising that many successful athletes often describe themselves as perfectionists (Hill et al., 2018), including Serena Williams, Bobby Jones, and John McEnroe (Flett & Hewitt, 2005). Given its links to psychopathology and anxiety, in combination with its salience in sport, it would be valuable to examine perfectionism as a predictor of pain catastrophizing and pain hypervigilance among athletes.

Perfectionism

The present study sought to investigate perfectionism, "a multidimensional personality disposition that represents both the tendency to strive towards perfection and to evaluate the self in a critical manner" (Gaudreau & Thompson, 2010, p. 532). The 2 × 2 model of perfectionism (Gaudreau, 2016; Gaudreau & Thompson, 2010) recognizes two dimensions of perfectionism: personal standards perfectionism, characterized by self-activated setting and pursuit of excessively high, personally meaningful standards of performance; and evaluative concerns perfectionism, characterized by the tendency to perceive harsh, socially-prescribed, external

standards for perfection, set similarly harsh internal standards, and have doubts about one's own ability to achieve them (Gaudreau, 2016; Gaudreau & Thompson, 2010). The 2 × 2 model contends that both dimensions co-exist and combine within every individual to varying degrees. The model recognizes four prototypical within-person profiles across the two dimensions. These prototypical profiles reflect distinct perfectionism subtypes or distinct "ways of being a perfectionist" (Gaudreau, 2016, p. 175). The 2 × 2 model, and the four subtypes identified within it, is presented in Figure 2. The first of the four subtypes is pure personal standards perfectionism; people who follow this subtype have a high degree of personal standards perfectionism and a low degree of evaluative concerns perfectionism. The next subtype is pure evaluative concerns perfectionism, comprised of a low degree of personal standards perfectionism and a high degree of evaluative concerns perfectionism. The third subtype is mixed perfectionism, where people who fall under this subtype have a high degree of both personal standards perfectionism and evaluative concerns perfectionism. Lastly, there is non-perfectionism, where individuals have a low degree of both personal standards perfectionism and evaluative concerns perfectionism.

The degree with which each subtype is more or less susceptible or vulnerable to these outcomes is influenced by the degree of one's internalization, regulation, and person-environment congruences. These factors then converge to inform four hypotheses of the 2 × 2 model (Gaudreau & Thompson, 2010). The first hypothesis has three versions to aid in determining contexts where personal standards perfectionism is beneficial or damaging when compared to non-perfectionism (Gaudreau et al., 2018). Specifically, Hypothesis 1 contends that pure personal standards perfectionism should be associated with better (H1a), worse (H1b), or similar (H1c) outcomes compared to non-perfectionism. Hypothesis 2 alleges that pure

evaluative concerns perfectionism should be associated with worse outcomes than non-perfectionism (H2). Hypothesis 3 claims that pure evaluative concerns perfectionism should be associated with worse outcomes than mixed perfectionism (H3). Finally, Hypothesis 4 puts forth that mixed perfectionism should be associated with worse outcomes than pure personal standards perfectionism (H4).

Theoretical Relationships Between Perfectionism, Pain Catastrophizing, and Pain Hypervigilance

Recent reviews of research based both in and outside of sport generally show support for the 2 × 2 model's hypotheses (Gaudreau et al., 2018; Hill & Madigan, 2017). A similar degree of support is produced when theory is used to explain potential relationships involving perfectionism, pain catastrophizing, and pain hypervigilance among athletes. As presented earlier, a core characteristic of perfectionism is the continuous striving for extremely high personal performance standards "that are deemed important, valuable, and consequential for one's self-worth" (Gaudreau, 2016, p. 178). This is especially true in the case of mixed perfectionism and pure evaluative concerns perfectionism where such stringent performance standards are believed to be partially or primarily socially-prescribed, externally imposed, and internalized in a controlled (as opposed to autonomous) manner.

Pain, though, is commonly interpreted by athletes as a signal that performance goals are in jeopardy (Bardel et al., 2013). To athletes, pain is something that may preclude them from competing, impede their career development, or even stop their career in sport altogether. Applying a motivational perspective to the Fear-Avoidance Model, Crombez and colleagues (2012) suggested that when pain is perceived to challenge important personal goals, pain-related fear is a likely outcome. As such, while all perfectionists should be sensitive to, and fearful of

pain, this tendency should be strongest among mixed perfectionists and pure evaluative concerns perfectionists. This application of theory supports some, though not all, of the 2 × 2 model's hypotheses. In support of H1b and H2, it suggests that both pure personal standards perfectionism and pure evaluative concerns perfectionism should be associated with higher levels of pain catastrophizing and pain hypervigilance compared to non-perfectionism. In support of H4, it suggests that mixed perfectionism should be associated with higher pain catastrophizing and hypervigilance than pure personal standards perfectionism. Support for H3 is unclear, in whether pure evaluative concerns should show higher levels of pain catastrophizing and hypervigilance in comparison to mixed perfectionism.

Past Research on Perfectionism, Pain Catastrophizing, and Pain Hypervigilance

Trends in past research on these variables of interest appear to support the hypothesized relationships among them in the present study's findings. There do not appear to be any existing studies on the relationship between perfectionism and pain catastrophizing among athletes. There are three studies on the relationship between perfectionism and pain catastrophizing among individuals with chronic pain. Two of the studies by Mehta et al. (2016) and Rice et al. (2016) measured perfectionism uni-dimensionally, in that they did not distinguish between personal standards perfectionism and evaluative concerns perfectionism. Given that the 2 × 2 model is founded on the assumptions that perfectionism is a multidimensional construct, such studies are not useful in the present analysis. The third of these studies by Randall et al. (2018), assessed perfectionism multidimensionally, in that they acknowledged the separate relationships personal standards perfectionism and evaluative concerns perfectionism have with other variables of interest. Pain-related cognitions and perfectionism were measured in 239 children with chronic

pain and their parents. Among both parents and children, evaluative concerns perfectionism and personal standards perfectionism exhibited positive correlations with pain catastrophizing.

There is also no empirical research on the relationship between perfectionism and pain hypervigilance among athletes, or among any population for that matter. Several studies have examined the relationship between perfectionism and the processes inherent to hypervigilance in general. One of these processes is facilitated detection for threatening stimuli. Howell et al. (2016) examined the relationship between perfectionism and this process among 56 Australian adults. This study used a dot-probe task to present stimulus words to participants on a computer screen in a random order and location. The amount of time it took for participants to detect the words was recorded. Howell and colleagues (2016) varied whether the words were emotionally positive or negative, and relevant or irrelevant to perfectionism. For example, "success" reflected a word that was emotionally positive and relevant to perfectionism, while "attack" reflected a word that was emotionally negative and irrelevant to perfectionism. The results showed that those high in concern over mistakes—a central facet of evaluative concerns perfectionism—attended to emotionally negative perfectionism-relevant words more quickly than those low in concern over mistakes.

The second process is difficulty disengaging from threatening stimuli, and this was examined in three studies (Gotwals & Tamminen, in press; Kobori & Tanno, 2012; Tonta et al., 2019). Similar to Howell et al. (2016), Kobori and Tanno (2012) examined the relationships between facets of perfectionism and the ability to attentionally disengage after being exposed to words that were emotionally negative or neutral, and relevant or irrelevant to perfectionism among 40 Japanese undergraduate students. The modified Stroop colour-naming task was used, and showed the participant emotionally negative or neutral, perfectionism-relevant or -irrelevant

words. In other words, if one's attention was engaged by (i.e., ruminating on) the stimulus word's relevance to perfectionism or emotional valence, then colour-naming performance suffered (i.e., response time increased, the wrong colour was named).

Tonta et al. (2019) sampled 104 Australian undergraduate students who, like Howell et al. (2016), completed a dot probe task. This dot-probe task presented the participant with visual probes in set, on-screen locations. So, if one's attention was engaged by (i.e., ruminating on) a specific type of word (i.e., by emotional valence, relevance to perfectionism), then the person displayed a greater attentional preference for the specific target word subtype that was shown on-screen and more mistakes were made during task completion (e.g., incorrect input, response time increased). Attentional preference was quantitatively calculated by an index developed by the research team. Results provide ambiguous support such that Kobori and Tanno (2012) found that those high in self-oriented perfectionism, a central facet of personal standards perfectionism, had a greater delayed response time to name the correct colour of the stimulus words when compared to those low in self-oriented perfectionism. Conversely, Tonta and colleagues (2019) found that those high in evaluative concerns had delayed response times to match visual probes with on-screen word stimulus orientation tasks. Both studies found that participants who reported higher degrees of the respective dimensions of perfectionism had difficulty attentionally disengaging from words that focused on emotionally negative, perfectionism-relevant themes. To perfectionists, pain may be an emotionally negative and personally relevant stimulus, given that it may signal that their high priority achievement standards are in jeopardy. As such, the pattern of relationships between perfectionists and hypervigilance to emotionally negative and perfectionism-relevant words may be similar to the pattern of relationships between perfectionism and hypervigilance to pain.

Gotwals and Tamminen (in press) found a link between perfectionism and mistake- and failure-rumination through a different approach than Kobori and Tanno (2012) and Tonta et al. (2019). Specifically, Gotwals and Tamminen used a qualitative approach in which three varsity student-athletes (i.e., participants of a variety of varsity team sports) who endorsed pure personal standards perfectionism and seven who endorsed mixed perfectionism took part in semi-structured interviews and used audio-diaries to chronicle their experiences with failure and success across an athletic season. Analysis of the subsequent data resulted in a theme that captured the perfectionists' responses to failure. For the mixed perfectionistic athletes, the theme of a tendency to ruminate on their mistakes for extended periods of time emerged through their responses. In contrast, the pure personal standards perfectionistic athletes reported the ability to quickly move on after failure and re-direct their attention to the next challenge.

Several trends are evident when findings from the reviewed research are taken collectively. First, across both pain catastrophizing and hypervigilance, evaluative concerns perfectionism demonstrated a positive relationship with both, such that a person who reports a high degree of evaluative concerns perfectionism tends to also report a high degree of these variables of interest. This may provide supportive evidence for H2. Second, personal standards perfectionism also demonstrated a positive relationship with pain catastrophizing, such that a person who reports a high degree of personal standards perfectionism tends to report high degrees of pain catastrophizing. This may provide supportive evidence for H1b; however, with regards to personal standards perfectionism and pain hypervigilance, there do not yet appear to be any studies to clarify their relationship. When applied to the 2 × 2 model's hypotheses, this suggested that the subtypes characterized by a higher degree of both evaluative concerns perfectionism and personal standards perfectionism (e.g., pure personal standards perfectionism,

pure evaluative concerns perfectionism, and mixed perfectionism) are more likely to be vulnerable to the consequences of pain catastrophizing and hypervigilance. It is important to note, though, that these trends were based on the results of a small number of studies, with only one conducted among athletes.

The Moderating Role of Sport Pain Ethic Endorsement

The previous sections established that perfectionism may be related in meaningful ways to pain catastrophizing and pain hypervigilance among athletes. Establishing the boundary conditions of such relationships has been identified as "perhaps the most important avenue for future [perfectionism] research in sport, dance, and exercise" (Hill et al., 2020, p. 29). The Fear-Avoidance Model provides guidance in this respect. In this model, personality is not recognized as the only factor that influences the pathway that one takes after experiencing pain. A second recognized factor is culture; more accurately, cultural beliefs about pain (see Figure 1). This reflects the notion that, rather than being completely idiosyncratic, individuals' beliefs and assumptions about pain are largely formed, shaped, and reinforced by their culture (Crombez et al., 2012). In support of this notion, a large body of research has shown that people with different cultural backgrounds think about and respond to pain in distinct ways (e.g., Goubert et al., 2004a; Houben et al., 2005; Sargent, 1984).

The perspective of pain generally endorsed in the culture of high-performance sport fits within the sport ethic: "a set of norms accepted as the dominant criteria for defining what is required to be defined and accepted as an athlete" (Coakley, 2007, p. 161). This ethic is uncritically accepted in high-performance sports and is encouraged, upheld, and reinforced by meaningful significant others (e.g., teammates, coaches, and family members) and institutions (e.g., the media and sport organizations; Brewer & Redmond, 2016; Coakley, 2007). When it

comes to pain, the sport ethic contends that "an athlete accepts risks and plays through pain" (Coakley, 2007, p. 162). Several authors have described this aspect of the sport ethic in detail and specified the beliefs and assumptions that it encompasses (see Bourgeois et al., 2009; Brewer & Redmond, 2016; Coakley, 2007; Deroche et al., 2011; Weise-Bjornstal, 2010). For example, according to the sport pain ethic, "true athletes" accept no obstacles in pursuit of possibilities (Coakley, 2007); they accept that as one progresses through competition levels in sport, they also must take on increasing levels of pain and risk of injury. In addition, "true athletes" are expected to be tough and ignore pain (Bourgeois et al., 2009; Weise-Bjornstal, 2010), see pain as a challenge and something to be endured (Liston et al., 2006; Meyers et al., 2015; Thornton et al., 2019), and normalize pain as something inherent to competition (Brewer & Redmond, 2016; Hibberd & Myers, 2013). The sport ethic also contends that there are several benefits of playing through pain, including allowing for continual goal pursuit, demonstrating the high prioritization of sport in an athlete's life (Brewer & Redmond, 2016), and showing strength of character, all of which can help one gain respect from others (Deroche et al., 2011).

It was earlier suggested that pure personal standards perfectionism, mixed perfectionism, and pure evaluative concerns perfectionism may show meaningful relationships with pain catastrophizing and pain hypervigilance among athletes because pain may signal that important performance goals are in jeopardy. It was further argued that these relationships may be especially strong in the case of mixed perfectionism and pure evaluative concerns perfectionism where performance goals are perceived to be socially-prescribed and externally-imposed. Perfectionists' vulnerabilities to pain catastrophizing and pain hypervigilance, though, may have been alleviated through endorsement of the sport pain ethic. This is because the sport pain ethic preaches that playing through and ignoring pain allows athletes to continually strive for personal

goals as well as manage the impression of others, demonstrate strength of character, and gain social respect (Brewer & Redmond, 2016; Deroche et al., 2011; Weise-Bjornstal, 2010). This suggests that endorsement of the sport pain ethic may have moderated relationships that perfectionism subtypes show with pain catastrophizing and pain hypervigilance. Moderation occurs when the relationship between two variables (e.g., X and Y) is dependent or conditional on a third variable (e.g., W). That is, "the effect of X on […] Y is moderated by W if its size, sign, or strength depends on or can be predicted by W" (Hayes, 2018, p. 220). In the present case, pure personal standards perfectionists, mixed perfectionists, and pure evaluative concerns perfectionists should have been less likely to catastrophize about, and be hypervigilant to, pain when endorsement of the sport pain ethic is high, as opposed to low. This contingency should have been most apparent among mixed perfectionists and pure evaluative concerns perfectionists.

