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Testing a model of personal attributes and emotions regarding physical activity and sedentary behaviour

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ABSTRACT
The purpose of this study was to test a model of personal appraisals (distal) and emotions (proximal) as predictors of physical activity (PA) and sedentary behaviour using the Control Value Theory (CVT). Data was collected using a cross-sectional design and focused on college students ($N = 345; M_{age} = 19.63, SD = 1.87$) enrolled in a general education college course. The survey tools asked students about their perceptions of perceived control, value, enjoyment, boredom, and anxiety regarding physical activity. Students also reported their moderate-to-vigorous PA (MVPA) and sedentary time. Results showed all variables to be reliable ($\alpha > .70$) and confirmatory factor analysis supported factor structure. As hypothesised within CVT, control and value appraisals predicted enjoyment, boredom, and anxiety in students with one exception between value and enjoyment. However, 60%, 42%, and 42% of the variance were accounted for in each emotion, respectively. Enjoyment was a significant predictor of both PA and sedentary behaviour. Indirect relationships from control to PA and sedentary behaviour were also significant via enjoyment. Although indirect relationships were found between control value and behaviour via enjoyment, the effect size was minimal. In conclusion, discrete emotions represent motivational constructs that may help explain subjective experiences and volitional PA. Enjoyment was a predictor of one’s PA behaviour and a deterrent to sedentary time. However, a greater number of emotions need exploration and may aid in filling some of the gaps understanding PA behaviour.

Exploring emotions as predictors of physical activity and sedentary behaviour

Although several benefits of physical activity (PA) have been identified (U.S. Department of Health and Human Services [USDHHS], 2008), there has been a steady reduction in PA and increase in sedentary behaviours amongst individuals progressing from high school to college (Deforche, Van Dyck, Deliens, & De Bourdeuhuij, 2015). In congruence, the decline in motivation to participate in PA from high school to college has been highlighted as an area of concern and possible intervention to reduce unhealthy behaviours (Barkoukis, Ntoumanis, & Thogersen-Ntoumani, 2010). Motivation is one major factor...
identified to combat the decline in PA and the progressive increase in sedentary behaviour. There have been a variety of theories to evaluate and interpret one’s motivation including the Self-Determination Theory (Deci & Ryan, 2002), Expectancy-Value Theory (Wigfield & Eccles, 2002), and Achievement Goal Theory (Elliot, 2005), to point out a few. Recently, however, emotions have been identified as another construct that can aid in understanding and interpreting the subjective experience (Linnenbrink-Garcia, Patall, & Pekrun, 2016; Pekrun, 2006; Simonton & Garn, 2019; Yli-Piipari, Barkoukis, Jaakkola, & Liukkonen, 2013) but has limited investigation in PA settings and with previously mentioned theories.

Going beyond traditional cognitive models of motivation that focus on information processing, emotions have been identified as an affective centre piece that lacks in-depth understanding in the field (Ekkekakis & Brand, 2019; Ekkekakis & Zenko, 2016). Researchers argue that motivational theories should include emotions and provide a whole person perspective, which place the emotional subjective experience in the same footing as other cognitive constructs (Schutz & Pekrun, 2007). For instance, strong relationships have been found between emotions and specific domains or events, which in turn, predicted outcomes called action tendencies (Fredrickson, 2001). Emotions developed during these events can influence individual behaviours, cognitions, expressions, and motivation (Linnenbrink-Garcia et al., 2016). Ideally, positive and activating emotions will elicit adaptive outcomes and highly motivated tendencies, whereas negative and deactivating emotions can lead to maladaptive or amotivated behaviours. Thus facilitating positive activating emotions may have numerous positive implications for PA behaviours (Jaakkola, Yli-Piipari, Watt, & Liukkonen, 2016) and other psychosocial functions (Hogan, Catalino, Mata, & Fredrickson, 2015).

To better understand the intricacies of behaviours and subjective experiences, several researchers suggest evaluating discrete emotions over affective states (Linnenbrink-Garcia et al., 2016; Pekrun, 2006), particularly as it relates to PA-related outcomes (Mouratidis, Vansteenkiste, Lens, & Auweele, 2009; Simonton, Garn, & Solmon, 2017; Yli-Piipari et al., 2013). Although these terms are often used interchangeably, affect tends to be a general state of feeling that is overarching, less intense, and can encompass several motivational tendencies (Pekrun, 2006). Emotions, on the other hand, have specificity, greater intensity, duration, and have distinct object foci (Pekrun, 2006; Pekrun, Frenzel, Goetz, & Perry, 2007). This means their resulting actions and outcomes are identifiable and specific. Emotions and motivation are interrelated as well but need distinction as they may provide important information as it relates to achievement or volitional behaviour. For example, motivation provides information about one’s competence, drive, and perceived direction toward achieving a goal (Linnenbrink-Garcia et al., 2016), whereas emotions provide physiological and psychological feedback to coordinate one’s behaviour (Linnenbrink-Garcia et al., 2016; Shuman & Sherer, 2015).

