Wearable activity monitors and goals: Perceptions on physical activity, attitudes and motivational outcomes

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Submitted in partial fulfillment of the requirements for the degree of

Master of Science

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Abstract

Evidence attesting to the benefits of wearable activity monitors for increasing PA has been reported (USDHHS, 2018). Goal setting is one behavior change technique that often accompanies wearable activity monitors and has been deemed an essential component to any health behavior change intervention (National Institute for Health and Care Excellence, 2014). Specific to PA behavior, goal setting has been deemed effective regardless of age, sex, and activity status (McEwan et al., 2016). Therefore, the purpose of this study was to determine if affective goals confer unique benefits on physical activity (PA), attitudes and behavioral regulations consistent with the Organismic Integration Theory (OIT; Ryan & Deci, 2017) among users of wearable activity monitors. Affective goals were compared with instrumental goals, step count and a no goal condition. Adopting a randomized experimental post-test only design, undergraduate students (N = 153) were assigned to one of eight conditions. Participants read a scenario then completed a battery of questionnaires housed on a secure online interface. Differences by condition were not found for short- or long-term PA or attitudes (p's > .05). Differences were noted for extrinsic regulation (p = 0.025; ηp² = .105). Results indicated that extrinsic regulation was higher in the no goal condition when compared to most other conditions. These findings imply that goal setting, regardless of type, may offset increases in extrinsic motivation associated with the use of wearable activity monitors. Users of wearable activity monitors looking to improve PA, positive attitudes and motivation associated with PA may benefit by utilizing goal setting in combination with other commonly used BCTs. A further investigation upon goal setting and users of wearable activity monitors is warranted.¹

¹ Keywords: affective goal setting, physical activity, wearable activity monitors, motivational regulations, extrinsic
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Wearable activity monitors and goals: Perceptions on physical activity, attitudes and motivational outcomes

Epidemiological and biomedical evidence supports the role of regular physical activity (PA) on physical and psychological health (U.S. Department of Health & Human Services [USDHHS], 2018). PA is defined as “bodily movement produced by skeletal muscles that result in energy expenditure.” (USDHSS, 2018, p. C-3). Physical inactivity is the fourth leading health risk factor for global mortality accounting for 6% of premature deaths (World Health Organization [WHO], 2010). Regular PA has shown to be a primary and secondary preventative measure for various chronic medical conditions such as cardiovascular disease, and cancer (Warburton & Bredin, 2016; Warburton, Nicol, & Bredin, 2006). Further, PA has been linked to risk reduction for cognitive disorders such as dementia, Alzheimer’s, as well as autoimmune (e.g., multiple sclerosis) and neurological disorders (e.g., Parkinson’s disease; USDHHS, 2018).

The public health significance of PA renders the development and publication of evidence-informed guidelines detailing the frequency, duration, intensity, and total amount of PA necessary (WHO, 2010). Canada’s guidelines state that adults aged 18-64 years should amass at least 150 minutes of moderate- to-vigorous intensity PA in bouts of 10 minutes or more (Canadian Society for Exercise Physiology, 2011). Despite these recommendations, only 15% of adult Canadians meet these guidelines (Statistics Canada, 2011). Recently, updated evidence on the benefits supporting PA and health was undertaken in the United States (USDHHS, 2018). Based on this review, it was recommended that adults accumulate 150 – 300 minutes of moderate-intensity or 75 – 150 minutes of vigorous-intensity aerobic activity per week (USDHHS, 2018). One notable change was the elimination of the message that PA should be completed in bouts of 10 minutes or more. Evidence now supports that PA, regardless of
duration, contributes to health benefits (USDHHS, 2018). Given the low rate of individuals meeting PA recommendations, combined with noted health benefits, efforts to increase PA are needed. Given the recent popularity of wearable activity monitors (i.e., Fitbits, Smartwatches, mobile applications), the use of technology may serve as one means to promote PA (Nasir & Yurder, 2015).