Testing a Proposed Model of Moderated Moderation Among Endurance Athletes

This introduction built and presented models that included pain catastrophizing and pain hypervigilance as outcomes, perfectionism as a predictor, and endorsement of the sport pain ethic as a moderator. Figures 3 and 4 visually depict these models. When contextualized within the 2 × 2 model of perfectionism, the models reflected cases of moderated moderation (Hayes, 2018). The proposed models were supported by theory from the psychology of pain, perfectionism, and sport sociology literatures (Coakley, 2007; Crombez et al., 2012; Gaudreau & Thompson, 2010). As repeatedly indicated throughout this introduction, there has been very little empirical evidence to back up the models, especially when it comes to evidence produced within sport. For example, researchers had not yet investigated the independent relationships that perfectionism and sport pain ethic endorsement may have shown with pain catastrophizing and

pain hypervigilance among athletes, let alone considered an interaction between the two predictors.

Testing the proposed models would be valuable given the highly dysfunctional and debilitating outcomes associated with pain catastrophizing and hypervigilance, the salience of perfectionism among athletes, and the ubiquity of the pain ethic in sport (Bardel et al., 2013; Coakley, 2007; Flink et al., 2013; Hill et al., 2018). Athletes from different types of sports may think, feel, and respond to pain in different ways (Assa et al., 2018). As a result, it may be beneficial to test the proposed models within a single type of sport that provides a rich context when it comes to pain. High performance endurance sports serve as an example (Assa et al., 2018; Geva & Defrin, 2013; Roebuck et al., 2018). Pain is common, salient, and a meaningful component of taking part in endurance sports at the high-performance level (Fitzgerald, 2015; Roebuck et al., 2018; Simpson et al., 2014). For example, endurance athletes are systematically and routinely exposed to discomfort through training that is designed to tax the limits of their physical capabilities. The difficulty and volume of training could lead to, and exacerbate, painful chronic conditions that must be monitored and addressed on a daily basis. Finally, endurance sport races are expected to produce a large amount of suffering; it is commonly believed that one's quality of performance is determined primarily by how well one copes with that suffering (Fitzgerald, 2015). As such, it was assumed that how endurance athletes think about pain, or more specifically, the degree to which they catastrophize about pain and are hypervigilant in their attention to pain, may have meaningfully influenced their affective and behavioural experiences both within and outside the context of their sport (Assa et al., 2018; Geva & Defrin, 2013; Roebuck et al., 2018).

The Present Study: Purpose and Hypotheses

The purpose of the study was to examine the relationships between perfectionism and pain catastrophizing and pain hypervigilance among endurance athletes and to test whether endorsement of the sport pain ethic moderates the relationships depicted in Figures 3 and 4. The 2 × 2 model of perfectionism provided a foundation for this examination. Past research findings that evidence relationships between perfectionism, pain catastrophizing, and pain hypervigilance do not always align with the 2 × 2 model's general hypotheses about how perfectionism subtypes should differentially relate to negative, dysfunctional, and maladaptive constructs. This body of literature is very small and rarely based in sport. As a result, the present study's hypotheses were founded on the 2 × 2 model's general hypotheses. In line with H1b and H2, it was expected that pure personal standards and pure evaluative concerns perfectionism would show stronger positive relationships with pain catastrophizing and pain hypervigilance in comparison to non-perfectionism. In line with H3 and H4, it was expected that mixed perfectionism would show weaker relationships with pain catastrophizing and pain hypervigilance in comparison to pure evaluative concerns perfectionism, but stronger relationships in comparison to pure personal standards perfectionism. Regarding the moderating role of sport pain ethic endorsement, it was expected that all of these hypothesized, comparative relationships would be exacerbated when sport pain ethic endorsement was low and inhibited when sport pain ethic endorsement was high.

Method

Design

Self-report data was collected from endurance athletes via a publicly-available one-time online survey, reflecting a cross-sectional research design. Procedures for this study adhered to regulations and guidelines for research conducted during the current pandemic as put forth by the

Lakehead University Office of Research Services and the Vice-President of Research and Innovation (see https://www.lakeheadu.ca/research-and-innovation/research-faqs-relating-to-covid-19/research-faqs-for-covid-19-).

Targeted Participants

Two hundred individuals who trained for and competed in endurance sport were targeted. Endurance sports are generally characterized by the performance of "continuous aerobic exercise for prolonged durations" (Assa et al., 2018, p. 2) and include sports such as long-distance running, cycling, and cross-country skiing (Schwellnus et al., 2019). In endurance sports, pain is a common, salient, and meaningful component of training and competition (Fitzgerald, 2015; Roebuck et al., 2018; Simpson et al., 2014). A sample size of 200 was targeted because samples of this approximate size have been used in tests of moderation models involving pain catastrophizing and/or pain hypervigilance (e.g., Ginzburg et al., 2014; Kratz et al., 2012; Wong et al., 2015) and in tests of the 2 × 2 model of perfectionism in sport (e.g., Gaudreau & Verner-Filion, 2012; Mallinson et al., 2014). As such, it was expected that obtaining 200 participants would provide sufficient power to test the model specified in the present study.

As mentioned earlier (and described in more detail later in the procedures section), data was collected via a publicly-available online survey. Because the survey was publicly available, the student-researcher was not able to control who participated in the project. The student-researcher, however, was able to control whether or not certain participants' data was included in the subsequent analysis. In order for participants' data to be included in the study, they met four criteria. First, the participant was 16 years of age or older. Second, the participant trained in a consistent and systematic manner for an endurance sport; specifically, they had at least three training sessions per week that were devoted to improving performance in their sport. Third,

participants evaluated sport as personally meaningful and important.

Participants' data was excluded from the present study's analysis if they were dealing with injuries that would be exacerbated by completing an online survey and/or that may have jeopardized the validity of their responses (e.g., if they had an acute concussion or were experiencing post-concussion syndrome).

Instruments

Four instruments were used to assess pain catastrophizing, pain hypervigilance, perfectionism in the sport domain, and endorsement of the sport pain ethic. Demographics questions were always asked first while the remaining four instruments' order was randomized by the online program with the purpose of controlling for order effects.

Demographics

A questionnaire was developed by the student researcher to collect demographic information related to participants' personal characteristics, involvement in endurance sport, and experience with pain and injury. This questionnaire is presented in Appendix A. Questions pertaining to personal characteristics addressed topics such as age, gender identity, and home country ("What country would you call home?"). For their background in sport, participants were asked pertinent questions addressing topics such as their primary sport, current training regimen, and importance of their sport to self (1 = *not at all*; 5 = *very important*). Regarding injury status, participants were asked questions addressing topics including their current injury status, if they had any existing chronic conditions, and any injury-related performance restrictions (e.g., "To what degree does your current injury status restrict your ability to train for and compete in your sport?", 1 = *not restricted*; 5 = *completely restricted*). Finally, participants were asked to answer questions addressing topics such as the frequency of which pain was a

feature of their training and participation in competition, the degree of pain that was associated with any current injury(ies), and their self-perception of injury proneness (e.g., "To what extent do you consider yourself injury-prone?", 1 = *not at all*; 5 = *very much so*).

Pain Catastrophizing

A modified version of the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995; Sullivan, 2009) was used to measure the degree to which participants conducted catastrophic thinking in relation to the pain that they experienced through participation in their sport. This instrument is presented in Appendix B. The PCS is comprised of 13 items which correspond to three aspects of general pain catastrophizing including rumination (4 items; "I can't seem to keep it [pain] out of my mind"), magnification (3 items; "I become afraid that the pain will get worse"), and helplessness (6 items; "It's awful and I feel that it overwhelms me"). Responses to each item are based on a 5-point Likert scale (0 = *not at all*; 4 = *all the time*) and were summed to produce a total pain catastrophizing score, ranging from 0-52, where higher scores reflect higher levels of pain catastrophizing (Sullivan, 2009). The PCS is claimed to be the most commonly used measure of catastrophic thinking in relation to pain in general (Sullivan, 2009) and is reported to be reliable and valid. For example, among samples of athletes, PCS scores have shown appropriate factor structure, theoretically meaningful relationships with external constructs in the fear-avoidance model, and adequate levels of internal consistency (Dover & Amar, 2015; Sullivan, Tripp, et al., 2000).

The original design of the PCS was intended to assess one's degree of catastrophic thinking in relation to pain in general. For this study two modifications were applied to re-orient the instrument to assess one's degree of catastrophic thinking in relation to pain in sport. The first modification related to the instrument's instructions. In the original instrument, the

instructions refer to a broad spectrum of painful experiences (e.g., tooth pain, headaches, joint pain). In the present study, the instructions were modified to focus on pain that athletes experience when training or competing in sport. The second modification pertained to the item stem. The original reflects the instrument's ability to be generally applied across painful experiences, but in the present study, the stem was modified to emphasize focus on sport-based pain.

Pain Hypervigilance

A modified version of the Pain Vigilance and Awareness Questionnaire (PVAQ; McCracken, 1997) was used to assess participants' attentional vigilance to the pain they experienced through participation in their sport. This questionnaire is presented in Appendix C. The PVAQ is comprised of 16 items designed to assess the degree to which individuals have maintained focused attention on pain, including its onset, intensity, and changes in location (e.g., "I pay close attention to pain", "I am quick to notice changes in pain intensity", "I am quick to notice changes in location or extent of pain"). Respondents were asked to consider how frequently each statement was a true description of their behaviour over the last two weeks. Responses to each item were based on a 6-point Likert scale (0 = *never*; 5 = *always*) and were summed to produce a total pain hypervigilance score ranging from 0-80, where higher scores indicated higher levels of pain hypervigilance (McCracken, 1997; Roebuck et al., 2018). The PVAQ is reported to be reliable and valid in chronic pain populations. For example, PVAQ scores have shown theoretically meaningful relationships with external constructs in the Fear-Avoidance Model, been supported through confirmatory factor analysis, and demonstrated adequate test-retest reliability (Esteve et al., 2013; Kunz et al., 2017; Monticone et al., 2016; Roelofs et al., 2003). Although the PVAQ has rarely been utilized in sport-based research,

several recent studies have used it to assess pain hypervigilance among high performance athletes (see Kuppens et al., 2019; Roebuck et al., 2018).

The original PVAQ was intended to assess the degree of one's "awareness, consciousness, vigilance, and observation of pain" (McCracken, 1997, p. 276) over the two weeks prior to administration. In the present study, two modifications were applied so the instrument was able to assess one's general tendency to devote attention to pain that was associated with sport participation. First, the original instrument's items were worded to refer to pain in general. In the present study the items were edited slightly to refer to pain in relation to sport. For example, the original item "I am very sensitive to pain" was revised to read "I am very sensitive to pain that relates to my sport." Second, the original instrument asked respondents to indicate the frequency to which they exhibited behaviours reflecting pain hypervigilance over the previous two weeks. This orientation was reflected in the original instrument's response format (0 = *never*; 5 = *always*). In the present study, the two-week limitation was removed and different anchors were used in the response format (0 = *strongly disagree*; 5 = *strongly agree*) to encourage respondents to consider their general tendencies toward pain hypervigilance in their sport.

Perfectionism

The second version of the Sport Multidimensional Perfectionism Scale (SMPS-2; Gotwals et al., 2010) was used to measure perfectionism towards sport. This questionnaire is presented in Appendix D. The SMPS-2 is comprised of 42 items and six subscales. The personal standards perfectionism dimension is represented by two subscales including personal standards (7 items; "I have extremely high goals for myself in my sport") and organization (6 items; "I have and follow a pre-competitive routine"). The evaluative concerns perfectionism dimension is

represented by four subscales including concern over mistakes (8 items; “If I fail in competition, I feel like a failure as a person”), doubts about actions (6 items; “I usually have trouble deciding when I have practiced enough heading into a competition”), perceived parental pressure (9 items; “In competition, I never feel like I can quite meet my parents’ expectations”), and perceived coach pressure (6 items; “Only outstanding performance in competition is good enough for my coach”). Responses to each item are based on a 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*), where higher scores indicate higher levels of each dimension. The SMPS-2 is the most commonly used measure of perfectionism towards sport and is supported by evidence reporting considerable reliability and validity (Stoeber & Madigan, 2016). For example, among samples of athletes scores on the SMPS-2 have repeatedly demonstrated appropriate factor structure, adequate levels of internal consistency, and relationships with external constructs that are in line with 2 × 2 model of perfectionism (Gotwals et al., 2010; Hill et al., 2020).

The SMPS-2 is designed to measure perfectionism in team sport athletes (e.g., hockey, basketball, volleyball). Accordingly, some items contain words that are relevant within team sport contexts (e.g., “player”, “game”, “teammate”). Such wording, though, is not meaningful within endurance sport contexts. To address this, minor modifications were made to the wording in these items. For example, the item “If a team-mate or opponent (who plays a similar position to me) plays better than me during a competition, then I feel like I failed to some degree” was revised to read “If a team-mate, colleague, or opponent performs better than me during a race, then I feel like I failed to some degree”. Similarly, the item “If I play well but only make one obvious mistake in the entire game, I still feel disappointed with my performance” was revised to read “If I perform well but only make one obvious mistake in the entire race, I still feel disappointed with my performance”. The present study did not utilize the Perceived Parental

Pressure and Perceived Coach Pressure SMPS-2 subscales. The Perceived Parental Pressure subscale was not used because participants were 16 years of age or older, with many expected to be adults living away from their parents. To such athletes, the expectations and critical nature of their parents may not have been meaningful or relevant to their current perspective on achievement in sport. Additionally, since it was not guaranteed that all participants had coaches, the Perceived Coach Pressure subscale was omitted. As a result, the Personal Standards and Organization subscales were used to represent personal standards perfectionism and the Concern Over Mistakes and Doubts About Actions subscales were used to represent evaluative concerns perfectionism. In the present study, scores from these respective sets of subscales were first standardized and then aggregated to create proxies of the two perfectionism dimensions (Stoeber & Madigan, 2016).

Sport Pain Ethic Endorsement

There is no instrument specifically designed to measure personal endorsement of the ethic of pain in sport. In the present study, endorsement of this ethic was measured through a revised version of the Direct Coping subscale from the Sports Inventory for Pain (Meyers et al., 1992). The Direct Coping subscale assesses strategies that athletes can use to cope with the immediate experience of "pain, discomfort, and injury during competition, treatment, or rehabilitation" (Meyers et al., 2015, p. 1036). Bourgeois and colleagues (2009) suggested that "high scorers tend to ignore pain, realizes that pain is a part of competition, and in general, tends to 'tough it out'" (p. 20). There are currently two versions of the Direct Coping subscale including one that was developed for the original Sports Inventory for Pain (Meyers, Bourgeois, et al., 1992) and another that was developed for the Sport Inventory for Pain-15 (a revised and updated version of the original instrument; Bourgeois et al., 2009). The original version of the

Direct Coping subscale contains eight items. The updated version of the subscale contains seven items including four items from the original version of the subscale and three newly developed items. Items from both versions of the subscale are presented in Table 1. In both versions, the response format was on a 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*).