Although the relationship between emotions and behaviours/outcomes has been evaluated in several achievement settings and within academics (Pekrun, Elliot, & Maier, 2009), there is limited work regarding emotions in PA settings. Recent studies evaluating emotions in school physical education (PE) experiences showed that positive and negative experiences may have decisive effects on lifelong activity behaviours and beliefs (Ladwig, Vazou, & Ekkekakis, 2018; Yli-Piipari et al., 2013), however, more research is needed. Discrete emotions, such as pride and shame, have also recently been evaluated in long-
distance performance training and found to foster practice training in different ways (Gilchrist, Conroy, & Sabiston, 2017). However, the use of emotional laden frameworks to evaluate emotions has been limited. To advance our knowledge in the intricacies of subjective motivation and behaviour choice, measuring discrete emotions over affect may improve and advance our understanding of motivation to engage in volitional PA behaviours.

**Control-value theory**

One framework that positions discrete emotions as a central tenet for understanding the subjective experience is the Control-Value Theory (CVT; Pekrun, 2006). Specifically, emotion, its antecedents, and its outcomes are theoretically defined and positioned in a causal order. CVT presents control-value appraisals as proximal predictors of discrete emotions. Control appraisals are considered one’s evaluation of their attributes and causality over their success/failure of activities and outcomes (Perry, Chipperfield, Hladkyj, Pekrun, & Hamm, 2014). Perceived control is often expressed by a combination of outcome expectations, attributions, as well as perceived competence regarding a task (Pekrun, 2006). Value appraisals are defined as the perceived subjective interest and importance one has regarding the activity or outcomes (Frenzel, Pekrun, & Goetz, 2007). Within CVT, value is often expressed as the perceived usefulness of the activity and its capacity to reach one’s potential goals (Pekrun, 2006). Recent studies suggest that while feelings of control are essential for positive experiences, control in combination with perceived worth (i.e., value) is more likely to result in a positive and activating emotion (Putwain et al., 2018).

Emotions that develop from control-value appraisals can be categorised by valence, activation, object focus, and motivation (Pekrun, 2017). Valence separates emotion into positive and negative psychological perception, or in other terms, pleasant vs. unpleasant (Pekrun et al., 2009). Positive emotions are linked to adaptive behaviours and well-being and negative emotions to maladaptive behaviours (Linnenbrink-Garcia et al., 2016). Activation refers to the type of arousal the emotion promotes at a physiological level (Daschmann, Goetz, & Stupnisky, 2014). For example, activating emotions promote cognitive focus and attentiveness and deactivating emotions may inhibit focus and reduce motor function (Pekrun, 2006, 2017). Within CVT, emotions can also be parcelled by their object focus which considers when an emotion is experienced. This is important because certain emotions may be captured before, during, or after an event. For example, students may feel hope before an event, enjoyment during, and pride following the event. Although these examples are all positive and activating emotions, the experiences may shift, and one may experience negative and/or deactivating emotions as well.

Lastly, as suggested by the psychological and physiological make-up of emotion, special links exist between the type of emotion and level of motivation. However, given the array of emotions theorised by Pekrun and colleagues, the oversimplification of relationships between emotions and motivation may cloud our understanding of how emotions develop and how they lead to specific behaviours. To understand the intricacies of those tendencies tied to emotional experiences, a more nuanced approach should be considered, including the evaluation of discrete emotions.
Discrete emotions

Discrete emotions, by definition, are uniquely developed and tied to specific events and/or "are likely organised in domain-specific ways" (Pekrun, 2006, p. 324). The domain specificity of emotions has traditionally been focused in research on academics and tested the emotions of specific academic content domain (i.e., emotions in Math, Science, English; Bong, 2001; Goetz, Frenzel, Pekrun, & Hall, 2006). The emotions connected to an academic domain are viewed as more nuanced as compared to the assumption that emotions are generalised to one's personality traits (Pekrun, 2006). In any case, emotions are recognised as being predicted by their control-value appraisals which are also viewed as domain (content) specific (Bong, 2001; Goetz et al., 2006; Pekrun, Goetz, Titz, & Perry, 2002). Although distinct characteristics between emotions and academic domains have been found, less work has been done on nuanced topics within a domain. This may also be an important issue to address in PA-related research as many motivational theories look at the domain of PA as opposed to different PA-related topics (e.g., running vs. playing basketball). The topics in a domain may further invoke different emotions and action tendencies, but more research is needed.