**Wearable Activity Monitors**

Wearable activity monitors are designed to be worn on an individual’s body to track movement and/or biometric data (Ridgers & Lai, 2018). Wearable activity monitors enable the user to monitor their PA by providing feedback via a visual display or through an accompanying mobile application (app). Common components of these monitors include a visual display, internal memory, a movement tracker (i.e., accelerometer or pedometer) as well as a method to provide feedback to the user (Haghi, Thurow, & Stoll, 2017; Hoy, 2016; Lewis, Lyons, Jarvis, & Baillargeon, 2015). Wearable activity monitors are promoted as conduits through which personal data are generated that can be used to make changes in individual habits resulting in improved health and fitness levels. For example, the WHO (2018) has recently partnered with Google in fitness app development and insurance providers have initiated a process that requires the use of a fitness tracking device (BBC, 2018) to combat physical inactivity and improve health.

Approximately thirty-three percent of people monitor or track their health or fitness via wearable activity monitors (Martin & Gerhardt, 2016). In 2016, there were approximately 325 million wearable activity monitors worldwide, with sales expected to double by 2020 (Statista, 2017). Worldwide revenue for these devices approximates 33.8 billion dollars/year, with this number projected to more than double by 2022 (Statista, 2019). With considerable evidence
supporting the popularity of wearable activity monitors (e.g., Martin & Gerhardt, 2016), researchers and practitioners are beginning to expand their knowledge on the effects these devices may have on PA behavior and health.

Researchers understanding of whether wearable activity monitors are effective in promoting PA is complex (Ridgers & Lai, 2018; Romeo et al., 2018). Interventions involving wearable activity monitors on increasing PA are equivocal (Jakicic et al., 2016; USDHHS, 2018; Wang et al., 2015). For example, Kim and colleagues (2018) revealed no significant changes in PA behavior in university-aged students following a 15-week intervention whereby participants were asked to use wearable PA monitors. Thompson and colleagues (2014) revealed that participants who were given wearable activity monitors were significantly less active at the end of a 6-month intervention. In comparison, Papalia and colleagues (2018) results indicate that participants who wore wearable activity monitors completed more moderate and vigorous PA than those who did not. In their recent meta-analytic review, Romeo et al. (2018) concluded that the use of PA apps did not result in significant increases in steps per day or time spent in moderate-to-vigorous physical activity (MVPA) compared to controls. Yet, the use of wearable activity monitors may be associated with increased PA in select cohorts (USDHHS, 2018). More specifically, “moderate” evidence supports wearable devices for increasing PA in adults who are overweight or obese, with “limited” evidence attesting to their utility for those living with musculoskeletal disorders (USDHHS, 2018).

**Wearable activity monitors and behavior change techniques**

Manufacturers of wearable activity monitors often include behavior change techniques (BCTs) that may support motivation and PA behavior change (Duncan et al., 2017; Mercer, Li, Giangregorio, Burns, & Grindrod, 2016). Schoeppe et al. (2016) found greater improvement in
PA for those using mobile applications combined with BCTs than those using stand-alone mobile applications. BCTs are the ‘active ingredient(s)’ (e.g., self-regulation, goal setting, rewards, social support, etc.) of any intervention designed to change processes that regulate behavior (Michie et al., 2013). Common BCTs found in wearable activity monitors include feedback on performance, facilitated self-monitoring and supported goal setting (Conroy, Yang, & Maher, 2014; Lyons, Lewis, Mayrsohn, & Rowland, 2014; Mercer et al., 2016). When combined with goal setting and other behavioral strategies, “strong” evidence supports the use of wearable activity monitors to increase PA in the general adult population and those living with type II diabetes (USDHHS, 2018, F11-49). An examination of all BCTs embedded in wearable activity monitors is outside the scope of this investigation. A focus on goal setting as one common BCT incorporated into wearable activity monitors will be expanded upon.

**Wearable activity monitors and goal setting**

Locke and Latham (1991) proposed that conscious human behavior is purposeful and regulated by an individual’s goals. A goal reflects the object or aim of actions an individual adopts (Tubbs & Exeberg, 1991). Setting goals facilitates behavior change by directing an individuals’ attention and effort which subsequently increases persistence (Locke & Latham, 2006). Across diverse domains, individual difference (e.g., goal commitment, perceived importance) and goal attributes (e.g., difficult, challenging) have been shown to moderate the goal setting – behavior change relationship (Locke & Latham, 1991). Specific to PA behavior, goal setting has been deemed effective regardless of age, sex, and activity status (McEwan et al., 2016). As ninety percent of users had a specific PA goal in mind prior to purchasing their wearable activity monitor (Canhoto & Arp, 2017), researchers have been encouraged to examine
which type of goal embedded in wearable activity monitors are best for motivating individuals to be more active (Sullivan & Lachman, 2017).