The strategies to cope with pain that are featured in the Direct Coping subscale appear to reflect central aspects of the pain ethic in sport. For example, the item "When injured, I just ignore pain" appears to reflect the belief that sport-based pain should be ignored (Weise-Bjornstal, 2010), the item "Pain is just a part of competition" appears to reflect normalization of sport-based pain (Brewer & Redmond, 2016), and the item "When injured, I tell myself to be tough and carry on" appears to reflect the belief that sport-based pain should be played through (Coakley, 2007). This suggests that with modification, items could be used to assess athletes' endorsement of the sport pain ethic. In particular, there appear to be 10 Direct Coping items that, similar to these examples, closely reflect central aspects of the sport pain ethic. These 10 items are presented in Table 1 and include all seven items from the newer version of the subscale and three from the original version that were not carried over when updating the instrument. These items were found to accurately reflect themes from the sport pain ethic which were not represented in the newest version. In the present study, the 10 COP items identified in Table 1 were re-oriented and modified to measure endorsement of the sport pain ethic. Table 1 juxtaposes the original COP items against the modified versions that were used in this thesis. There were three general modifications to take note of. The first concerns the fact that COP items reflect coping strategies that individual athletes personally take to deal with the pain they experience in sport. To represent endorsement of an ethic (Coakley, 2007), these items were re-oriented to reflect attitudes and "norms [that] are accepted uncritically, without question or

qualification, and often followed without recognizing limits" (p. 163). For example, the Direct Coping item that reads "When in pain, I tell myself that it doesn't hurt" were modified to read "When athletes feel pain, they should tell themselves it doesn't hurt." The second general modification concerns the fact that several Direct Coping items refer specifically to being "hurt" or "injured" and do not refer to the pain associated with those conditions. This limits the scope of these items as pain can be experienced in many aspects of sport beyond injury. The third general modification was a new item stem, "I believe that…" to reflect one's personal belief of these statements. The present study adopted a broader perspective and focused on pain associated with sport participation in general. Accordingly, the present study's references to being hurt or injured were replaced with statements that refer to athletes' experiences of pain in general. For instance, the Direct Coping item that reads "When injured, I tell myself to be tough and carry on" was modified to read "When athletes feel pain, they should tell themselves to be tough and carry on."

Hereafter, the 10 Direct Coping items modified for use in the present study were collectively referred to as the Sport Pain Ethic Endorsement Scale (SPEES). The full instrument is presented in Appendix E. As indicated, responses to each item were based on a 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*) with scores ranging from 1-50. Higher SPEES scores are intended to indicate a greater degree of endorsement of the sport pain ethic. Given the extent of modifications applied to Direct Coping items to create the SPEES, the scale should be considered an exploratory instrument that is in need of psychometric evaluation.

Procedure

Participant Recruitment

After receiving ethical approval from the Lakehead University Research Ethics Board, several recruitment strategies were used to recruit prospective participants. Convenience and

purposive sampling were used by promoting the study through social and physical media, accessing potential participants through gatekeepers, and recruiting potential participants directly. A gatekeeper was thereafter defined as any individual who had regular access to endurance athletes currently engaging in training or competition (e.g., athletic trainers, coaches, event organizers). Gatekeeper(s) were provided with a script (see Appendix F) and an information letter (see Appendix G) that described the study and asked for their cooperation in recruiting potential participants. More specifically, gatekeepers were asked to use the script provided to help identify potential participants who fit the inclusion criteria and facilitated the student-researcher's ability to connect with those potential participants over email. A promotional poster (see Appendix H) was shared via email to gatekeepers and potential participants and posted with permission from local businesses where athletes frequented (i.e., physiotherapy office). A promotional video was shared via email to gatekeepers and potential participants, where the research team encouraged its distribution along with the survey link and poster.

Potential participants and gatekeepers were sought after, if they were a part of, represented, or had connections to athletes in, endurance sport clubs, training programs, or other unofficial organizations, or were known by the research team to have met the inclusion criteria for eligibility.

Lastly, snowball sampling was also used to recruit potential participants. During recruitment, potential participants were asked to identify other athletes who met the inclusion criteria and to facilitate the student researcher's ability to connect with those athletes to share information about the study. A small incentive was offered to participants in the form of a draw to win one of four $25 (CAD) VISA gift cards.

Data Collection

SurveyMonkey®, an online cloud-based survey tool, was used to administer processes associated with obtaining informed consent and collecting data. As a first step, prospective participants were given the opportunity to review the present study's information letter (see Appendix J). They were subsequently presented with an informed consent form (see Appendix H) and were asked to indicate their informed consent to take part in the study. Next, participants were asked to complete and submit the demographics questionnaire, followed by the PCS, PVAQ, SMPS-2, and SPEES. The order of those latter four questionnaires were randomized to control for order effects. It was estimated that completing the entire set of questionnaires would take approximately 20 minutes of a participant's time; SurveyMonkey reported Typical Time Spent as 13 minutes and 9 seconds. Once participants responses were submitted, they received a message of gratitude for their participation and a link to click if they wanted to enter a draw to win one of four $25 (CAD) VISA gift cards.

Data Analysis

The model represented by the present study's purpose and hypotheses represents a case of moderated moderation (Hayes, 2018). Multiple regression was the statistical tool used to test this model. Analyses were conducted in line with guides on testing the 2 × 2 model of perfectionism (Gaudreau, 2012; Gaudreau & Thompson, 2010) and current perspectives using multiple regression to test and explore (moderated) moderation models (e.g., Hayes, 2018). The data analysis was conducted through version 25 of the Statistical Package for the Social Sciences (SPSS) in conjunction with the PROCESS macro, developed by Hayes (2018).

Two sets of analyses (see Figures 3 and 4) were conducted, where one had pain catastrophizing as the outcome variable and the other had pain hypervigilance as the outcome

variable. In each set, personal standards perfectionism was the predictor variable and evaluative concerns perfectionism and sport pain ethic endorsement were the moderator variables. If significant moderation effects were detected, then effects would have been probed through visual depiction, simple slope analyses, and/or the Johnson-Neyman technique. If evaluative concerns perfectionism and/or sport pain ethic endorsement were not shown to be significant moderators, then the interaction terms involving those variables would be iteratively removed and the analyses would be re-run with a focus only on main effects. In these cases, the main effects of personal standards perfectionism and evaluative concerns perfectionism would be used to make statistical inferences about hypotheses based on the 2 × 2 model of perfectionism (Gaudreau, 2012). All findings were interpreted in line with the perspective that pain catastrophizing and pain hypervigilance are negative, dysfunctional, and maladaptive outcomes.

Results

Preliminary Analyses

Screening for Inclusion Criteria Violations

There were 339 participants who responded to at least one item in the present study's survey. As previously stated, the student-researcher had no control over who filled out the survey and could only remove inappropriate or irrelevant responses after the fact. The first step in the preliminary analyses was to screen the dataset produced by this sample for participants who did not meet the study's inclusion criteria based on their responses to the participant pre-screening instrument (see Appendix L) and the demographics questionnaire (see Appendix A). Three such participants were identified; one indicated that they were not yet 16 years old, one indicated they had a health condition which jeopardized the quality and accuracy of their responses, and one indicated they did not find that taking part in endurance sport was important and meaningful to

them. These three participants were removed from the dataset. Subsequent screening identified 25 participants who reported no prior experience competing in their endurance sport and one participant who did not identify their degree of past competitive experience. Past competitive experience was not originally included as a requirement for participation in the study; however, many items from the SMPS2 ask respondents to consider how they think, feel, and behave in relation to competition (see Appendix D). It is questionable whether athletes who had no past competitive experience could provide valid responses to such questions. As a result, these 26 participants were removed from the dataset. Altogether, this screening process resulted in a dataset comprised of responses from 310 participants.

Addressing Missing Data

The next step in the preliminary analyses process was to identify participants with excessive missing data. In this study, participants were defined as having excessive missing data if they were missing responses to every item within one or more of the questionnaires that represented the study's primary variables (i.e., the PCS, PVAQ, SMPS2, and SPEES). Based on this criterion, 91 participants were identified as having excessive missing data. These participants were excluded from the dataset. In the resulting sample of 219 participants, the amount of missing data points within the primary variable questionnaires was very small (i.e., 51 instances of missing data points out of a total of 14,454 or 0.35%; Tabachnik & Fidell, 2013). Little's Missing Completely at Random test was performed to determine if this missing data was missing in a predictable or random manner. The result of the test was not significant ($x^2(1209, N = 219) = 1167.77, p = .79$) indicating that the data were indeed missing completely at random. Expectation-Maximization was then used to impute values for these missing data points.

Primary Variables: Creation, Evaluation, and Inter-Relationships

Variables representing each of the study's primary constructs were then created. Variables representing pain catastrophizing and pain hypervigilance were created by respectively totalling responses to the PCS and PVAQ. Variables representing lower-order perfectionism facets and sport pain ethic endorsement were created by calculating mean item scores for the SMPS2 subscales and the SPEES. Next, variables representing the higher-order perfectionism dimensions of personal standards perfectionism and evaluative concerns perfectionism were created. Following recommendations by Stoeber and Madigan (2016), this was done by first standardizing and then aggregating subscale scores representing lower-order facets of each dimension. As indicated in the instruments sub-section of the method section, the organization and personal standards subscales were standardized and aggregated to represent personal standards perfectionism and the concern over mistakes and doubts about actions subscales were standardized and aggregated to represent evaluative concerns perfectionism. Table 2 presents descriptive statistics, distributional characteristics, and internal consistency estimates (in the form of Cronbach's alphas) for the study's primary variables. As indicated, all internal consistency estimates were greater than .70 suggesting that each instrument/subscale demonstrated adequate internal consistency (Nunnally & Bernstein, 1994).

Table 3 presents the bivariate correlations between primary variables. As indicated, pain catastrophizing showed a moderate positive relationship with evaluative concerns perfectionism and a moderate positive relationship with pain hypervigilance. Pain hypervigilance showed a small positive relationship with personal standards perfectionism and a small negative relationship with sport pain ethic endorsement. Further, personal standards perfectionism showed small positive relationships with evaluative concerns perfectionism and both perfectionism dimensions showed small positive relationships with sport pain ethic endorsement.

Outlier Analysis

The final step in the preliminary analysis process was to screen the dataset for outliers. Potential univariate outliers, via standardized scores, were screened first. Participants were defined as univariate outliers if they had z-scores across any of the predictor (Evaluative Concerns Perfectionism), moderator (Personal Standards Perfectionism, Sport Pain Ethic Endorsement), or outcome (Pain Catastrophizing, Pain Hypervigilance) variables that were outside the range of ±3.29 (Tabachnik & Fidell, 2013). Based on this definition, no participants qualified as univariate outliers. Participants were defined as multivariate outliers across the predictor (Evaluative Concerns Perfectionism) and moderator (Personal Standards Perfectionism, Sport Pain Ethic Endorsement) variables if the probability of their Mahalanobis' D^2 score was less than .001 (Tabachnik & Fidell, 2013). No participants met this criterion. As a result, data from all participants (N = 219) were carried forward for further analysis.

Participants

Among the 219 participants in the final dataset, 134 identified as male, 84 identified as female, and one chose not to specify. The mean age of the participants was 38.34 years (SD = 16.08). The participants reported a variety of sports as their primary endurance sport, including running (35.6%), cycling (21.0%), cross-country/nordic skiing (21.0%), or a sport that combined one or more of these sports (e.g., triathlon, 12.8%). Participants reported an average of 15.43 years (SD = 11.31 years) of experience in their sport, on average took part in 6.79 (SD = 2.66) training sessions per week, and, tended to train in Canada (93.2%). In terms of the highest past level of competition, 46.6% had competed at the city or provincial/state level and 52.5% competed at the national, continental, or world level. In terms of their present or upcoming season, the participants were relatively evenly spread between the city level (18.7%), the

provincial/state level (24.7%), the national level (24.7%), and the continental/world level (22.4%), while a minority (8.2%) did not intend to compete. The vast majority of participants (98.6%) rated their endurance sport as being important or very important to them and 84.1% of them indicated that it was important or very important to perform well in their sport. Based on this information, the average participant appeared to be an experienced, active, and dedicated Canadian-based endurance athlete who placed high personal value on engaging and performing well in their primary endurance sport.

In terms of their experience with injury and pain, the vast majority of participants were either currently uninjured or only slightly injured (90.0%), reported being unrestricted or just slightly restricted by their injuries (83.1%), and shared that their current injuries caused them little-to-no pain (75.8%). Most participants (68.5%) did not report any chronic conditions that caused them pain when training or competing in their sport. Among the 31.1% that did report chronic conditions, athletes generally reported that their condition caused them "some pain" (M = 2.88, SD = 0.663) when training or competing. Perhaps most importantly, all of the participants reported that pain was a feature of their training and racing, with 57.9% indicating that this feature was frequent or very much. Altogether, this information suggests that while most participants were not currently or chronically dealing with painful injuries, they were often exposed to pain through their engagement in endurance sport.

Primary Analyses

Predicting Pain Catastrophizing

As indicated in the introduction and method sections, this study's purpose and hypotheses reflected a moderated moderation model (Hayes, 2018) with evaluative concerns perfectionism as the predictor variable, and personal standards perfectionism and sport pain ethic endorsement

as the moderator variables. Multiple regression was used to test how well that model predicted pain catastrophizing and pain hypervigilance. Regarding the prediction of pain catastrophizing, the model explained a significant amount of variance (R^2 = 0.23, *MSE* = 65.90, $F(7, 211)$ = 10.41, $p < .001$). Table 4 presents the coefficients for every variable in the model along with the results from associated tests of significance. The coefficient for the three-way interaction was significant (β = -2.12, $p < .05$), supporting the presence of moderated moderation. This suggests that the influence of personal standards perfectionism on the effect of evaluative concerns perfectionism on pain catastrophizing was itself conditional on sport pain ethic endorsement. Figure 3 presents a visual representation of this model. The Johnson-Neyman technique indicated that the interaction between evaluative concerns perfectionism and personal standards perfectionism transitioned between not statistically significant to significant when scores for sport pain ethic endorsement were ≥ 4.28 (see Figure 5). To put this transition value into perspective, scores for sport pain ethic endorsement had a potential range of 1.00 – 5.00; in the present sample, 97.26% of participants had sport pain ethic endorsement scores below 4.28 and only 2.74% (or approximately six participants) scored at or above that level. In other words, the region along the distribution of sport pain ethic endorsement where the interaction between evaluative concerns perfectionism and personal standards perfectionism was significant was backed by data from a very small number of participants. In such cases, Hayes (2018) stated that they "would be somewhat reluctant" to interpret the interaction given that "there are simply not enough data in this end of the distribution" (p. 259). In the present case, caution may be especially warranted given that the instrument used to measure sport pain ethic endorsement (i.e., the SPEES) was an exploratory, designed specifically for this thesis, and not backed by previously established evidence of reliability and validity. As a result, it was decided that the

present model of moderated moderation was not sufficiently supported by the data to warrant interpretation. In line with the iterative process outlined in the data analysis sub-section of the method, the regression was then repeated with the three-way interaction term between evaluative concerns perfectionism, personal standards perfectionism, and sport pain ethic endorsement removed from the analysis.