Emotions produce physical and psychological reactions that influence one's expressions, cognition, motivation, and behaviour (Shuman & Sherer, 2015). As compared to general affective states, emotions are often more intense and can be tied to on-going or outcome experiences (Pekrun et al., 2007). Therefore, emotions are linked to the environment but develop from previous personal experiences and appraisals. As mentioned previously, emotions can fluctuate which may theoretically produce different levels of motivation. An understated importance of discrete emotions is the potential enhancement they provide in improving our understanding of different levels of motivation and resulting outcomes. Emotions are viewed as markers of motivation and can represent a way in which individuals interpret their subjective experiences (Fredrickson, 2001). For example, enjoyment is a positive, activating emotion and has ties to intrinsic forms of motivation (Deci & Ryan, 2002; Linnenbrink-Garcia et al., 2016). Boredom is a negative and deactivating emotion that is linked to amotivation (Daschmann et al., 2014; Shuman & Sherer, 2015). While, an emotion like anxiety is negative activating and is linked to extrinsic and avoidance forms of motivation (Pekrun et al., 2007).

However, due to less comprehensive frameworks, it has been difficult to see how emotions are formed (Kilpatrick, Hebert, & Bartholomew, 2016). The unique characteristics regarding discrete emotions make them appealing to motivational researchers, but emotion research has been mostly fragmented as it has evolved (Pekrun, 2017; Pekrun et al., 2007). Although emotions and affect have been used in previous research interchangeably, little has been done to evaluate how individuals use discrete emotions to interpret their experiences and their influence on volitional behaviours.

Motivation, emotions, and behaviours

Apropos with understanding the unique control-value interactions that explain discrete emotions within PA research, more information is also needed on how emotions relate to activity behaviours (Ekkekakis & Zenko, 2016). Within current research, motivation is seen as the bridge between personal attributes, feelings, and competencies to PA
behaviours (Elliot, 2005; Kilpatrick et al., 2016). However, results providing information on one’s motivation and emotion as it relates to volitional PA is limited (Ekkekakis & Brand, 2019). First, motivation is often defined as one’s energy and direction toward a goal or behaviour (Linnenbrink & Pintrich, 2002). Additionally, motivation is often referenced as either being intrinsic, engaging in behaviour due to interest in the task, or extrinsic, engaging in a behaviour/activity for a reward (Deci & Ryan, 2002). Although motivation is commonly explained using this dichotomous approach, theories such as the Self-Determination Theory (SDT; see Deci & Ryan, 2002) present motivation on a continuum. Thus motivation can range from amotivation to different forms of extrinsic and intrinsic motivation. Previous research shows that when students attain levels of intrinsic motivation they are more likely to engage in PA-related behaviours (Standage, Duda, & Ntoumanis, 2003; Vallerand, 2007) whereas those who experience extrinsic levels of motivation are often less active and do not sustain activity levels over time (e.g., quitting after a few sessions; Standage et al., 2003; Yli-Piipari, Watt, Jaakkola, Liukkonen, & Nurmi, 2009). Lastly, those who feel amotivation or not motivated, have shown clear relationships with less PA (Ntoumanis, Pensgaard, Martin, & Pipe, 2004).

In addition, Achievement Goal Theory (AGT, see Elliot, 2005) also presents a common motivational framework to explore PA-related behaviours. Within AGT, an individuals’ goal orientation can be viewed as mastery or performance driven. Mastery orientations are described as engaging in a behaviour for self-improvement and sustained effort to practice. Performance orientations are characterised as those who engage to earn a reward and choose to compare their performance to others. It has been found that mastery-oriented individuals have higher levels of intrinsic motivation and positive affective experiences with PA as opposed to those who are more performance based (Biddle, Wang, Kavussanu, & Spray, 2003). Both commonly used theories present important work as it relates to PA motivation and behaviour, however, less attention has been given to discrete emotions within these motivational theories.

Overall, motivation often reflects one’s perception of being capable of doing something and having a reason to do it, whereas emotions then reflect physiological and psychological processes that coordinate one’s subjective experience to engage (Linnenbrink-Garcia et al., 2016; Reeve, 2016). In other words, emotions and motivation work together and explain both one’s capabilities for an activity and their subjective experience within the activity (see Simonton & Garn, 2019). In other words, both feelings of motivation and positive emotional reactions are needed to engage/inhibit the desired behaviour (Reeve, 2016).