Monitoring step count has been identified as the primary PA metric of interest for users of wearable PA monitors (Alley, Schoeppe, Guertler, Jennings, Duncan & Vandelanotte, 2016). Specific, measurable, achievable, realistic and time-bound goals (e.g., walk 10,000 steps per day within 4 weeks) that can be tracked through wearable activity monitors are advantageous as they are linked with specific and realistic expectations for behavior (Lieffers, Haresign, Mehling, & Hanning, 2016; Locke & Latham, 1991). Select activity monitors such as FitBit allow for the monitoring of graded smaller goals (e.g., taking 250 steps per hour) to facilitate the achievement of larger goals. In their review, Bravata and colleagues (2007) found that participants who set a PA goal increased their step count by more than 2000 steps per day. Yet, a meta-analysis demonstrating the effectiveness of goal specificity on PA determined this construct to have little to no significance on the participant’s engagement in PA (McEwan et al., 2016). It is still not well understood whether PA goal setting embedded in wearable activity monitors are sufficient for changing individual’s behavior (Lieffers et al., 2016; Shih, Han, Poole, Rosson, & Carroll, 2015).

Participatory motives may be one alternative to understand how goal setting may be associated with PA behavior. Participatory motives are the contents of individuals' goals (i.e., what an individual aims to attain, or avoid, through PA participation; Ingledew & Markland, 2008). Fourteen specific participatory motives for PA behavior engagement have been identified: affiliation, appearance, challenge, competition, enjoyment, health pressures, ill-health avoidance, nimbleness, positive health, revitalization, social recognition, strength/endurance, stress management, and weight management (Ingledew & Markland, 2008). While significant gender
differences have been noted, university-aged students most strongly endorse enjoyment, stress management, positive health and appearance (Cerar, Kondric, Ochiana & Sindik, 2017; Kilpatrick, Herbert & Bartholomew, 2005). Health pressures (e.g., because my doctor advised me to exercise) was the least important participatory motive in university students (Cerar et al., 2017; Kilpatrick et al., 2005) with researchers believing this motive is not salient in younger samples (Ingledew, Markland, & Ferguson, 2009).

Building on participatory motives, Ryan and Deci (2017) advanced goal content theory (GCT) to note the importance of understanding the content of the goals that an individual pursues (i.e., what a person pursues). Intrinsic goal contents such as “health”, “skill development” and “social affiliation” are said to be inherently satisfying and thus, more likely to increase behavior (Ryan & Deci, 2017; Vansteenkiste, Niemiec, & Soenens, 2010). In contrast, extrinsic goal contents such as “image” and “social recognition” are pursued for external values. Researchers have noted a positive association between intrinsic goal contents and exercise adherence in comparison to extrinsic goal contents (Sebire, Standage, & Vansteenkiste, 2009). Further, intrinsic goal contents positively predicted MVPA and bouts of MVPA as derived through accelerometry (Sebire, Standage, & Vansteenkiste, 2011). With respect to wearable activity monitors, 20 percent of current users reported that health was the primary reason for using the device (Maher, Ryan, Ambrosi, & Edney, 2017). Therefore, health appears to be one prominent reason for usage.

Affective goals and physical activity

Many social cognition models, including GCT (Ryan & Deci, 2017), focus on cognitive at the expense of affective influences on behavior. One understudied goal to understanding PA behavior are people’s affective goals (Williams, Dunsiger, Ciccolo, Lewis, Albrecht, & Marcus,
Behavioral decision making is often grounded in how pleasant or unpleasant an experience is, specifically at the outset and termination of a particular behavior (Parfitt, Olds & Eston, 2015). It has been argued that there is a lack of information on proximal benefits of PA (Thai, Taber, Oh, Segar, Blacke, & Patrick, 2019) and that PA promotion strategies may be more effective if they resonate with an individual’s daily interests (e.g., energy, happiness; Segar, Eccles, & Richardson, 2011). Further, Van Cappellen and colleagues (2017) suggest that positive affect can facilitate long-term adherence to positive health behaviors. Researchers argue that affective, as opposed to health, goals are more effective to understanding PA behavior given the temporal salience of the outcome (Conner, Rhodes, Morris, McEachan, & Lawton, 2011; Evans, Cooke, Murray, & Wilson, 2014; Mailey, Dlugonski, Hsu, & Segar, 2018).