With the three-way interaction term removed, the tested model reflected a case of additive multiple moderation in that, evaluative concerns perfectionism served as the predictor variable and personal standards perfectionism and sport pain ethic endorsement each served as individual moderator variables (Hayes, 2018). Here, sport pain ethic endorsement acts as its own individual moderator variable for the relationship between evaluative concerns perfectionism and pain catastrophizing and its moderator relationship with personal standards perfectionism was not included in the analysis. The model explained a significant amount of variance in pain catastrophizing ($R^2 = 0.21$, $MSE = 65.90$, $F(5, 213) = 11.82$, $p < .001$). Table 5 presents the coefficients, along with the associated tests of significance, for each variable in the model. The coefficient associated with the two-way interaction between evaluative concerns perfectionism and sport pain ethic endorsement was not significant ($\beta = -0.75$, $p > .05$). This study conceptualized sport pain ethic endorsement as a moderator of the perfectionism–pain catastrophizing relationship, but not as a distinct predictor of pain catastrophizing. The present findings, though, do not support that moderating role. As a result, the regression analysis was repeated with the two-way interaction term between evaluative concerns perfectionism and sport pain ethic endorsement and the term representing the individual effect of sport pain ethic endorsement removed from the analysis.

Having removed sport pain ethic endorsement as a moderator and individual predictor, the subsequent model represented a case of simple moderation (Hayes, 2018) with evaluative concerns perfectionism as the predictor and personal standards perfectionism serving as the sole moderator. The model explained a statistically significant amount of variance in pain catastrophizing ($R^2 = 0.18$, $MSE = 67.34$, $F(5, 213) = 14.87$, $p < .001$). Table 6 presents the coefficients and associated tests of significance for each of the model's variables. There were no significant two-way interaction between evaluative concerns perfectionism and personal standards perfectionism ($\beta = 0.20$, $p > .05$). As a result, the regression analysis was repeated with evaluative concerns perfectionism and personal standards perfectionism retained as individual predictors and sport pain ethic endorsement omitted.

The resulting model reflected a test of the main effects of personal standards perfectionism and evaluative concerns perfectionism (Hayes, 2018). The model (see Figure 6) explained a significant amount of variance in pain catastrophizing ($R^2 = 0.18$, $MS = 67.03$, $F(2, 218) = 22.75$, $p < .001$). Coefficients and additional results from the test of main effects are presented in Table 7. The coefficient associated with evaluative concerns perfectionism was significant and positive ($\beta = 4.81$, $p < .001$), whereas the coefficient associated with personal standards perfectionism was not significant ($\beta = -0.31$, $p > .05$). Collectively, these results indicated that for any level of personal standards perfectionism increases in evaluative concerns perfectionism were associated with increases in pain catastrophizing.

In line with Gaudreau (2012), Figure 6 illustrates the results of the main effects regression analysis within the context of the 2 × 2 model of perfectionism and identifies whether the results support each of the model's hypotheses. The non-significant main effect for personal standards perfectionism suggested that pure personal standards perfectionism and non-

perfectionism showed similar associations to pain catastrophizing. This supported H1c. The same finding suggested that pure evaluative concerns perfectionism was associated with similar levels of pain catastrophizing when compared with mixed perfectionism. This did not support H3. The significant positive main effect for evaluative concerns perfectionism suggested that pure evaluative concerns perfectionism and mixed perfectionism were associated with higher levels of pain catastrophizing in comparison to non-perfectionism and pure personal standards perfectionism, respectively. This respectively supported H2 and H4.

Predicting Pain Hypervigilance

The same iterative multiple regression process used to test the prediction of pain catastrophizing was used to test the prediction of pain hypervigilance. The first tested model reflected moderated moderation with evaluative concerns perfectionism serving as the predictor variable and personal standards perfectionism and sport pain ethic endorsement as moderator variables. The model explained a significant amount of variance in pain hypervigilance (R^2 = 0.08, MSE = 114.43, $F(7, 211) = 2.70$, $p < .05$). Table 8 presents the coefficients for every variable in the model along with results from the associated tests of significance. The coefficient for the three-way interaction was not significant ($\beta = -0.96$, $p > .05$), meaning that personal standards perfectionism's influence on evaluative concerns perfectionism's effect on pain hypervigilance was not conditional on sport pain ethic endorsement. As a result, the regression was repeated with the three-way interaction term between evaluative concerns perfectionism, personal standards perfectionism, and sport pain ethic endorsement removed from the analysis.

The resulting model reflected a case of additive multiple moderation (Hayes, 2018), where evaluative concerns perfectionism acted as the predictor variable and personal standards perfectionism and sport pain ethic endorsement served as the moderator variables. The model

explained a significant amount of variance in pain hypervigilance (R^2 = 0.08, *MSE* = 113.67, $F(5, 213) = 3.03$, $p = .01$). Table 9 presents the coefficients and associated tests of significance from the test of additive multiple moderation. There was no significant two-way interaction between evaluative concerns perfectionism and sport pain ethic endorsement ($\beta = -1.82$, $p > .05$). In line with the analytical approach adopted when pain catastrophizing served as the outcome variable, the regression analysis was repeated with sport pain ethic endorsement removed from the analysis as a moderator and predictor variable.

The tested model now reflected a case of simple moderation (Hayes, 2018); evaluative concerns perfectionism and personal standards perfectionism acted as the predictor and moderator, respectively. The model did not explain a statistically significant amount of variance in pain hypervigilance (R^2 = 0.04, *MSE* = 118.05, $F(3, 215) = 2.09$, $p > .05$). Table 10 presents the coefficients and associated tests of significance for the simple moderation model. There was no significant two-way interaction between evaluative concerns perfectionism and personal standards perfectionism ($\beta = 0.10$, $p > .05$). As a result, the regression analysis was repeated with evaluative concerns perfectionism and personal standards perfectionism as individual predictors and sport pain ethic endorsement removed as a moderator and predictor variable.

With evaluative concerns perfectionism and personal standards perfectionism serving as predictors, the model reflected a test of the main effects (Hayes, 2018). The resulting equation explained a significant amount of variance in pain hypervigilance (R^2 = 0.04, *MS* = 117.51, $F(2, 218) = 3.12$, $p < .05$); coefficients and associated tests of significance are presented in Table 11 for the test of main effects. The coefficient associated with personal standards perfectionism was significant and positive, ($\beta = 2.50$, $p < .05$), while the coefficient associated with evaluative concerns perfectionism was not significant ($\beta = -0.50$, $p > .05$). In other words, this indicated that

for any value of evaluative concerns perfectionism, increases in personal standards perfectionism were associated with increases in pain hypervigilance.

Figure 7 illustrates these results and identifies whether the four hypotheses of the 2 × 2 model of perfectionism were supported (Gaudreau, 2012). First, pure personal standards perfectionism exhibited worse outcomes when compared with non-perfectionism on pain hypervigilance, supporting H1b. Next, non-perfectionism and pure evaluative concerns perfectionism did not significantly differ on pain hypervigilance, which was not in support of H2. In comparison to mixed perfectionism, pure evaluative concerns perfectionism was associated with lower levels of pain hypervigilance, which did not support H3, in fact, it directly contradicted its expectations. Finally, H4 was not supported either, such that mixed perfectionism and pure personal standards perfectionism were not associated with significantly different levels of pain hypervigilance.

Discussion

The present study's purposes were to examine the relationships between perfectionism and pain catastrophizing and pain hypervigilance among endurance athletes and to test whether endorsement of the sport pain ethic moderated those relationships (see Figures 3 and 4). With the hypotheses from the 2 × 2 model as a foundation, findings were expected to fall in line with H1b and H2, such that pure personal standards perfectionism and pure evaluative concerns perfectionism would, respectively, show stronger positive relationships with pain catastrophizing and pain hypervigilance in comparison to non-perfectionism. Concerning H3 and H4, mixed perfectionism would show weaker relationships with pain catastrophizing and pain hypervigilance in comparison to pure evaluative concerns perfectionism and stronger relationships in comparison to pure personal standards perfectionism. Lastly, with sport pain

ethic endorsement as a moderator, it was expected that comparative relationships between perfectionism and pain catastrophizing and pain hypervigilance would be exacerbated when sport pain ethic endorsement was low, and inhibited when sport pain ethic endorsement was high. These hypotheses were tested through analysis of self-report data provided by 219 endurance athletes, mostly comprised of experienced, dedicated, actively participating, Canadian-based individuals who viewed high performance and engagement in their primary sport as personally valuable. Implementing an iterative multiple regression analysis process revealed a main effect for evaluative concerns perfectionism in relation to pain catastrophizing and a main effect for personal standards perfectionism in relation to pain hypervigilance. Regarding sport pain ethic endorsement as a moderator, there was no evidence to support it in such a role in the relationship between perfectionism and pain cognitions. In the following sections, these results are discussed in relation to past research focused on both the 2 × 2 model's hypotheses and that which investigated the relationships between multidimensional perfectionism and pain catastrophizing and pain hypervigilance.

Perfectionism and Pain-Related Cognitions

The Relationship Between Perfectionism and Pain Catastrophizing

As previously stated, a positive main effect was found for evaluative concerns perfectionism as related to pain catastrophizing. Pain catastrophizing has shown to have associations with negative long-term implications (Sullivan et al., 2002; Vlaeyen & Linton, 2000, 2012) and was described as an exaggerated, negative focus on pain sensations eliciting ruminative pain-related thoughts, feelings of helplessness, and magnification of the threat value of pain (Sullivan, Tripp, et al., 2000, 2001; Sullivan et al., 1995). Given this, the finding supported the 2 × 2 model's H2 and H4, meaning that pure evaluative concerns perfectionism

was associated with worse outcomes than non-perfectionism, and that mixed perfectionism was associated with worse outcomes than pure personal standards perfectionism.

The present study represents the first which investigated the relationship between multidimensional perfectionism and measures of pain catastrophizing among endurance athletes. Though the literature presented one other study examining this relationship among 239 pairs of children living with chronic pain and their parents, Randall and colleagues (2018) also produced results which would support H2 and H4. Considering the existing supportive trends for each hypothesis of the 2 × 2 model, these findings align with approximately 94% of occasions for both H2 and H4 (Hill et al., 2020). The results of the present study reinforce those trends by indicating that, of the four perfectionism subtypes, mixed perfectionism and pure evaluative concerns perfectionism showed the strongest relationship to the tendency to catastrophize about pain experienced through training and competing in endurance sport.

In being the first study to examine multidimensional perfectionism's relationship with pain catastrophizing among endurance athletes, it is imperative to replicate the methods used. In doing so, there comes an opportunity to examine a potential mechanism or mediator behind the observed relationship between evaluative concerns perfectionism and pain catastrophizing. A potential mediator highlighted in the literature was fear of failure (Flett et al., 2007). Fear of failure has shown some significant relationships with perfectionism on several other occasions in sport (i.e., Elison & Patridge, 2012; Frost & Henderson, 1991; Sagar & Stoeber, 2009). Specifically, the trends suggested that the fear of failure exhibits a positive relationship with evaluative concerns perfectionism (Correia et al., 2018). In sport, pain can commonly be interpreted as a sign that performance goals are in jeopardy (Bardel et al., 2013); in other words, athletes often interpret pain as a signal of impending failure. So, endurance athletes who report

high fear of failure should also have the tendency to catastrophize about pain. Considering the present study's findings, the positive relationship between pure evaluative concerns perfectionism and mixed perfectionism with pain catastrophizing could in part be explained by each of the subtypes' propensity to experience fear of failure. Research focused on replication may help more firmly establish the relationship between evaluative concerns perfectionism's association to pain catastrophizing. Additionally, further investigation into potential mediators may illuminate the underlying mechanism behind their relationship.

The Relationship Between Perfectionism and Pain Hypervigilance

A positive main effect was found for personal standards perfectionism in the prediction of pain hypervigilance. When applied to the 2 × 2 model's subtypes, this suggested that pure personal standards perfectionism (which is defined by high levels of personal standards perfectionism) was more strongly associated with pain hypervigilance than non-perfectionism (which is defined by low levels of personal standards perfectionism). Pain hypervigilance reflects excessive selective attention for pain-related information (Crombez et al., 2007) and is associated with a host of negative outcomes, including maintenance of pain and injury (Todd et al., 2018; Van Damme et al., 2004), increased emotional distress (Roelofs et al., 2003; Todd et al., 2018), and more pain-focused visits to the physician's office (Roelofs et al., 2003). As a result, the present findings support the 2 × 2 model's H1b: namely, that pure personal standards perfectionism is associated with worse outcomes in comparison to non-perfectionism.

The scenario where pure personal standards perfectionism was significantly associated with worse outcomes in comparison to non-perfectionism is relatively rare (approximately 30% of the time in sport-based research according to Hill et al., 2020). Gaudreau and colleagues (2018) and Hill and colleagues (2020) suspected that comparisons between pure personal

standards perfectionism and non-perfectionism may depend on moderating factors. For example, according to Gaudreau et al. (2018), individuals exhibiting pure personal standards perfectionism may be more susceptible or sensitive to the influences of the environment than others. In a supportive or everyday life environment, pure personal standards perfectionism should be significantly associated with better outcomes in comparison to non-perfectionism, as in, support for H1a. On the other hand, in a scenario of "profound or chronic distress (e.g., when stressors accumulate or disturb the normal functioning of individuals)" (p. 61), pure personal standards perfectionism should be significantly associated with worse outcomes in comparison with non-perfectionism, supporting H1b (Gaudreau et al., 2018). Of note, our sample reported pain as being a frequent feature of their training and/or racing and reported training approximately 6.79 (*SD* = 2.662) times a week. In the present sample, this suggested that the experience of pain during training and competition may have been a source of chronic stress. Perhaps this is why, in the present sample, pure personal standards perfectionism was found to be more significantly associated with a worse outcome (i.e., pain hypervigilance) in comparison to non-perfectionism. To test this contention, future research could replicate the current study within sports that differ in the degree to which pain is a salient feature of training or competing (e.g., tennis versus running versus football). Such research would shed light on the relative degree to which, and under which conditions, perfectionism is linked with enhanced attentiveness to pain (Gaudreau et al., 2018) and would reinforce that perfectionism is a double-edged sword (Stoeber, 2011).

It is interesting to note that evaluative concerns perfectionism showed no association with pain hypervigilance; the results showed no significant correlation between evaluative concerns perfectionism and pain hypervigilance and a non-significant main effect in the prediction of pain hypervigilance. In contrast, it was initially expected that evaluative concerns perfectionism

would be significantly associated with pain hypervigilance, as it has typically been framed as maladaptive (Crombez et al., 2005). This presents a conundrum where, if evaluative concerns perfectionism tends to be consistently associated with maladaptive outcomes (Hill et al., 2020), and if both pain catastrophizing and pain hypervigilance supposedly reflect maladaptive cognitive tendencies (Crombez et al., 2005; Sullivan, Tripp, et al., 2000), then it brings into question why evaluative concerns perfectionism was positively related to one and not the other.