Emotions may provide inimitable information connecting individual experiences and their volitional PA behaviours. As mentioned previously, discrete emotions are tied to specific previous experiences and have specific action tendencies. CVT posits that resulting emotions are the affective construct that bridges the gap from experiences to behaviour and are the proximal influence on said behaviour. Proximal relationships from emotions have been identified with learning and school achievement (Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011), engagement in PE (Garn, Simonton, Dasinger, & Simonton, 2017), and with barriers to engage in PA (Ntoumanis et al., 2004). Pekrun (2006) suggests that emotions are as essential when it comes to behaviour because emotions can explain behaviours regardless of context. In other words, emotions are built by personal appraisals indirectly by the environment. This may be a major contributor to understanding PA
behaviour or sedentary behaviour because one’s context is often identified as a barrier to activity (Garn, McCaughtry, Martin, Shen, & Fahlman, 2012).

Regardless of barriers or context, those who gain positive and activation emotional experiences are theoretically more likely to engage in volitional behaviours. Specially, enjoyment and boredom have received attention as they relate to PA. For example, enjoyment is related to self-efficacy, PA benefits, and structured PA (Barr-Anderson, Neumark-Sztainer, Schmitz, & Pate, 2008). Positive affect and enjoyment have been identified as constructs that slow the onset or prevent the decline of PA-related motivation (Yli-Piipari et al., 2013). Overall, research has shown enjoyment as a key characteristic of those motivated to pursue and feel satisfied with PA (Daschmann et al., 2014; Yli-Piipari et al., 2009). In opposition, boredom has been linked with decreased engagement (Garn et al., 2017) and reduced intention to be active (Yli-Piipari et al., 2009). Those experiencing boredom are often profiled as low motivation or amotivated which is predictive of low PA levels (Ntoumanis et al., 2004; Standage et al., 2003). Anxiety is linked to negative thoughts about the stress and worry related to engaging in PA (Barkoukis et al., 2010). Although, anxiety has been reported as moderately negatively related with PA (Yli-Piipari et al., 2009) there are mixed results on anxiety and PA. Anxiety may only be invoked when the environment is filled with pressure or uncertainty and may actually facilitate performance in sport settings (Peres, Curry, Famose, & Sarrazin, 2002). Boredom and anxiety have often been lumped together as negative affect towards PA, which typically leads to reduction in activity levels, effort, and persistence (Biddle et al., 2003). However, combining anxiety and boredom may reduce our ability to evaluate the nuances and differences of their action tendencies. For example, a bored individual may share distinct motivational and behaviour characteristics towards PA as opposed to a person who is feeling anxiety. Therefore, understanding student emotional experiences may be a nuanced approach that explains transfer of PA and sedentary behaviour that has not been identified previously.

The present study

The purpose of this study was to test a model regarding PA and sedentary behaviour in college students using the CVT as a framework. This study explored the relationships between control-value appraisals with emotion, emotion with PA and sedentary outcomes, and indirect relationships via emotional experiences as proposed by Pekrun (2006; See Figure 1). Using CVT, three general research questions were addressed: (a) what are the relationships between perceptions of high/low control and high/low value beliefs with the PA-related emotions of enjoyment, boredom, and anxiety? (b) What is the relationship between PA-related enjoyment, boredom, and anxiety with PA and sedentary behaviours? (c) Are there indirect relationships between PA-related control-value appraisals and PA and sedentary behaviours via one’s enjoyment, boredom, and/or anxiety?

Methods

Participants

A total of 345 students (66.7% female) from a large Southeastern university enrolled in “Introduction to Sociology” participated in the study. The mean age for the group was
19.63 (SD = 1.87) with the majority of the students reporting Caucasian (75%) as their race. Students reported their years in college as first year (57%), second year (20%), third year (11%), and fourth year (12%) and over 25 different declared majors. These courses were purposefully sampled due to its wide variety of student backgrounds. Thus generalisability could be drawn from the population given this course is required for a wide variety of students in college.

**Procedures**

Researchers obtained permission to conduct the study from their universities institutional review board. Professors teaching the desired course were contacted to set up a meeting to explain the scope of the study. Following permission by the instructors, the researchers visited each course section to explain the study. Students were informed how to access the survey and were informed there was no right or wrong answers. All data and consent were collected using the online platform Qualtrics (Provo, UT, 2017). No personal information was collected on the surveys to ensure anonymity. Surveys took approximately 10–15 min to complete and the students were given 1-week window to complete the survey.

**Measures**

**Demographics.** All students’ age, sex, ethnicity, major and grade classification were collected via self-report.

**Control beliefs.** The perceived competence subcomponent of the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989) was used to represent control beliefs.