Much of researcher understanding of the relative benefits of affective versus cognitive (e.g., health) information linked to PA can be understood through consideration of 1) attitudes and b) messaging. Linked with the theory of planned behavior (Ajzen, 1991) attitudes represent the overall evaluation of the behavior and can be examined as either cognitive (i.e., instrumental) or affective judgements. Rhodes, Fiala and Conner (2009) describe affective judgments as the overall pleasure/displeasure, enjoyment, and feeling states expected from engagement in PA. In other words, affective judgments are expectations of an experience and involve more cognitive processing than feelings of positive/negative affect in the moment (i.e., affective responses; Ekkekakis, Hall & Petruzello, 2008). In contrast, instrumental judgements are cognitions that an individual has regarding the utility of a given behavior (e.g., health, weight appearance; Bellows-Riecken, Mark, & Rhodes, 2013). Affective judgements have been found to elicit greater influence on PA behavior than instrumental judgements (Conner et al., 2011; Rhodes et al., 2009). Furthermore, Rhodes, Gray and Husband (2019) reported that changes in affective
judgement were associated with changes in subsequent PA. Of added note, the benefits of affective judgements on PA appear robust regardless of demographic variables and instrumentation used (McEachan, Taylor, Harrison, Lawton, Gardner, & Conner, 2016; Rhodes et al., 2009).

Researchers have demonstrated the effectiveness of affective judgement-related messages to successfully aid individuals with increased PA (Conner et al., 2011). Ruissen and colleagues (2018) found that mental contrasting interventions adopting affective as opposed to instrumental messaging resulted in greater PA. Both affective and instrumental messaging were more effective at PA behavior change compared to a control (Ruissen, Rhodes, Crocker & Beauchamp, 2018). The utility of affective judgement messages when compared to messages linked with instrumental judgments may be particularly effective to promote PA for inactive individuals (Sirriyeh, Lawton, & Ward, 2015). Most recently, Forster and colleagues (2017) developed a mobile app focused on the recall of positive affective judgements to support PA habit formation. As calls to examine which type of goals for individuals using wearable activity monitors are best for motivating PA (Lieffers et al., 2016; Sullivan & Lachman, 2017) with consideration of affective goals, as opposed to those linked with PA or instrumental cognitions, warrants further investigation.

**The pitfalls of wearable activity monitors**

Based on the collective evidence, wearable activity monitors do not aid individuals to achieve sustainable behavior change (Jarrahi, Gafinowitz, & Shin, 2018; Segar, 2017; Sullivan & Lachman, 2017) or enable users to make measurable health benefits (Jakicic et al., 2016). Therefore, the motivational impact of wearable activity monitors has received considerable attention (Duus, Cooray & Page, 2018; Segar, 2017). Wearable activity monitors can aid
individuals in feeling empowered, increased confidence in decision making, and assist with the
development of training programs (Duus et al., 2018; Little, 2017). These devices have further
been linked with increased motivation to achieve goals (Duus et al., 2018; Karapanos,
Gouveia, Hassenzahl, & Forlizzi, 2016), and positive emotions with daily goal attainment
(Duus & Cooray, 2015).

Although the motivational effects seem promising, they may be short-lived with respect
to PA engagement (Duus et al., 2018; Ledger & McCaffrey, 2014). Forty percent of participants
disengage with their device by 6 months, and by 1 year only ten percent still used their monitors
(Segar, 2017). An array of reasons have been identified as contributing to the discontinued use of
wearable activity monitors including the objectification of bodily movement (Toner, 2018), habit
formation (Nafus & Sherman, 2014), emotional distress and unhappiness (Duus et al., 2018;
Etkin, 2016; Goodyear, Kerner & Quennerstedt, 2017) and increased feelings of pressure and
guilt linked to goal attainment (Duus & Cooray, 2015). Finally, literature on wearable activity
monitors and PA suggests that when individuals place emphasis on extrinsic motivators such as
external rewards given from an app (e.g., badge, trophy), it can undermine intrinsic motivation
and lead to disengagement if the extrinsic reward is removed (Attig & Franke, 2018; Etkin,
2016; Karaponos et al., 2016; Renfree, Harrison, Marshall, Stawarz, & Cox, 2016).