Furthermore, in endurance sport, catastrophizing about pain appears counterintuitive to training and competing (Simpson et al., 2014), though being hyperattentive to pain-related information may have more beneficial qualities (Becker et al., 2018). While pain is biologically designed to interfere with cognitive processes, capture attention, and interrupt behaviour to prioritize escape from danger or physical harm (Crombez et al., 2012; Van Damme et al., 2004), athletes may find it beneficial to be aware of changes in pain levels or location (Bardel et al., 2013). In particular, pain may be considered adaptive for warning an athlete about impending or actual injury or that one's threshold for optimal training outcomes has been met (Bardel et al., 2013). If this contention is valid, it may help to explain the present pattern of findings. That is, given that evaluative concerns perfectionism tends only to be associated with negative outcomes and that in endurance sport, pain catastrophizing is a negative cognitive process, but that pain hypervigilance is considered beneficial, it could make sense as to why evaluative concerns perfectionism was significantly related to pain catastrophizing, and yet unrelated to pain hypervigilance. Future research could examine this contention through examining cognitive task performance among endurance athletes in experimental pain or potential changes in long-term susceptibility that pain hypervigilance shows with injury susceptibility among this population.

Sport Pain Ethic Endorsement

Results pertinent to sport pain ethic endorsement were expected to show that it moderated the relationships perfectionism shared with pain catastrophizing and pain hypervigilance. While these expectations fell short with regards to pain hypervigilance, the hypothesis about pain catastrophizing was supported; more specifically, the influence of personal standards perfectionism on the effect of evaluative concerns perfectionism on pain catastrophizing was conditional on sport pain ethic endorsement. This moderation effect, however, was only present at very high levels of sport pain ethic endorsement (specifically, at or above 4.28 on a scale of 1.00 to 5.00 on the SPEES). A very small portion of the present sample (2.74%) scored in this range. Since this moderation effect was backed by such a small amount of data, it was decided that interpreting it would be inappropriate (Hayes, 2018). Future research could further investigate the validity of this potential effect by replicating the present study within sports where high levels of sport pain ethic endorsement are suspected to be common (e.g., basketball, American football, or professional car racing; Coakley, 2007).

Before investigating too much further into sport pain ethic endorsement as a moderator of another relationship, it must be recognized that the SPEES is a new instrument. No other instrument appears to exist which measures one's endorsement of the sport pain ethic, so it was necessary to create one based off of the existing instruments designed to assess similar constructs. As a result, it is unclear if the present results are because sport pain ethic endorsement was not a meaningful moderator or because the SPEES did not reliably or validly assess that construct. In that respect, the present study did produce some evidence that supported the reliability and validity of scores produced from the SPEES. For example, in the present study the SPEES showed high levels of internal consistency ($\alpha = .93$). The study also produced evidence of concurrent validity via significant correlations between the SPEES and other primary

variables. Specifically, pain hypervigilance correlated negatively with sport pain ethic, which was expected since pain hypervigilance is denoted by extreme vigilance for pain-related signals while the sport pain ethic encourages athletes to ignore the pain they experience while training and competing. Additionally, sport pain ethic endorsement correlated positively with evaluative concerns perfectionism, which was also expected since those who report high degrees of evaluative concerns perfectionism are often overly concerned with the ramifications of failure (Flett & Hewitt, 2005), and pain's commonly foreboding interpretation of failure (Bardel et al., 2013). Athletes reporting high degrees of evaluative concerns perfectionism would therefore be likely to endorse aspects of the sport pain ethic, such as ignoring pain and accepting pain as a part of sport.

Future research should expand the psychometric evaluation of the SPEES. This could include exploring the reliability and validity of the instrument's scores through other forms of evidence. For example, the reliability of the SPEES could be supported through test-retest reliability—testing one group's response consistency over time. Content validity evidence could be supported through expert review of the items comprising the SPEES to be reflective of the sport pain ethic. Finally, construct validity of the SPEES could be supported through careful examination of participants' responses, as in, considering one's response process involved in responding to this new measure (Furr & Bacharach, 2008). Such evidence would help researchers judge how much faith they can have in the SPEES as a measure of sport pain ethic endorsement.

Limitations and Future Directions

A number of limitations and suggestions for future research have already been discussed. Several others are worth noting. One is that the present study is limited to the specific models

tested. In those models, pain catastrophizing and pain hypervigilance served as distinct outcomes. The Fear-Avoidance Model positioned the two constructs as being sequentially related. Specifically, the avoider pathway showed that individuals perceive pain as a catastrophe and, as a result, become hypervigilant for potentially painful movements. This suggests an alternative model that could have been tested in which the relationship between perfectionism and pain hypervigilance is mediated by pain catastrophizing. Future researchers may want to recognize the theoretical connection between pain catastrophizing and pain hypervigilance and reflect this connection in the models they propose and test.

The present study used a cross-sectional design and assessed athletes' general perceptions of the degree to which they catastrophized about pain and were hypervigilant to pain when training and competing. This limits the study in two ways. First, due to the cross-sectional design it would not be appropriate to infer that perfectionism caused any levels of pain catastrophizing or pain hypervigilance. Second, athletes' general perceptions of pain catastrophizing and pain hypervigilance may not be as predictive as the levels they actually experience in relation to a specific event. To address these limitations, future research may use a quasi-experimental design in which perfectionism is assessed prospectively and then related to the levels of pain catastrophizing and pain hypervigilance that athletes experience in relation to a specific race or challenging training session.

Lastly, the present study was limited by the fact that participants were from a wide variety of endurance sports (e.g., ultramarathon, cross-country skiing, and rowing). As a result, it is not clear if the findings generalize to any one specific endurance sport. To best address this limitation, it may be warranted to replicate the present study within specific endurance sports and compare findings to see the degree to which trends emerge across sports.

Conclusion

The purpose of this study was to examine relationships that perfectionism showed with pain catastrophizing and pain hypervigilance among endurance athletes and to test whether endorsement of the sport pain ethic moderated those relationships. Within a sample of experienced, active, and dedicated athletes from a wide-variety of endurance sports, the findings indicated that pure evaluative concerns perfectionism and mixed perfectionism were associated with relatively higher levels of pain catastrophizing, that pure personal standards perfectionism was associated with relatively higher levels of pain hypervigilance, and that these levels were not influenced by the degree to which athletes endorsed the ethic of pain in sport. The study was the first to examine the relationship between perfectionism and pain catastrophizing among athletes and the first to examine the relationship between perfectionism and pain hypervigilance among any population. With such a limited amount of evidence, it would not be prudent to make recommendations regarding the practical application of the present findings. As it has been repeatedly emphasized throughout the discussion, replication of the study is necessary before such recommendations could be made. As such, future researchers are encouraged to re-examine the relationships between perfectionism, pain catastrophizing, and pain hypervigilance using prospective designs that target specific competitions, within sports that vary in the degree to which pain is salient during training and competition, and after further investigating the reliability and validity of measuring endorsement of the pain ethic in sport.

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Table 1

Item Development for the Sport Pain Ethic Endorsement Scale

Original COP Items	COP Items Modified for the SPEES
Items from the SIP-15	
I owe it to myself and those around me to perform even when my pain is bad.	Athletes owe it to themselves, and to those around them, to perform even when doing so comes with a lot of pain.
When in pain, I tell myself that it doesn't hurt.	When athletes are in pain, they should tell themselves that it doesn't hurt.
When I am hurt, I just go on as if nothing happened.	When athletes feel pain, they should just go on as if nothing happened.
When injured, I tell myself to be tough and carry on.	When athletes feel pain, they should tell themselves to be tough and carry on.
When hurt, I tell myself I can't let pain stand in the way of what I do.	Athletes can't let pain stand in the way of what they do.
When injured, I just ignore pain.	Athletes should just ignore pain.
I do not allow pain to interfere with my performance.	Athletes should not allow pain to interfere with their performance.
Items from the SIP that were not included in the SIP-15	
Pain is just a part of competition.	Pain is just a part of training and competition.
See pain as a challenge, and it doesn't bother me.	Athletes should see pain as a challenge and not let it bother them.
No matter how bad pain gets, I can handle it.	No matter how bad pain gets, athletes should be able to handle it.

Note. COP = Direct Coping subscale; SPEES = Sport Pain Ethic Endorsement Scale; SIP-15 = Sports Inventory for Pain-15; SIP = Sports Inventory for Pain. Items retrieved from "The Sports Inventory for Pain: Empirical and confirmatory factorial validity", by A.E. Bourgeois, M.C. Meyers, and A. LeUnes, 2009, *Journal of Sport Behaviour*, *32*(1), p. 19-34, and "Predicting pain response in athletes: Development and assessment of the Sports Inventory for Pain", by M.C. Meyers, A.E. Bourgeois, S. Stewart, and A. LeUnes, 1992, *Journal of Sport & Exercise Psychology*, *14*, p. 249-261.

Table 2

Descriptive Statistics, Distributional Characteristics, and Estimates of Internal Consistency for Primary Variables

Variables	M	SD	Skewness	Kurtosis	Internal Consistency
Pain Catastrophizing[a]	26.45	9.01	0.80	-0.18	.91
Pain Hypervigilance[b]	46.10	10.99	-0.33	0.35	.87
Perfectionism Facets[c]					
Personal standards	3.28	0.83	-0.22	-0.42	.86
Organization	3.95	0.56	-0.51	0.38	.81
Concern Over Mistakes	2.42	0.84	0.49	-0.49	.88
Doubts About Actions	2.62	0.81	0.28	-0.76	.86
Perfectionism Dimensions					
Personal Standards Perfectionism	0.00	0.84	-0.25	0.14	--
Evaluative Concerns Perfectionism	0.00	0.80	0.36	-0.34	--
Sport Pain Ethic Endorsement[c]	2.66	0.84	0.11	-0.42	.93

[a] Possible range of scores: 0.00–52.00. [b] Possible range of scores: 0.00-80.00. [c] Possible range of scores: 1.00-5.00.

Table 3

Bivariate Correlations between Primary Variables

Variable	1	2	3	4	5
1. Pain Catastrophizing	--				
2. Pain Hypervigilance	.29**	--			
3. Personal Standards Perfectionism	.03	.19**	--		
4. Evaluative Concerns Perfectionism	.43**	-.01	.13*	--	
5. Sport Pain Ethic Endorsement	-.04	-.14*	.23**	.24**	--

* $p < .05$

** $p < .01$

Table 4

Regression Results for the Test of Moderated Moderation in the Prediction of Pain Catastrophizing

Variable	Coeff.	*SE*	*t*	*p*	95% CI	
					LL	*UL*
Constant	31.25	2.37	13.17	.00	26.57	35.93
Evaluative Concerns Perfectionism	7.28	2.68	2.71	.01	1.99	12.56
Personal Standards Perfectionism	1.85	2.74	0.68	.49	-3.54	7.24
Sport Pain Ethic Endorsement	-1.74	0.83	-2.09	.04	-3.39	-0.10
Evaluative Concerns Perfectionism × Personal Standards Perfectionism	5.24	2.61	2.01	.05	0.10	10.38
Evaluative Concerns Perfectionism × Sport Pain Ethic Endorsement	-0.64	1.02	-0.63	.53	-2.66	1.37
Personal Standards Perfectionism × Sport Pain Ethic Endorsement	-0.57	0.97	-0.58	.56	-2.48	1.34
Evaluative Concerns Perfectionism × Personal Standards Perfectionism × Sport Pain Ethic Endorsement	-2.12	1.00	-2.12	.03	-4.10	-0.15

Table 5

Regression Results for the Test of Moderation in the Prediction of Pain Catastrophizing

Variable	Coeff.	*SE*	*t*	*p*	95% CI	
					LL	*UL*
Constant	31.25	2.37	13.17	.00	26.57	35.93
Evaluative Concerns Perfectionism	7.21	2.83	2.55	.01	1.63	12.79
Personal Standards Perfectionism	0.03	0.75	0.04	.97	-1.44	1.50
Sport Pain Ethic Endorsement	-1.76	0.82	-2.14	.03	-3.39	-0.14
Evaluative Concerns Perfectionism × Personal Standards Perfectionism	0.20	0.81	-2.14	.80	-1.40	1.80
Evaluative Concerns Perfectionism × Sport Pain Ethic Endorsement	-0.75	1.07	-0.70	.48	-2.85	1.35

Table 6

Regression Results for the Test of Simple Moderation in the Prediction of Pain Catastrophizing

Variable	Coeff.	*SE*	*t*	*p*	95% CI	
					LL	*UL*
Constant	26.44	0.56	47.62	.00	25.35	27.54
Evaluative Concerns Perfectionism	4.80	0.72	6.67	.00	3.38	6.22
Personal Standards Perfectionism	-0.29	0.78	-0.38	.71	-1.83	1.24
Evaluative Concerns Perfectionism × Personal Standards Perfectionism	0.10	0.81	0.12	.90	-1.51	1.70

Table 7

Regression Results for the Main Effects in the Prediction of Pain Catastrophizing

Variable	Coeff.	*SE*	*t*	*p*	95% CI	
					LL	*UL*
Constant	26.45	0.56	47.41	.00	25.35	27.55
Evaluative Concerns Perfectionism	4.81	0.71	6.74	.00	3.40	6.21
Personal Standards Perfectionism	-0.31	0.76	-0.41	.69	-1.80	1.18

Table 8

Regression Results for the Test of Moderated Moderation in the Prediction of Pain Hypervigilance

Variable	Coeff.	*SE*	*t*	*p*	95% CI	
					LL	*UL*
Constant	53.63	2.78	19.26	.00	48.14	59.12
Evaluative Concerns Perfectionism	5.02	3.66	1.37	.17	-2.18	12.23
Personal Standards Perfectionism	3.54	2.83	1.25	.21	-2.04	9.12
Sport Pain Ethic Endorsement	-2.72	1.00	-2.71	.01	-4.70	-0.74
Evaluative Concerns Perfectionism × Personal Standards Perfectionism	2.65	4.14	0.64	.52	-5.52	10.81
Evaluative Concerns Perfectionism × Sport Pain Ethic Endorsement	-1.77	1.26	-1.41	.16	-4.24	0.70
Personal Standards Perfectionism × Sport Pain Ethic Endorsement	-0.14	1.09	-0.13	.90	-2.28	2.00
Evaluative Concerns Perfectionism × Personal Standards Perfectionism × Sport Pain Ethic Endorsement	-0.96	1.44	-0.67	.51	-3.81	1.89

Table 9

Regression Results for the Test of Moderation in the Prediction of Pain Hypervigilance

Variable	Coeff.	*SE*	*t*	*p*	95% CI	
					LL	*UL*
Constant	53.62	2.72	19.71	.00	48.25	58.98
Evaluative Concerns Perfectionism	4.99	3.64	1.37	.17	-2.19	12.17
Personal Standards Perfectionism	2.99	1.00	3.00	.00	1.03	4.96
Sport Pain Ethic Endorsement	-2.72	0.97	-2.79	.01	-4.65	-0.80
Evaluative Concerns Perfectionism × Personal Standards Perfectionism	0.40	1.42	0.28	.78	-2.39	3.19
Evaluative Concerns × Sport Pain Ethic Endorsement	-1.82	1.23	-1.47	.14	-4.25	0.61

Table 10

Regression Results for the Test of Simple Moderation in the Prediction of Pain Hypervigilance