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**Figure 1.** Hypothesised CVT model of relationships regarding personal appraisals, emotions, and outcomes as proposed by Pekrun (2006). CON = Control beliefs; VAL = Value beliefs; ENJ = Enjoyment; BOR = Boredom; ANX = Anxiety; PA = Physical activity; SED = Sedentary time.
with regard to PA behaviours. This scale has a total of six items and is measured on a seven-point scale ranging from “very true” (7) to “not true at all” (1). Participants are prompted to rate how true each statement is for them regarding PA, an example item is, “I think I am pretty good at physical activity.”

**Value beliefs.** The value/usefulness subscale also a subcomponent of the IMI was used to represent students’ value beliefs regarding PA (McAuley et al., 1989). The scale consisted of seven items and measured on a seven-point scale ranging from “very true” (7) to “not true at all” (1). An example item was, “I believe participating in physical activity could be of value to me.”

**Emotions.** Enjoyment, boredom, and anxiety were measured using subscales of the Achievement Emotions Questionnaire (AEQ; Pekrun et al., 2011) and adapted to align with feelings regarding PA. An example enjoyment item was, “I feel enjoyment during physical activity.” Example boredom and anxiety items included, “I get bored during physical activity,” and “thinking about participating in physical activity makes me feel uneasy.” All items were measured on a five-point Likert scale ranging from “agree a lot” (5) to “disagree a lot” (1). These scales valid and reliable for college students regarding PA behaviour (Garn et al., 2017).

**Physical activity and sedentary behaviour.** The recreational and sedentary subscales of the Global Physical Activity Questionnaire (GPAQ; Chu, Ng, Koh, & Muller-Riemenschneider, 2015) were used to collect PA and sedentary behaviour. The GPAQ is used to estimate the total weekly volume of moderate-to-vigorous physical activity (MVPA) in a typical week. Participants were asked to report the frequency (number of days) and duration (minutes in a typical day) for both moderate and vigorous activities. Results were combined to give a weekly average of MVPA. Students were a single item to measure sedentary time, “How much time do you usually spend sitting or reclining in a typical day?” The GPAQ is a valid and reliable tool (Chu et al., 2015) and provides an inexpensive method for collecting PA information.

**Data analysis**

Confirmatory factor analysis (CFA) was employed to test the construct validity and confirm factor structure (Brown, 2015) of the latent measures used. To handle missing data, researchers used the full information maximum likelihood method (FIML; Enders, 2010). Two CFAs were conducted, the first on control and value beliefs (i.e., appraisals) and the second on enjoyment, boredom, and anxiety (i.e., emotions) using the Mplus 7.4 software. Descriptive statics and bivariate correlations were also calculated for all latent and observed variables. Internal consistency estimates were assessed using composite reliability calculators which are calculated using latent variable indicator factor loadings and uniquenesses (Brown, 2015). Scores above .70 are considered an acceptable fit. Observed variable totals were calculated for MVPA and sedentary time, means and standard deviations were found and outliers (<3%) were removed.

Structural equation modelling (SEM) was used to test the research questions regarding direct and indirect relationships. An SEM allows researchers to investigate the measurement and structural model of the observed data to evaluate proper fit and variable relationships (Kline, 2016). All latent variables were scaled using a marker variable approach where the marked factor indicator becomes the reference point for the latent
construct (Little, 2013). This means that the estimated factor loadings base their relationship on the marked indicator. For consistency, each latent factors’ first indicator represented the marker variable for analysis (Little, 2013). The measurement model is similar to CFA as it measures appropriate fit of the observed data with the proposed model and encompasses data from all variables. The structural model provides direct and indirect path analysis results among all factors. For this analysis, exogenous latent variables and their residual variances are allowed to covary assuming they share a relationship (Kline, 2016). Maximum likelihood ration (MLR) estimation procedures were used in this analysis for assumptions on data non-normality. Lastly, nonparametric bootstrapping (1000 resamples) was used to produce test statistics and 95% confidence intervals (CIs) for all indirect relationships. Bootstrapping aides in interpretation of non-normal data and removing error to evaluate true indirect relationships. CIs that do not include zero are viewed as having statistically significant relationships (Hayes, 2013).

The chi-square test ($\chi^2$) was used to estimate the model, but it is often sensitive to sample size and complexity. Therefore, fit indices such as the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), and root mean square error of approximation (RMSEA) were also used (Hu & Bentler, 1999). CFI and TLI scores of .90 are considered adequate and .95 or higher as good. RMSEA scores of .08 are considered adequate and .06 or lower as good (Hu & Bentler, 1999).