Organismic integration theory (OIT; Ryan & Deci, 2017) provides a theoretical framework
for understanding and explaining motivation in PA settings. According to Ryan and Deci (2017),
motivation is conceptualized as a continuum that ranges from non-self-determined (i.e., controlled)
to more self-determined motives posited to underpin behavior. The least self-determined form of
motivation, amotivation, is characterized by lack of intention to engage in a behavior and is
displayed when individuals perceive the contingencies between their actions and
the outcomes of their actions as purposeless (Ryan & Deci, 2002). Situated at the opposite end of the continuum is the most self-determined form of behavioral regulation (i.e., intrinsic motivation) which refers to participation in an activity by an individual for its own sake and is undertaken in the absence of any external reward (Ryan & Deci, 2017). Between these anchor motives are four forms of extrinsic regulation that differ in their degree of internalization by the individual and/or integrated with their sense of self. Engaging in a behavior to attain a reward, to avoid punishment, or negative evaluation represents external regulation (Ryan & Deci, 2017). Introjected regulation refers to actions that are performed due to a sense of intrapersonal pressure based on negative emotions (e.g., guilt) and/or to support contingent self-worth (Ryan & Deci, 2017). More self-determined forms of motivation are regulated by behavioral engagement because it is a highly-valued activity (identified regulation) or the extent to which engaging in the behavior is congruent with values or is symbolic with a person’s sense of self (integrated regulation; Ryan & Deci, 2017).

Researchers have found that more self-determined regulations, notably identified (Silva et al., 2010; Wilson, Rodgers, Fraser, & Murray, 2004; Wilson, Sabiston, Mack, & Blanchard, 2012) and integrated, (Teixeira, Carraça, Markland, Silva, & Ryan, 2012) are linked with increased PA. Consistent with Ryan and Deci (2017), controlled regulations that underpin the extrinsic forms of motivation have been found to display a small negative, or no, relationship with PA behavior (Brunet & Sabiston, 2011; Gunnell, Crocker, Mack, Wilson, & Zumbo, 2014; Teixeira et al., 2012; Wilson et al., 2004). The above findings hold regardless of whether PA is assessed through self-report (e.g., Wilson et al., 2012) or with wearable activity monitors (e.g., Castonguay & Miquelon, 2018). Gunnell et al. (2014) noted that increased intrinsic goal content was positively associated with both autonomous and controlled regulations over six months.
Finally, Sibley and Bergman (2016) found that health goal contents negatively predicted extrinsic regulation and positively predicted identified and intrinsic regulations in university students.

**Significance of the research**

The broad appeal of wearable activity monitors as a vehicle for promoting PA holds promise for individuals (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015) and has been taken up by organizations to improve health (e.g., WHO, 2018). Yet, whether wearable activity monitors can promote PA behavior change is equivocal (Segar, 2017; Sullivan & Lachman, 2017). The inclusion of behavior change techniques within wearable activity monitors may support the initiation and maintenance of PA (Schoeppe et al., 2016). While the majority of wearable activity monitors include elements that support goal setting (Conroy et al., 2014), how goal setting best aids individuals to participate in PA with respect to those who use wearable activity monitors is unclear (Sullivan & Lachman, 2017). Researchers interested in the benefits of wearable activity monitors on PA behavior have typically examined PA (e.g., 10,000 steps; Alley et al., 2016). Instrumental goals (e.g., health, weight management) have demonstrated their utility as components of interventions targeting PA behavior change (Conner et al., 2011; Rodearmel et al., 2006). More recently, evidence supports the effectiveness of affective goals on PA (Rhodes et al., 2009). Only recently have affective goals been introduced into wearable activity monitors, yet there was limited success in changing PA (Forster et al., 2017). Currently, it is unclear whether individuals who use wearable activity monitors and set affective goals are more likely to report greater PA than those who set instrumental or PA goals.