Variable	Coeff.	*SE*	*t*	*p*	95% CI	
					LL	*UL*
Constant	46.09	0.74	62.18	.00	44.63	47.55
Evaluative Concerns Perfectionism	-0.51	0.95	-0.53	.60	-2.38	1.37
Personal Standards Perfectionism	2.51	1.02	2.46	.01	0.50	4.52
Evaluative Concerns Perfectionism × Personal Standards Perfectionism	0.10	1.41	0.07	.94	-2.68	2.88

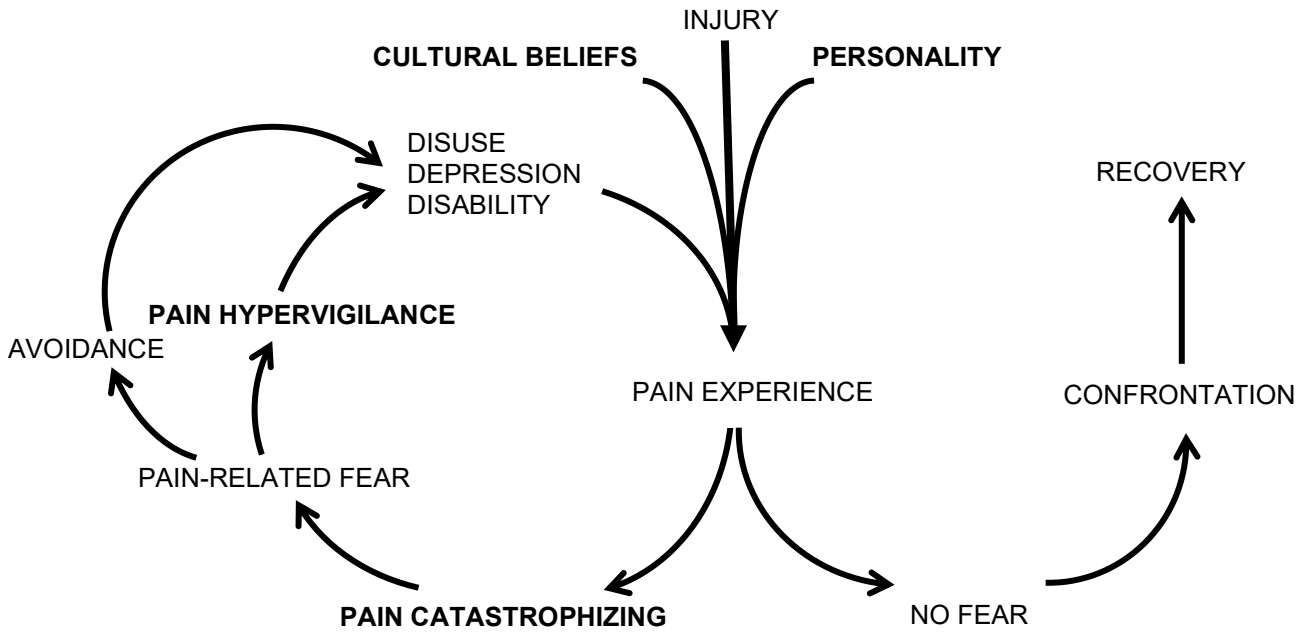
Table 11

Regression Results for the Main Effects in the Prediction of Pain Hypervigilance

Variable	Coeff.	*SE*	*t*	*p*	95% CI	
					LL	*UL*
Constant	46.10	0.74	62.41	.00	44.64	47.55
Evaluative Concerns Perfectionism	-0.50	0.93	-0.54	.59	-2.33	1.33
Personal Standards Perfectionism	2.49	1.01	2.46	.01	0.50	4.49

Figure 1

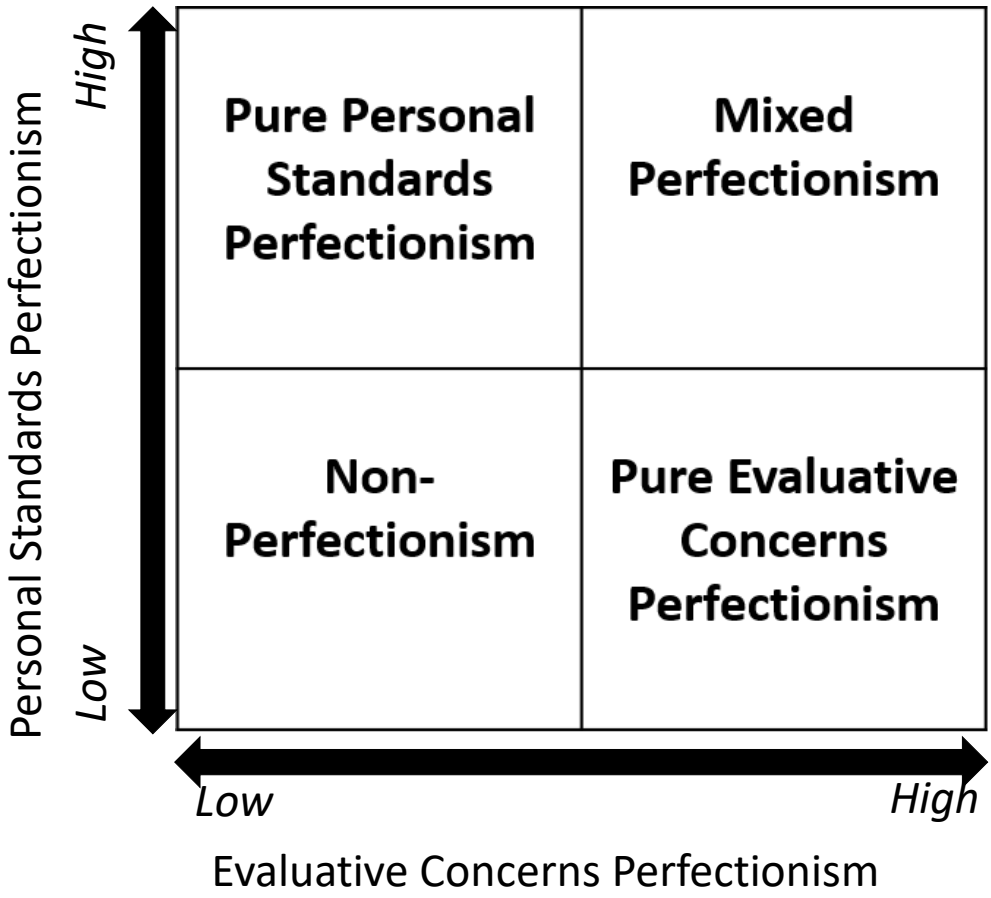
The Fear-Avoidance Model of Pain



Note. This modified model shows how cultural beliefs and personality converge and influence one's pain experience, and thereby one's tendency to interpret pain as non-threatening or a catastrophe. Adapted from "Fear-avoidance and its consequences in chronic musculoskeletal pain: A state of the art," by J.W.S. Vlaeyen and S.J. Linton, 2000, *Pain*, *85*, p. 329 (https://doi.org/10.1097/AJP.0b013e3182385392).

Figure 2

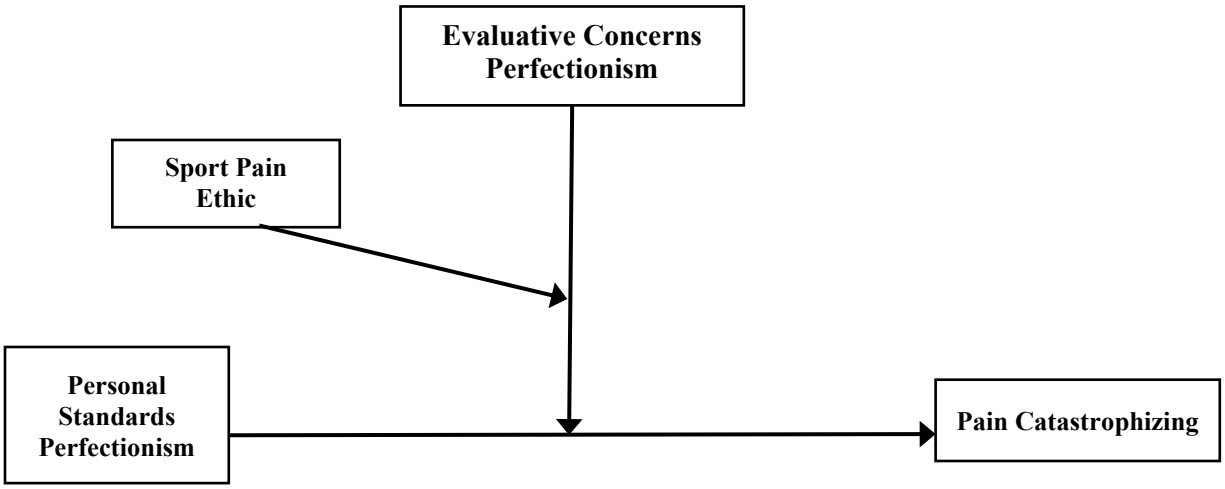
The 2 × 2 Model of Perfectionism



Note. This figure shows which perfectionism subtypes are formed with which of the within-person combinations by the varying degrees of personal standards perfectionism and evaluative concerns perfectionism in each. Adapted from "Testing a 2 × 2 model of dispositional perfectionism" by P. Gaudreau & A. Thompson, 2010, *Personality and Individual Differences*, *48*, 532-537 (https://doi.org/10.1016/j.paid.2009.11.031).

Figure 3

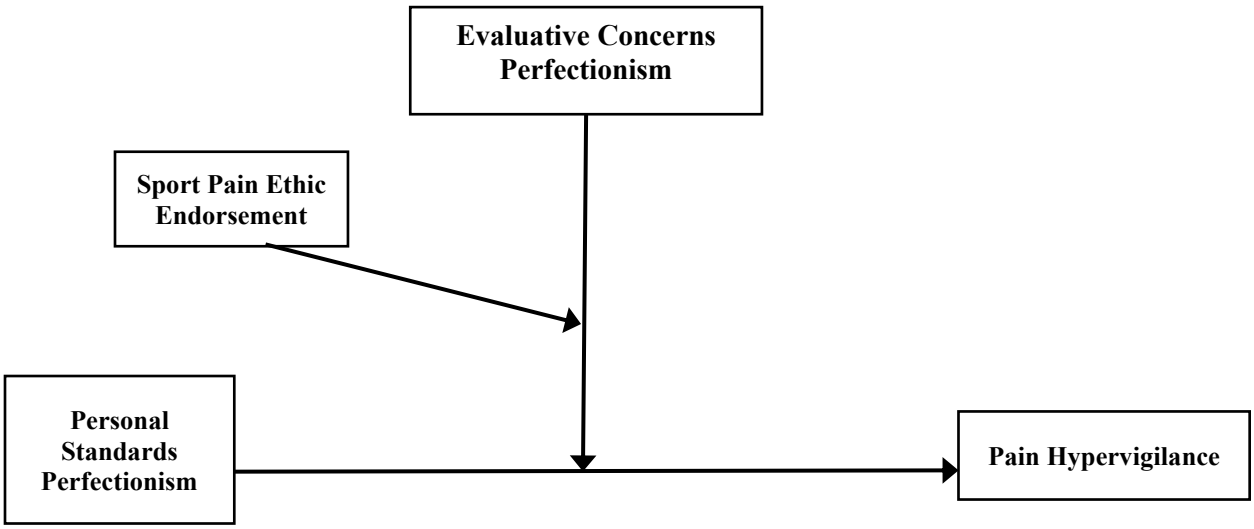
Model of Moderated Moderation: The Interactive Roles of Personal Standards Perfectionism, Evaluative Concerns Perfectionism, and Sport Pain Ethic Endorsement on Pain Catastrophizing



Note. This figure illustrates the effect of personal standards perfectionism on pain catastrophizing as predicted by evaluative concerns perfectionism and moderated by sport pain ethic endorsement. These relationships were examined in the present study.

Figure 4

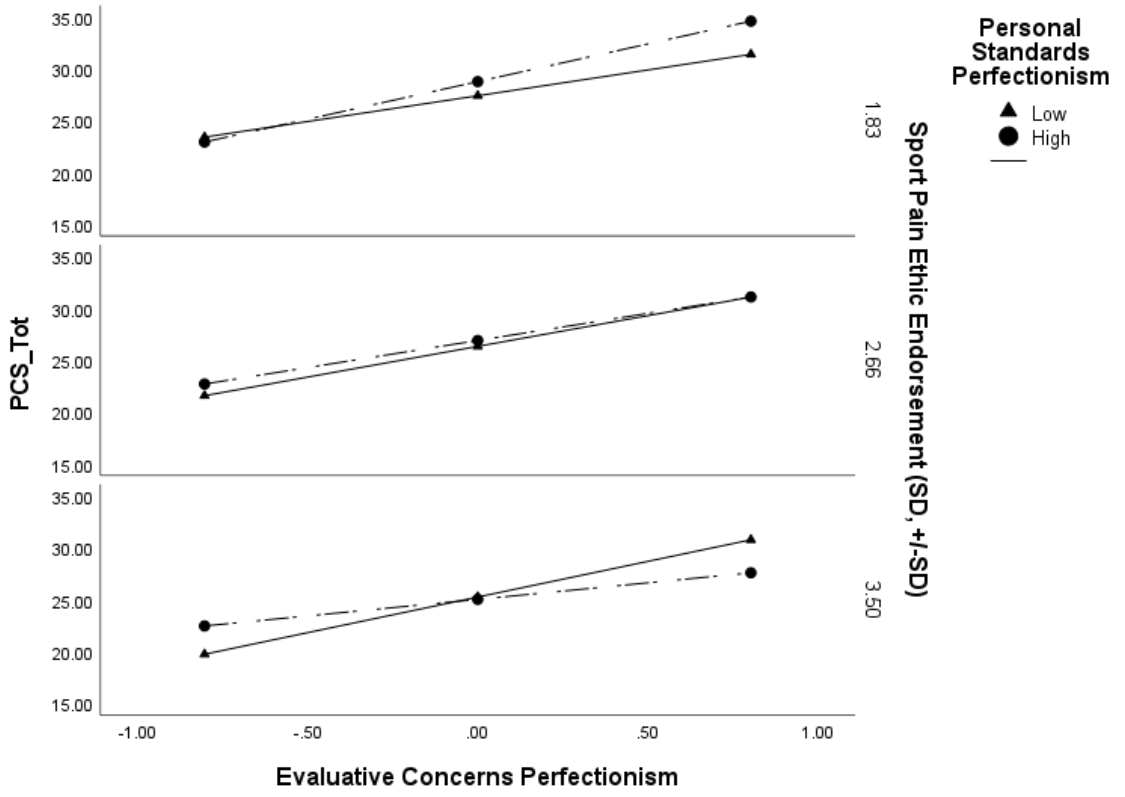
Model of Moderated Moderation: The Interactive Roles of Personal Standards Perfectionism, Evaluative Concerns Perfectionism, and Sport Pain Ethic Endorsement on Pain Hypervigilance



Note. This figure illustrates the effect of personal standards perfectionism on pain hypervigilance as predicted by evaluative concerns perfectionism and moderated by sport pain ethic endorsement. These relationships were examined in the present study.