**Results**

An initial set of CFAs was used to evaluate factor structure of the two exogenous groups (control-value appraisals and emotions). A small amount of missing data (i.e., <3%) was handled using the FIML technique. Factor structure of the control-value appraisals ($\chi^2(26) = 102.596$, $p < .001$; CFI = .934; TLI = .908; RMSEA = .093) and emotion variables ($\chi^2(186) = 418.312$, $p < .001$; CFI = .942; TLI = .935; RMSEA = .060) showed adequate to good fit, respectively. The less than ideal RMSEA for the appraisal CFA may reflect higher correlations between the unique variances of item indicators (Little, 2013). When examining the modification indices (Kline, 2016), it appeared that strain occurred between control items (3 – “After working at this activity for a while, I feel pretty competent” and 4 – “I am satisfied with my performance at this task”) causing misfit. Due to the wording of these indicators it was determined that misfit was due to method artefacts and all items remained in final analysis. Thus, although the RMSEA for control-value was higher than desired, the researchers felt comfortable moving forward with analysis given the other global fit results. After confirming factor structure for the appraisal and emotion sections, descriptive statistics and bivariate correlations were evaluated (Table 1). All composite reliability levels showed a good fit (range: .89–.92). The correlation matrix shows that all variables shared significant relationships except sedentary behaviour with value ($p = .069$) and anxiety ($p = .172$). Following acceptable CFA and reliability results researchers moved forward with the SEM.

**Structural equation modelling**

Results supported overall fit for the hypothesised model (see Figure 1), $\chi^2(449) = 1027.021$, $p < .001$; CFI = .926; TLI = .918; RMSEA = .061. The measurement model analysis also
revealed good fit for all standardised factor loadings and their respective latent variables (CON range = .724–.901; VAL range = .729–.899; ENJ range = .766–.861; BOR range = .699–.848; ANX range = .655–.895). Results showed partial support with several significant relationships between latent variables as proposed within our research questions (see Table 2). Control had a positive significant relationship with enjoyment and negative relationships with boredom and anxiety. Interestingly, as a single predictor of enjoyment, control accounted for approximately 60% of the variance. Value also shared significant negative relationships with boredom and anxiety but did not have a significant relationship with enjoyment. In combination, control and value contributed to 42% of the variance in explaining both boredom and anxiety. Evaluating the relationships between emotions and outcomes, only enjoyment was found to be a significant predictor. In addition, enjoyment had a positive relationship with PA and a negative relationship with sedentary behaviour. Although enjoyment played a significant role in predicting PA and sedentary behaviour a small amount of variance was accounted for (10% and 3%, respectively).

Two indirect relationships were identified as significant and both were via enjoyment (Table 3). The first was control to PA via enjoyment (95% CI = .013–.038) and the
second was control to sedentary behaviour via enjoyment (95% CI = −.041–.000). Given the lack of significant direct relationships from value to enjoyment and from negative emotions to outcomes, one can assume that an indirect relationship is not possible among the other variables.

Following the findings from the CVT hypothesised model and to be exhaustive and comprehensive in our investigation, an alternative direct model was tested. The alternative model positioned the control-value appraisals as well as the emotions as predictors of MVPA and sedentary time. Model fit was acceptable ($\chi^2(445) = 1008.945, p < .001; CFI = .928; TLI = .919; RMSEA = .061$) and nearly identical to the hypothesised indirect model. However, only the value appraisal ($\beta = .219, p < .001$) predicted sedentary behaviour and none of the appraisals or emotions were found to predict MVPA. As anticipated, the amount of variance accounted for in the alternative direct model was nearly identical to the indirect model (MVPA = 11%; Sedentary time = 6%). Although the direct model revealed a similar fitting model and was slightly less complex, this model did not add any significant findings and did not provide information on the appraisal–emotion relationship as theorised within CVT. Exploring the theorised antecedents of emotions is an important step into understanding how emotions are formed. So, although the emotions tested in this study did not contribute to the degree that was anticipated, exploring the appraisal–emotion relationship is an important finding, which is retained by focusing on the original indirect model.

### Discussion

Due to decreasing PA and increasing sedentary behaviours across the lifespan, it is important to understand how active behaviours are induced (Deforche et al., 2015; USDHHS, 2008). Motivation has been identified as a key construct for predicting and understanding volitional behaviours (Deci & Ryan, 2002), particularly for individuals in college may be as the habits and behaviours they develop will likely continue into adulthood (Barkoukis et al., 2010; Kilpatrick et al., 2016). One evolving area of interest for interpreting motivation is the study of discrete emotions (Pekrun, 2017). Emotions have the potential to bridge the

### Table 3. Indirect relationship from CVT model, results for MVPA and SED.

<table>
<thead>
<tr>
<th>Indirect path coefficients</th>
<th>$B$</th>
<th>$SE$</th>
<th>Boot 95% CI low</th>
<th>Boot 95% CI high</th>
<th>$\beta$</th>
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Note. MVPA = Moderate to vigorous physical activity; SED = Sedentary behaviours; CON = Control beliefs; VAL = Value Beliefs; ENJ = Enjoyment; BOR = Boredom; ANX = Anxiety.
gap between experiences and future behaviours, represented as action tendencies (Fredrickson, 2001). The purpose of this study was to test a model regarding control-value, emotion, and PA and sedentary behaviour in college students using the CVT as a framework.