Further, wearable activity monitors have been shown to have both motivational benefits and pitfalls (Bice, Ball, & McClaran, 2016; Goodyear et al., 2017). As such, greater understanding of
motivational consequences of wearable activity monitors is needed. Researchers have suggested that the use of wearable activity monitors may undermine intrinsic motivation for PA (Attig & Franke, 2018; Etkin, 2016; Karaponos et al., 2016; Renfree et al., 2016).

**Purpose and Hypotheses**

The purpose of this study was to determine if affective goals confer unique benefits on PA, attitudes and motivational regulations consistent with OIT (Ryan & Deci, 2017) compared to other types of goals among university students who use wearable activity monitors. The following study hypotheses were examined:

H1: Aligned with (Connor et al., 2011; Lowe, Eves & Carroll, 2002) users of wearable activity monitors who set affective goals would report greater PA than those who set either PA or instrumental goals or those in the no goal condition.

H2: Consistent with (Connor et al., 2011; Ruissen et al., 2018) users of wearable activity monitors who set affective goals would report more positive affective attitudes for PA than those who set either PA, instrumental, no goals. Further, users of wearable activity monitors who set instrumental goals would report more positive instrumental attitudes for PA than those in the PA, affective or no goal condition.

H3: Given the limited literature examining affective goals relative to other goal types adopted in this study, no differences would be found between users of wearable activity monitors on motivational regulations for PA.

**Methods**

**Participants**

Participants were undergraduate students enrolled at Brock University. Inclusion criterion was: 1) 17 years or age or older, 2) the ability to both read and write in the English language, 3)
currently enrolled in either part-time or full-time classes at the University, and 4) consent to participate in this study.

A priori power analysis for a Multivariate Analysis of Variance (MANOVA with 8 levels (i.e., condition) and two dependent variables was conducted in G*Power (Faul, Erdfelder, Buchner, & Lang, 2013). The target sample size for this study was one-hundred and twenty-eight participants ($n = 16$ per level). This target sample size was estimated based on a medium effect ($f = .25$), a fixed probability value ($\alpha = .05$) and statistical power ($\beta = .80$).

**Procedure**

Participants were recruited via various methods. First, recruitment posters were located around the University’s campus with permission (see Appendix A). Second, with permission, instructors/professors delivering undergraduate classes at Brock University were asked to advertise this study via their course site(s) in SAKAI using the script (see Appendix B). An email to guide communication between the Principle Student Investigator with course instructors/professors was used (see Appendix C for details). Access to courses being taught by the Faculty Supervisor was not sought. Finally, verbal presentations were made to undergraduate students in their respective classes in-person by the Principal Student Investigator. Consent of the course instructor/professor was first secured. The verbal presentation consisted of a semi-structured script, PowerPoint slides and lasted no more than 5 minutes in duration. See Appendix D for a sample of the script used to guide these verbal presentations that were used to recruit participants for this study.

Participants were asked to partake in this study in the Behavioral Health Sciences Research Lab located in Welsh Hall (WH) Room 141. Once arrived, the participant was brought into the annex room within the lab. At the discretion of the participant, the door was shut prior to
initiation of the study to maximize privacy. The Principle Student Investigator then explained the purpose and importance of the study, potential risks and benefits, and the requirements for involvement should they accept to participate in the given study. The participant was provided two printed copies of the Letter of Invitation (see Appendix E) and Informed Consent (see Appendix F). One copy of each could be retained by the participant for their records. Participants were reminded that study involvement is voluntary noting that participation can be declined. Should they had chosen to participate, participants had the opportunity to decline any questions they did not wish to answer and could withdraw their involvement in the study at any time without penalty. The participant was then provided with an opportunity to ask questions of the Principle Student Investigator prior to providing consent. The participant was asked to check a box confirming their informed consent, with one copy of this document secured in a locked filing cabinet in WH 141.