Figure 5

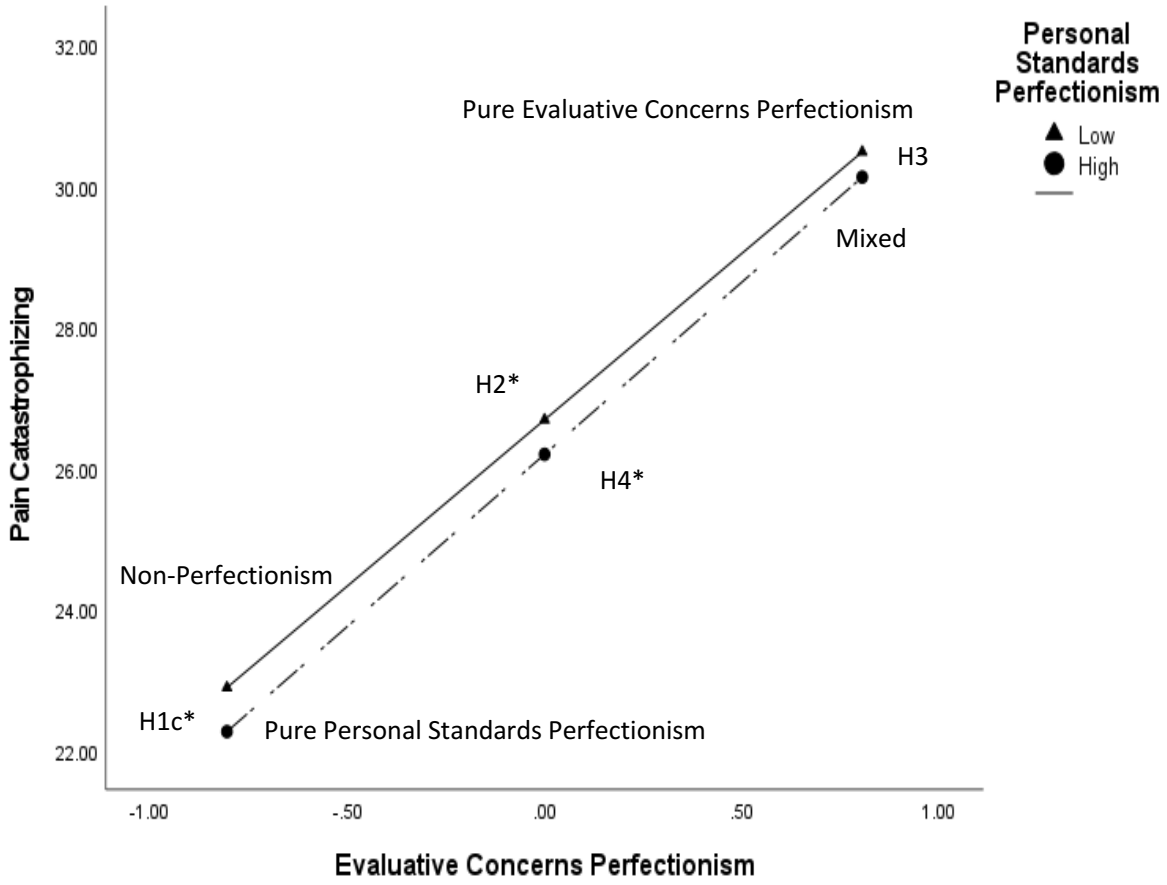
Moderated Moderation: The Conditional Effect of Evaluative Concerns Perfectionism on Personal Standards Perfectionism as a Function of Pain Catastrophizing and Sport Pain Ethic Endorsement



Note. The above figure illustrates the interaction between evlauative concerns perfectionism and personal standards perfectionism in the the prediction of pain catastrophizing at three levels of Sport Pain Ethic Endorsement Scale: one standard deviation below the mean, the mean, and one standard deviation above the mean.

Figure 6

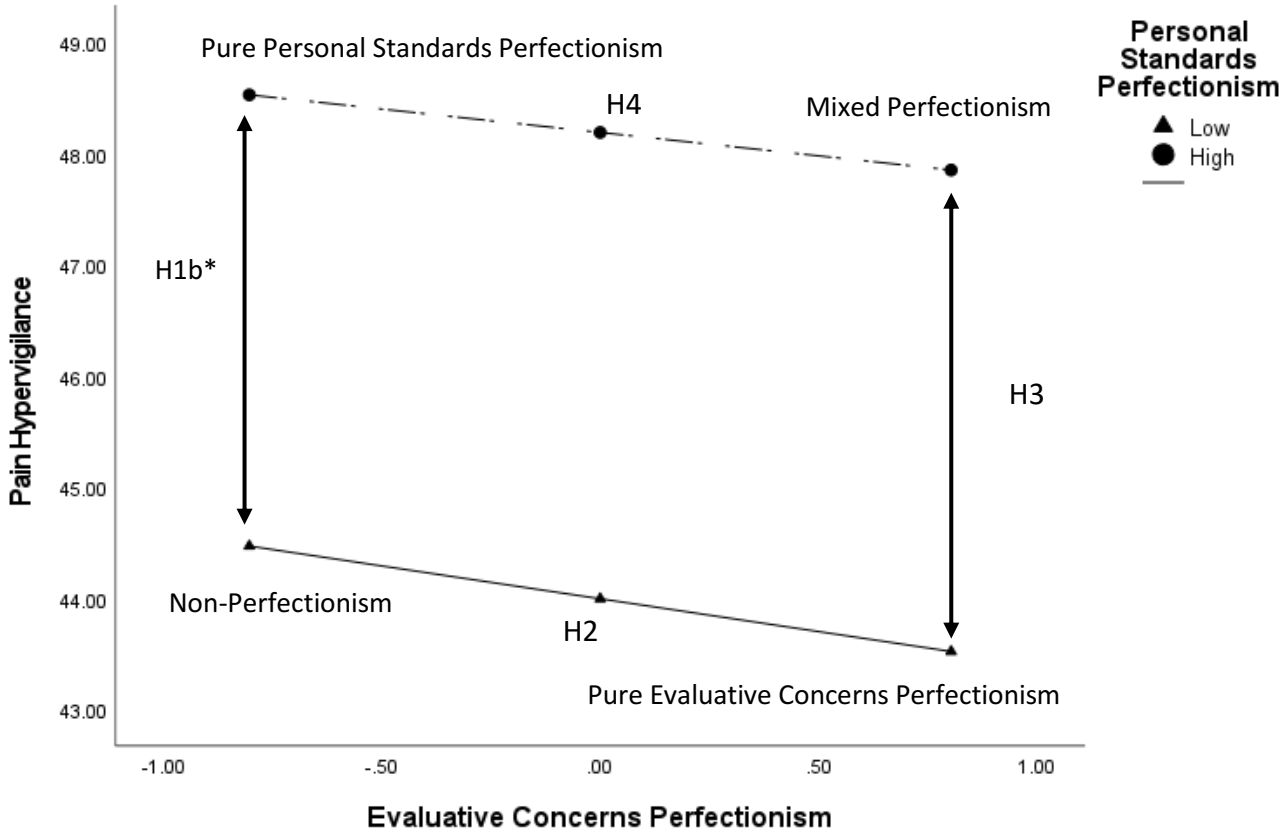
Main Effects Regression Analysis: Visualization of the Main Effects of Evaluative Concerns Perfectionism and Personal Standards Perfectionism in the Prediction of Pain Catastrophizing



Note. The above figure illustrates the significant and non-significant main effects of evaluative concerns perfectionism and personal standards perfectionism (respectively) in the prediction of pain catastrophizing. H1c, H2, H3, and H4 refer to the hypotheses of the 2 × 2 model of perfectionism. * indicates support for the associated hypothesis.

Figure 7

Main Effects Regression Analysis: Visualization of the Main Effects of Evaluative Concerns Perfectionism and Personal Standards Perfectionism in the Prediction of Pain Hypervigilance



Note. The above figure illustrates the significant and non-significant main effects of personal standards perfectionism and evaluative concerns perfectionism (respectively) in the prediction of pain catastrophizing. H1b, H2, H3, and H4 refer to the hypotheses of the 2 × 2 model of perfectionism. * indicates support for the associated hypothesis.

Appendix A: Demographics Questionnaire

Title presented to participants: *Your Personal Characteristics and Background in Sport*

Instructions: Please tell us a bit about your personal characteristics and your background in sport. Some of the sport questions will ask for information pertaining to your current injury status and your experience with pain.

Items and Response Formats:

Heading: Personal Characteristics

1. What gender (if any) do you identify with?

   Response format: Blank text box

2. How old are you?

   Response format: Blank text box

3. What country would you call home?

   Response format: Blank text box

Heading: Your Involvement in Endurance Sport

1. What is your primary sport? That is, what endurance sport do you train for and compete in the most?

   Response format: Blank text box

2. How long (in years) have you been taking part in your primary endurance sport?

   Response format: Blank text box

3. In what country do you spend the majority of your time training for and competing in your primary endurance sport?

   Response format: Blank text box

4. How important is your primary endurance sport to you?

Response format: 5-point Likert scale (1 = *Not at all important*; 5 = *Very important*)

5. How important is it to you to perform well in your primary endurance sport?

   Response format: 5-point Likert scale (1 = *Not at all important*; 5 = *Very important*)

6. What is the highest level that you have competed at in your primary endurance sport?

   Response format: Checkboxes for city level, provincial/state level, national level, continental level, world level, and "I have not competed at any level"

7. If the current pandemic does not change your plans, what is the highest level that you intend to compete at in the current or upcoming season?

   Response format: Checkboxes for city level, provincial/state level, national level, continental level, world level, and "I do not intend to compete in the current or upcoming season"

8. Fill in the blank: I currently train for my primary endurance sport ___ times per week. Include in your calculation training where you take part in your sport *and* training that's designed to improve your performance, but where you don't actually take part in your primary sport (e.g., a strength/mobility session or workout involving an alternative endurance sport).

   Response format: Blank text box

9. Besides your primary sport, what other endurance sports do you train for and compete in?

   Response format: Blank text box

Heading: Your Experience with Pain and Injury

1. To what extent is pain a feature of your training and racing in your primary endurance sport?

   Response format: 5-point Likert scale (1 = *not at all*; 5 = *very much so*)

2. Do you have any chronic conditions that cause you pain when training for or competing in your primary sport?

   Response format: Yes/No

3. If "yes" to the previous question, then what degree of pain is associated with your condition(s)?

   Response format: 5-point Likert scale (1 = *minor pain*; 5 = *intense pain*)

4. What is your current injury status?

   Response format: 5-point Likert scale (1 = *injury-free*; 5 = *seriously injured*)

5. To what degree does your current injury status restrict your ability to train for and compete in your sport?

   Response format: 5-point Likert scale (1 = *not restricted*; 5 = *completely restricted*)

6. What degree of pain is associated with your current injury status?

   Response format: 5-point Likert scale (1 = *no pain*; 5 = *intense pain*)

7. To what extent do you consider yourself injury-prone?

   Response format: 5-point Likert scale (1 = *not at all*; 5 = *very much so*)

Appendix B: Pain Catastrophizing Scale

Title presented to participants: *Your Thoughts and Feelings in Response to Pain*

Instructions: You will now be presented with statements that reflect thoughts and feelings that athletes can have in response to pain. Please indicate the degree to which you have these thoughts and feelings when you experience pain through your sport.

Response Format: 5-point Likert scale (0 = *not at all*; 4 = *all the time*)

Item Stem: When I'm in pain and it relates to my sport, …

Items:

1. I worry all the time about whether the pain will end.
2. I feel I can't go on.
3. It's terrible and I think it's never going to get any better.
4. It's awful and I feel that it overwhelms me.
5. I feel I can't stand it anymore.
6. I become afraid that the pain will get worse.
7. I keep thinking of other painful events.
8. I anxiously want the pain to go away.
9. I can't seem to keep it out of my mind.
10. I keep thinking about how much it hurts.
11. I keep thinking about how badly I want the pain to stop.
12. There's nothing I can do to reduce the intensity of the pain.
13. I wonder whether something serious may happen.

Appendix C: Pain Vigilance and Awareness Questionnaire

Title presented to participants: *Your Awareness of Pain*

Instructions: Athletes can be aware of several different aspects of pain, including the intensity, onset, and location of pain. Please help us understand your awareness of the pain you experience in your sport by indicating the degree to which you agree with each of the following statements.

Response format: 6-point Likert scale (0 = *strongly disagree*; 5 = *strongly agree*)

Items:

1. I am very sensitive to pain in my sport.
2. When it's connected to my sport, I am aware of sudden or temporary changes in pain.
3. When it's linked to my sport, I am quick to notice changes in pain intensity.
4. I am quick to notice effects of medication on pain that comes from my sport.
5. When it comes to my sport, I am quick to notice changes in location or extent of pain.
6. I focus on sensations of pain that pertain to my sport.
7. I notice pain that is connected to my sport even if I am busy with another activity.
8. I find it easy to ignore pain that relates to my sport.
9. When it's relevant to my sport, I know immediately when pain starts or increases.
10. When it comes to my sport, if I do something that increases pain, the first thing I do is check to see how much the pain has increased.
11. When it's linked to my sport, I know immediately when pain decreases.
12. I seem to be more conscious of pain than other athletes in my sport.
13. I pay close attention to pain that's connected to my sport.
14. When it has to do with my sport, I keep track of my pain level.
15. When it's related to my sport, I become preoccupied with pain.

16. When it comes to my sport, I do not dwell on pain.

Appendix D: Sport-Multidimensional Perfectionism Scale-2

Title presented to participants: *Your Orientation to Competition*

Instructions: The purpose of this questionnaire is to identify how athletes view certain aspects of their training and competitive experiences in sport. Please help us to more fully understand how athletes view a variety of their competitive experiences by indicating the extent to which you agree or disagree with the following statements. Some of the statements relate to your sport experiences in general, while others relate specifically to competitive or training experiences in your primary sport.

Response format: 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*)

Items:

1. If I do not set the highest standards for myself in my sport, I am likely to end up a second-rate athlete.
2. Even if I fail slightly in competition, for me, it is as bad as being a complete failure.
3. I usually feel uncertain as to whether or not my training effectively prepares me for competition.
4. On the day of a race, I have a routine that I try to follow.
5. I hate being less than the best at things in my sport.
6. I have and follow a pre-race routine.
7. If I fail in competition, I feel like a failure as a person.
8. I usually feel unsure about the adequacy of my pre-competition training.
9. I rarely feel that my training fully prepares me for races.
10. The fewer mistakes I make in competition, the more people will like me.
11. It is important to me that I be thoroughly competent in everything I do in my sport.