**Control-value and emotions**

Results showed relationships between control-value appraisals and emotions. These findings align with research in psychology, suggesting that when individuals feel control over their abilities and outcomes, they are more likely to experience positive emotions (Frenzel et al., 2007; Perry et al., 2014). Control appraisals appear to also detract from the onset of boredom and anxiety (Parker, Perry, Chipperfield, Hamm, & Pekrun, 2018). Those who experience boredom can perceive behaviours as too difficult (Daschmann et al., 2014) or may lack interest resulting from previous experiences.

When individuals feel control, they attribute their ability/success to themselves and believe they have causality over actions and outcomes. Also, if they are unsuccessful, they do not place blame on outside forces but believe their lack of success is something under their control. Therefore, developing a sense of control regarding their causality over outcomes will most likely decrease perceptions of difficulty and improve interest (Parker et al., 2018). Control may share similar relationships with anxiety, as one feels more control there is less unknown about the experience or potential outcomes (Perry et al., 2014), reducing anxiety. Increases in attributional control over outside sources may also reduce anxiety about PA, whereas the lack of perceived controllability will likely increase anxiety (Pekrun, 2017). Experiences common to PA that can be anxiety provoking may include low levels of perceived competence in a sport or game, not feeling comfortable with the equipment or people at a gym and fearing that one’s ability may not be sufficient for reaching intended goals. The results from this study suggest that high perceived controllability is potentially a prerequisite of having a positive emotional experience as it relates to PA.

Interestingly, value also contributed significantly to boredom and anxiety, but not to enjoyment. Value’s significant negative relationship with emotions boredom and anxiety aligns with previous research (Frenzel et al., 2007; Pekrun et al., 2004). The more individuals perceive a task as useful to achieving outcomes, the less likely they are to get bored and/or feel anxious about reaching the intended behaviour. When value is reduced, individuals can experience boredom which is associated with amotivation (Daschmann et al., 2014). On the other hand, anxiety often results in extrinsically driven motivation and may result from outside pressures. For example, individuals may be driven to be active to look a certain way physically. This is particularly important as it relates to PA behaviours as anxiety and lack of interest are often identified as barriers to future PA behaviours (Ntoumanis et al., 2004; Vallerand, 2007).

It is suggested that intrinsic forms of motivation are ideal for PA behaviours (Vallerand, 2007; Yli-Piipari et al., 2009). However, individuals may pursue PA for a myriad of extrinsically guided reasons. Although students may engage in activity for extrinsic reasons, their motivation and perceptions of well-being may reduce over time (Deci & Ryan, 2002). Disparately, emotions other than enjoyment may be connected to value when conceptualised as usefulness, such as pride and shame because these emotions are conceptualised
as outcome-driven emotions (Gilchrist et al., 2017; Pekrun, 2006). Thus it is likely that when one is motivated by the outcome, performance, or result they are more extrinsically motivated (Deci & Ryan, 2002). Emotions like pride and shame can result from either achieving, or not achieving the intended performance or outcome, respectively. If an individual perceives something as useful to reaching personal goals, they may be driven to achieve high activity levels and feel pride when accomplishing that goal. In addition, shame may be felt when students fail to reach the goal and they may feel embarrassed due to perceived lack of ability or other external pressure from peers who are active. Interestingly, the alternative indirect model findings showed value as a positive predictor with sedentary time. This suggests that individuals who perceive greater value (usefulness) of PA, reported higher sedentary time. This finding may also speak to the potential of outcome-related emotions as predictors of behaviour as students’ external pressure maybe turning individuals off from PA. Although they realise PA’s usefulness, they may not choose to be active (e.g., feeling shameful). However, more research is needed to explore this anomaly. Within CVT, value is often conceptualised as a construct of perceived usefulness and/or importance. In this study, the extrinsically driven value construct (i.e., usefulness) did not predict enjoyment. Although Pekrun (2006) suggests that value is a combination of importance, usefulness, and interest, there may be clear distinctions between intrinsic and extrinsic forms of value and the emotions they share a relationship with. If this is the case, research is needed to explore relationships between intrinsic forms of value (Frenzel et al., 2007; Simonton & Garn, 2019), emotions, and PA behaviours.