Once this process had been initialized, participants were randomly assigned (via GraphPad.com) to an experimental group and handed one of the eight vignettes illustrating a specific scenario prior to completing the questionnaires. The participant was then invited to sit at the computer within the annex room to complete the study questionnaire. The Principle Student Investigator then left the annex room to give the study participant maximal privacy during the data collection phase of this study. The participant was assured that the Principle Study Investigator may be contacted for any reason in the room adjacent to the annex in WH 141. Once the narrative had been read, the participant was then asked to answer questions pertaining to the narrative and demographics via an encrypted website (www.surveymonkey.com). This process took no longer than 30 minutes in total including reading the narrative in full. Once completed, the Principle Student Investigator informed the participant the potential summary feedback they
could receive after the given study has been analyzed and completed. The participant was asked if they wish to receive the summary feedback (see Appendix G for participant debriefing form), by which if they accept, a form of contact was asked of the participant (e.g., via email). This information was stored (in a separate folder than the informed consent) and locked in a filing cabinet. The participant was then thanked for his/her participation in the given study and shown out of the Behavioral Health Sciences Research Lab. A procedural flow chart can be found in Appendix H.

**Instrumentation**

Questionnaires were completed by participants in the order presented below. All items included in the questionnaires and in this study are presented in Appendix I.

**Physical activity.** The PA questionnaire implemented in this study was used to assess participant’s expectations towards future PA engagement. This instrument was adapted from previous work used in exercise psychology literature (Conner et al., 2011; Prochaska & Velicer, 1997). The questionnaire is a 2-item instrument assessing the short and long-term expectations of PA engagement (2 items; “Chris will continue to engage in physical activity four to five times per week for the next 6 months”). Items are scored on a 7-point Likert scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).

**Attitudes.** Affective and instrumental judgments towards PA were measured using sematic differential scales (Conner et al., 2011). Following the instructional stem “Chris finds physical activity… affective (4 items; Sample item: “pleasant”) and instrumental judgments (5 items; Sample item: “useful”). Each adjective pair is scored across a 7-point unipolar scale. Scores of each component were computed by averaging response options across affective and instrumental subscales. This instrument is adapted from questionnaires previous applied in
exercise psychology literature involving instrumental and affective judgements towards PA behavior (Bellows-Riecken et al., 2013; Conner et al., 2011; Ruissen, Rhodes, & Beauchamp, 2019). Evidence for reliability and validity of scores representing affective and instrumental attitudes have been reported (Bellows-Riecken et al., 2013; Conner et al., 2011).

**Motivation.** The Behavioral Regulation in Exercise Questionnaire-2R (BREQ-2R; Markland & Tobin, 2004; Wilson et al., 2006) was used to assess participants’ motivation (i.e., the range of behavioral regulations). For the purposes of this study, item wording was changed from “exercise” to “physical activity” to more accurately align with study objectives. Item responses followed the motivational stem of “Why are you physically active?”. The BREQ-2R is a 23-item instrument assessing amotivation (4 items; “…doesn't see the point in physical activity”), extrinsic (4 items; “because others say he/she should”), introjected (3 items; “he/she feels guilty when he/she doesn't engage in physical activity”), identified (4 items; “he/she values the benefits of physical activity”), integrated (4 items; "it is consistent with his/her values”), and intrinsic (4 items; “because it’s fun”) regulations. Items are scored on a 5-point Likert scale ranging from 0 (not true for me) to 4 (very true for me). Scores for each of the motivational regulations were computed by averaging response options across subscales. Construct validity evidence including structural validity and convergent validity have been reported in exercise (Wilson et al., 2006; Wilson, Rodgers, & Fraser, 2002) and PA contexts (Vancampfort et al., 2013; Verloigne et al., 2011). Support for estimates of internal consistency (Cronbach’s α, Cronbach, 1951) of scores for each of the behavioral regulations have been reported (Wilson et al., 2006; Wilson et al., 2012).

**Demographics.** Descriptive information for the sample was obtained through self-report questions based on age, sex, height, etc. Participants were reminded prior to completing this
section that questions answered pertain to the individual participating in the study in opposition to the character in the vignette for clarity purposes.

**Manipulation check.** Four questions were implemented in this section to determine if all independent variables had their anticipated effects on the dependent variables used in this study. Items are scored on a 7-point Likert scale ranging from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*). A sample item used in this section is as follows: “Chris had a goal to increase his immune system functioning to prevent colds and flu through physical activity”.