12. I follow pre-planned steps to prepare myself for competition.
13. Prior to competition, I rarely feel satisfied with my training.
14. I think I expect higher performance and greater results in my daily sport-training than most athletes.
15. I feel like other athletes generally accept lower standards for themselves in sport than I do.
16. I should be upset if I make a mistake in competition.
17. I follow a routine to get myself into a good mindset going into a race.
18. If a team-mate, colleague, or opponent performs better than me during a race, then I feel like I have failed to some degree.
19. I rarely feel that I have trained enough in preparation for a competition.
20. If I do not do well all the time in competition, I feel that people will not respect me as an athlete.
21. I have extremely high goals for myself in my sport.
22. I develop plans that dictate how I want to perform during competition.
23. I set higher achievement goals than most athletes who compete in my sport.
24. I usually have trouble deciding when I have trained enough heading into a race.
25. People will probably think less of me if I make mistakes in competition.
26. I set plans that highlight the strategies I want to use when I compete.
27. If I perform well but only make one obvious mistake in the entire race, I still feel disappointed with my performance.

Appendix E: Sport Pain Ethic Endorsement Scale

Title presented to participants: *Your Beliefs about Pain*

Instructions: Athletes can have very different beliefs, perspectives, and attitudes about pain in sport. Please help us understand your beliefs about pain by indicating the degree to which you agree with each of the following statements.

Response Format: 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*)

Item Stem: I believe that…

Items:

1. Athletes owe it to themselves, and to those around them, to perform even when doing so comes with a lot of pain.
2. When athletes are in pain, they should tell themselves that it doesn't hurt.
3. When athletes feel pain, they should just go on as if nothing happened.
4. When athletes feel pain, they should tell themselves to be tough and carry on.
5. Athletes can't let pain stand in the way of what they do.
6. Athletes should just ignore pain.
7. Athletes should not allow pain to interfere with their performance.
8. Pain is just a part of training and competition.
9. Athletes should see pain as a challenge and not let it bother them.
10. No matter how bad pain gets, athletes should be able to handle it.

Appendix F: Recruitment Scripts

Note
Presented below are parallel scripts that will be used by members of the research team and gatekeepers when promoting the proposed study to potential participants over email. The script can easily be adapted if research team members are promoting the study over the phone or Zoom® and if gatekeepers are promoting the study in- person.

Script for Research Team Members
I'm not sure if you know this, but I'm a sport psychology <<professor/graduate student>> at Lakehead University. I'm currently conducting a study that examines how endurance athletes' perspectives on achievement relate to their thoughts and attitudes towards pain. To recruit participants, we're reaching out to people who consistently take part in an endurance sport and who think that doing so is important and meaningful. I'm thinking that you may fit that description.

Taking part in the study involves completing an online survey that will take about 20 minutes. If you're interested in participating, click the link provided below. There, you'll be presented with more information about the study and given the opportunity to take part.

https://www.surveymonkey.com/r/VYZFJPG

If you participate in the study, your responses will be anonymous and confidential. This means that I will not know who participates and who doesn't and that no one outside of the research team will have access to your responses. Basically, the choice of whether or not to participate is yours and it will in no way affect our relationship or your experience in your sport.

Finally, I'd love it if you could spread word about the study. If you know anyone else who consistently trains for an endurance sport and who might be interested in taking part, feel free to pass on the survey link.

If you have any questions or want to run anything by me, just get in touch.

Thanks in advance for your consideration.

Script for Gatekeepers
Hi there,

John Gotwals and Alyssa Poulin are sport psychology researchers at Lakehead University. They recently asked me to help promote one of their studies. The study examines how endurance athletes' perspectives on achievement relate to their thoughts and attitudes towards pain. Attached are some promotional materials for the study. To recruit participants, they're trying to reach people who consistently take part in an endurance sport and who think that doing so is important and meaningful. You all probably fit that description.

Taking part in the study involves completing an online survey that will take about 20 minutes.

If you're interested in participating, click the link provided below. There you'll be presented with more information about the study and given the opportunity to take part.

https://www.surveymonkey.com/r/VYZFJPG

If you participate in the study, your responses will be anonymous and confidential. This means that I will not know who participates and who doesn't and will not have access to any of your responses. The choice is yours and it will in no way affect our relationship or your experience in our sport. If you have any questions, you can contact John and/or Alyssa. Their contact information is provided in the online survey and on the attached poster.

Finally, John and Alyssa told me that they'd love help spreading word about the study. So, if you know anyone else that might be interested in taking part, feel free to pass on the study's promotional material and survey link.

Thanks

Appendix G: Gatekeeper Information Letter

Lakehead UNIVERSITY

School of Kinesiology
t: (807) 343-8544
f: (807) 343-8944

Title of Study:	**Predicting pain catastrophizing and hypervigilance among endurance athletes: The interactive roles of perfectionism and sport pain ethic endorsement**
Student-Researchers:	**Ms. Alyssa Poulin**
Faculty Supervisor:	**Dr. John Gotwals**

Dear [Gatekeeper Name],

We are currently recruiting endurance sport athletes who are at least 16 years old to take part in the research project identified above. The purpose of this letter is to describe this study and to ask if you would be willing to collaborate with us in the identification of potential participants.

What is this Project?
The purpose of this project is to examine how endurance athletes' perspectives relate to how they think about pain in sport. Alyssa Poulin is a student in the MSc program offered out of the School of Kinesiology at Lakehead University. This project represents the thesis that is required by that program.

What Does Taking Part in this Project Involve?
Participation in this project involves the completion of five questionnaires. The questionnaires can be completed at any time that is convenient through SurveyMonkey↓an online survey platform. One of the questionnaires asks for general information about the athlete, their background in sport, and their experiences with pain in sport. A second questionnaire assesses athletes' perspectives on achievement in sport. The remaining questionnaires target athletes' thought processes and beliefs about pain in sport. It will take approximately 20 minutes to complete the questionnaires. There is an opportunity to participate in a draw to win one of four $25 (CAD) VISA gift cards; the link will be offered to participants at the end of the survey.

Who Are We Looking For?
We are looking to recruit individuals who are over the age of 16 years, currently training in a consistent and systematic manner for an endurance sport (e.g., xc-skiing, cycling, middle–long distance running), and who find their participation in that sport to be meaningful and important. Participants must also not be dealing with a health condition that can be exacerbated through the completion of an online survey.

We would greatly appreciate it if you could foster our ability to recruit individuals who have these characteristics and who may be interested in participating. This would involve distributing promotional materials and sharing the link to the online survey. Both could be done through various formats (e.g., email, videoconferencing, or in-person). To facilitate the process, we've developed a script for you to use when promoting the study. This text could be easily copied into an email or read out loud.

Take note, we will not be able to tell you if any specific individual decided to participate in the study or provide you with results based on data from any specific individual. However, we would gladly provide you with a summary of the general results of the study and discuss those results with you.

The study has been approved by the Lakehead University Research Ethics Board. If you have any questions related to the ethics of the research and would like to speak to someone outside of the research team, please contact the Research Ethics Board at 807-343-8283 or research@lakeheadu.ca.

We hope that you find this study interesting and will help us recruit potential participants.

Thank you for your consideration,

Ms. Alyssa Poulin

MSc. Kinesiology Candidate

(807) 630-2724

acpoulin@lakeheadu.ca

Dr. John Gotwals

Associate Professor

(807) 346-7952

john.gotwals@lakeheadu.ca

Appendix H: Promotional Poster

School of Kinesiology
t: (807) 343-8544
f: (807) 343-8944

Predicting pain catastrophizing and hypervigilance among endurance athletes: The interactive roles of perfectionism and sport pain ethic endorsement

Volunteers Needed for Study



We're looking for endurance sport athletes who:

- Are over 16 years old;
- Train at least 3 times a week; and
- Think that it's important to take part in their sport.

Click the link for more info and to complete the ~20 minute online survey. Then enter to win a $25 VISA gift card!

https://www.surveymonkey.com/r/VYZFJPG

Questions? Want more info?
Contact Alyssa Poulin at acpoulin@lakeheadu.ca

Lakehead UNIVERSITY

Appendix I: Participant Information Letter

Lakehead UNIVERSITY

School of Kinesiology
t: (807) 343-8544
f: (807) 343-8944

Participant Information Letter

Title of Study:	**Predicting pain catastrophizing and hypervigilance among endurance athletes: The interactive roles of perfectionism and sport pain ethic endorsement**
Primary Researcher:	**Ms. Alyssa Poulin**
Supervisor:	**Dr. John Gotwals**
Committee Members:	**Dr. Paolo Sanzo, Mrs. Leanne Smith, Dr. Nicholas Ravanelli**

Dear Potential Participant,

We are currently recruiting endurance sport athletes to take part in the research project identified above. The purpose of this letter is to describe the study so you can make an informed decision about whether to participate. When you click "Next" at the bottom of this page you will be given the opportunity to indicate that decision.

What is this Project?
The purpose of this project is to examine how endurance athletes' perspectives on achievement relate to how they think about pain in sport. Alyssa Poulin is a student in the MSc program offered out of the School of Kinesiology at Lakehead University. This project represents the thesis that is required by that program.

Who are we looking for?
Individuals must meet four criteria to take part in this study. First, they must be at least 16 years of age. Second, they must be participating in at least 3 training sessions/week which are dedicated to improving performance in an endurance sport. Third, they must evaluate their participation in that endurance sport as being personally meaningful and important. Fourth, they must not be dealing with a health condition (e.g., a concussion) that can be exacerbated through the completion of an online survey.

What Does Taking Part in this Project Involve?
Participation in this project involves the completion of five questionnaires. The questionnaires can be completed anonymously at any time that is convenient through SurveyMonkey↓an online survey platform. One of the questionnaires asks for general information about yourself, your background in sport, and your experiences with pain in sport. A second questionnaire asks about your perspective on achievement in sport. The remaining questionnaires ask about your thought

processes and beliefs about pain in sport. It will take approximately 20 minutes to complete the questionnaires. At the end of the online survey, participants will be given the opportunity to participate in a draw to win one of four $25 (CAD) VISA gift cards.

Ethical Issues Regarding Participation

1. Your decision to take part in the study is entirely voluntary.
2. The research team is taking steps to support the confidentiality and anonymity of participants' data. The questionnaires will not ask you to provide your name and the use of SurveyMonkey® will allow you to submit your questionnaire responses anonymously. Additionally, only members of the research team will have access to participants' data. Individuals associated with your sport (e.g., teammates or coach) or personal life (e.g., parents or significant other) will not have access to any of your data. After taking part in the study, a random identification number will be assigned to each participants' responses.
3. There are no benefits and few mental or physical risks associated with taking part in this project. However, symptoms associated with some health conditions can sometimes be exacerbated by screen time (as in the case of concussions). As a result, individuals currently dealing with such health conditions should not take part in this study.
4. When completing the questionnaires, you can choose to not answer or skip any question at your discretion. You can also choose to stop taking part in the study without consequence at any point prior to the submission of your questionnaire responses. After you submit your questionnaire responses, we will not be able to remove them from the study. This is because your questionnaire responses will be completely anonymous.
5. Please note that SurveyMonkey® is hosted by a server located in the USA. The US Patriot Act permits U.S. law enforcement officials, for the purpose of anti-terrorism investigation to seek a court order that allows access to the personal records of any person without the person's knowledge. In view of this, we cannot guarantee the full confidentiality of participants' data.

Data Usage, Data Storage and Study Summaries

1. All data collected for this study will be used for the purposes of Alyssa Poulin's MSc thesis. There is no intention to commercialize study findings and there are no conflicts of interests on the part of the research team.
2. Once the study is completed, all data will be securely stored for a minimum of five years on password-protected hard drives managed by Dr. John Gotwals (School of Kinesiology, Lakehead University). The survey will then be deleted from SurveyMonkey®.
3. Findings from this study will be presented in Ms. Poulin's MSc thesis. It is also our intention to publish the findings in peer-reviewed journals and to present them at academic conferences. In any of these cases, your identity and your individual results will be kept anonymous.
4. At the end of the online survey you will be given the opportunity to indicate interest in receiving a summary of the study's findings. It is anticipated that this report will be available by June 2021.

Research Ethics Board Review and Approval

We will be happy to discuss any aspect of the study with you at any time. If you have any questions or concerns, feel free to contact any member of the research team. The study has also

been reviewed and approved by the Lakehead University Research Ethics Board. If you have any questions related to the ethics of the research and would like to speak to someone outside of the research team, please contact Sue Wright at the Research Ethics Board (807 343-8283; research@lakeheadu.ca).

Thank you for your time and consideration,

Ms. Alyssa Poulin

MSc. Kinesiology Candidate

(807) 630-2724

acpoulin@lakeheadu.ca

Dr. John Gotwals

Associate Professor

(807) 346-7952

john.gotwals@lakeheadu.ca

Appendix J: Participant Informed Consent Form

Lakehead UNIVERSITY

School of Kinesiology
t: (807) 343-8544
f: (807) 343-8944

Informed Consent Form

Title of Study:	**Predicting pain catastrophizing and hypervigilance among endurance athletes: The interactive roles of perfectionism and sport pain ethic endorsement**
Student-Researchers:	**Ms. Alyssa Poulin**
Faculty Supervisor:	**Dr. John Gotwals**
Committee Members:	**Dr. Paolo Sanzo, Mrs. Leanne Smith, Dr. Nicholas Ravanelli**

Instructions: Please review the information about this study that is provided below. After doing so, if you agree to take part in the study, then please indicate so by clicking "next" to begin the survey.

Study Information
I have reviewed the information letter for this study and understand:

- The risks and benefits of taking part in this study.
- That I am a volunteer. When completing the study's questionnaires, I may choose not to answer any question. I can also withdraw from the study at any time prior to the submission of my questionnaire responses.
- That data will be securely stored with Dr. John Gotwals (School of Kinesiology, Lakehead University) for a minimum period of 5 years following completion of the study.
- That a summary of the study's findings will be made available to me upon request.
- The strategies that are in place to protect my anonymity and the confidentiality of my data.
- That I have been given an opportunity to ask questions and agree that all of my questions have been appropriately answered.

By clicking "next," I am indicating that I have not waived any rights to legal recourse in the event of research-related harm, that I have read and agree to the above information, and that I agree to participate in this study.

Appendix K: Participant Pre-Screening Instrument

Title presented to participants: *Participation Pre-Screening*

Instructions: As indicated earlier, there are a few requirements that individuals must meet in order to take part in this study. These are listed below. Please indicate whether or not you meet these requirements.

Response format: "Yes" or "No"

Items

1. I am 16 years old or older.
2. I take part in at least 3 training sessions/week which are dedicated to improving my performance in an endurance sport. This includes training where I actually take part in that sport *as well as* training that's designed to improve my performance, but where I don't actually take part in that sport (e.g., a strength/mobility session or workout involving an alternative endurance sport).
3. Taking part in endurance sport is meaningful and important to me.
4. Do you have a health condition that may jeopardize the quality or accuracy of your responses to an online survey or that may be exacerbated by completing an online survey?

If answer "No" to #1-3 or "Yes" to #4, then they are taken to a page with this info:

Unfortunately, you do not meet the requirements to take part in this study. Thank you for your consideration. If you have any questions about this or if you reached this page in error, please contact any member of the research team or Sue Wright at the Lakehead University Research Ethics Board (807 343-8283; research@lakeheadu.ca).

Thank you for your time and consideration,
Ms. Alyssa Poulin Dr. John Gotwals

MSc. Kinesiology Candidate

(807) 630-2724

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Associate Professor

(807) 346-7952

john.gotwals@lakeheadu.ca