**Emotions and behaviours**

Overall limited variance was explained for PA and sedentary behaviour given the emotions selected for this study. One potential explanation for the limited variance explained could be the domain perspective of PA as opposed to specific types of PA. Although previous research utilising CVT have consistently evaluated emotions at the domain (i.e., math, science, PE; Pekrun et al., 2002; Simonton et al., 2017) there is reason to believe that PA-type could provide more nuanced specificity to understanding individual emotions (Simonton & Garn, 2019). For example, one individual may thoroughly enjoy fitness training classes but find little interest in long-distance running. Although both activities could be categorised as PA and even cardiovascular exercise, the emotional responses may be different and nuanced. This is an important consideration for all emotion research given the close relationships and specificity to emotions appraisals with specific events (Pekrun et al., 2002).

As mentioned previously, most research suggests that intrinsic motives explain volitional behaviours like PA and may reduce negative behaviours like sedentary time (Deforche et al., 2015; Yli-Piipari et al., 2009). Although this study found similar relationships, the unanswered variance suggests there may be other extrinsically driven emotions that lead to these behaviours. For example, positive emotions such as pride and relief may also explain one’s choices to be active or reduce sedentary time. Individuals may be driven by achieving a toned body or gaining social acceptance with a peer group as a reason to be active, which are considered more externally driven reasons. These motivations likely lead to emotions other than enjoyment. Another important consideration may be the marriage between emotions and specific experiences. For example, some individuals may feel
enjoyment when playing basketball but boredom when running laps for their PA. Although PA is often measured in a general characteristic, specificity to the type of activity may highlight a greater understanding of one’s emotional experience and reduce variance when predicting behaviours.

Interestingly, boredom did not share a relationship with PA or sedentary behaviour. Previous research shows a negative relationship between boredom and MVPA (Viira & Raudsepp, 2000) and has been found as a major contributor to being sedentary and other unhealthy behaviours (Metos, Gren, Brusseau, & Frost, 2018). Boredom is often prominent when individuals find activities too easy or too difficult and/or hold a general lack of interest. Our results further elucidate the potential for other extrinsically driven emotions which may play a bigger role than boredom in predicting active/sedentary behaviours. For example, shame may predict sedentary behaviour as individuals realise that sitting for a long time is unhealthy but their class schedule and studying forces them to be sedentary. Overall, individual’s previous experiences and emotional interpretation regarding their PA and sedentary behaviours are interconnected. Understanding this relationship may improve our understandings of one’s subjective behaviour and the intricacies of interpreting their motivation.

**Limitations and future research**

Although all affective/emotional responses cannot be captured in a single study, this study adds to the literature regarding the relationships between discrete emotions and PA and sedentary behaviours. However, a greater amount of emotions needs to be considered for future studies. Overall, going beyond a dichotomous evaluation of pleasant versus unpleasant, and beyond enjoyment, boredom, and anxiety may be necessary. Emotions are complex and can often fluctuate; therefore, to truly evaluate emotional antecedents and emotions as mediators a longitudinal research design is warranted. Temporal relationships between antecedents, emotions, and outcomes may aid in the translation of personal experiences, emotions and PA-related behaviours. Additionally, the evaluation of emotions has been established in academic and PE arenas using the CVT, but more research is needed regarding PA-related behaviours. For example, measuring emotions as they relate to specific PA tasks (e.g., long-distance running vs. pick-up basketball) appears to be the next logical step in understanding individual behaviour. Providing more specificity to PA type is likely to increase the amount of variance that can be attributed from emotion to behaviour. It may be important to consider other direct and indirect models or potentially the use of a hybrid model to explore the complexities of one’s emotion and activity behaviours. Regardless, future research should place importance on the role of discrete emotions potentially explaining volitional activities such as PA or sedentary behaviours.

**Conclusion**

Emotions share a strong relationship with one’s control and value beliefs as established through the CVT. Enjoyment and control beliefs were significantly related to greater PA time and reduced sedentary time. Although negative emotions like boredom and anxiety were not significant in predicting behaviours, the overall
variance accounted for was less than ideal. These findings suggest that while the potential antecedents of emotion are present, other emotions may better capture one’s subjective experiences and explain motivational tendencies. To summarise Linnenbrink-Garcia et al. (2016), motivation directs behaviours, beliefs, goals, and experiences to shape engagement and learning. Emotion (1) coordinates the physical, psychological, and expressive components that influence behaviour; (2) represent essential markers of motivation and interpretation of experiences, although further information is needed to explain volitional behaviours; (3) connections to events and tasks clearly have a major contribution guiding one’s behaviour. Using an emotional approach may provide intricate details that have not been isolated in previous research utilising generalised affective perspectives. Given the unpredictability of human behaviour and the importance of PA-related behaviours, researchers should use a whole person perspective.

**Disclosure statement**

No potential conflict of interest was reported by the author(s).

**References**