**Vignettes.** Eight separate vignettes were implemented in this study (see Appendix J). The template of each vignette was modified from previous experimental protocols used in the field of exercise/health psychology (Lindwall & Martin Ginis, 2010; Morris et al., 2016) and sport psychology (Deck et al., 2018). Vignettes were created to describe the average university student. All vignettes used in this study consisted of a word count between 142 and 159. Readability index scores remained consistent throughout all eight scenarios (i.e., SMOG: 5.6 - 6.6; Flesch-Kincaid grade level: 5.9 – 6.3).

**Data Analysis**

Data analyses proceeded sequentially. Inspection of missing data and non-response error was first assessed through Missing Values Analysis in SPSS. Any missing data was replaced using a multiple imputation procedure adopting an expectation-maximization (EM) algorithm resulting in a more realistic estimate of variance (Tabachnick & Fidell, 2019). Second, univariate normality (i.e., means, standard deviation, skewness and kurtosis) of the data was then inspected. Internal consistency reliability estimates (Cronbach’s α, Cronbach, 1951) were computed to determine reliability for all scores from multi-item instruments.

Third, separate one-way Analyses of Variance (ANOVAs) were conducted to examine
differences across each goal condition (i.e., vignette) on the single-item indicator of short- and long-term PA. It should be noted that a high correlation \((r = .82)\) between dependent variables (affective and instrumental attitudes) was found. Based on recommendations by Tabachnick and Fidell (2019) a composite score for attitudes was created. Therefore, an ANOVA was used to test the second hypothesis in opposition to a MANOVA. Prior to running the ANOVA models, all required statistical assumptions were examined. Assumptions include: (a) the dependent variable being measured at an interval or ratio level, (b) the independent variables consisting of two or more categorical, independent groups, (c) independence of observations, (d) homogeneity of variance, (e) absence of outliers, and (f) univariate normality.

Finally, a Multivariate Analysis of Variance (MANOVA) was conducted to examine differences on motivational regulations by goal condition. The MANOVA used to analyze data in this study was implemented to examine mean differences among groups on multiple dependent variables (Tabachnick & Fidell, 2019). Each independent variable (i.e., affective goal, instrumental goal, step goal, no goal x 2 sex) was represented in each case scenario. The MANOVA examined mean differences between independent variables and motivational regulations (i.e., intrinsic, integrated, identified, introjected, extrinsic, amotivation). Where there were significant model differences \((p < .05)\), Tukey’s post hoc analyses were conducted to determine differences between groups. Prior to running the MANOVA model, all required statistical assumptions were examined. Assumptions include: (a) the two or more dependent variables being measured at an interval or ratio level, (b) the independent variables consisting of two or more categorical, independent groups, (c) independence of observations, (d) adequate same size, (e) linear relationship between each pair of dependent variable for each group of the independent variable, (f) multicollinearity, (g) homogeneity of variance-covariance matrices, (h)
absence of univariate and multivariate outliers and, (i) multivariate normality (Tabachnick & Fidell, 2019). Partial eta-squared effect sizes were also calculated to examine information complementary to null hypothesis significance testing (Harlow, Mulaik, & Steiger, 1997). Interpretation of effect sizes for small ($\eta^2_p = .01$), moderate ($\eta^2_p = .06$), and large ($\eta^2_p = .14$) effects were based on partial eta-squared values (Stevens, 1996).

**Results**

**Participant Characteristics**

A total of 153 individuals ($M_{age} = 19.11$ years; $SD_{age} = 2.94$ years) provided informed consent to partake in this study (see Table 1). Of the 153 participants who responded, the majority were female (55.6%), single (98.7%), unemployed (50.3%) and self-identified as primarily “White” (78.8%). Approximately three-quarters ($n = 113; 74.3\%$) of the participants responded that they had used a wearable activity monitor before (however, 98 participants (64.1%) did not track their PA via a wearable activity monitor at the time of data collection. For those who did speak to their current tracking of their PA via a wearable activity monitor, majority expressed tracking their PA 7 days per week (52.7%).

**Missing Values Analysis**

There were no non- (those who provided consent but elected not to provide additional information) or partial responders (those who did not provide information on any of the outcome variables) in this study. For those who responded, missing data was found for in items measuring outcome variables in the study. A missing values analysis was run indicating that no more than 1.3% of the data was missing on any short- or long-term PA item. Little’s (1988) test for these variables ($\chi^2 = 150, df = 1, p = .699$) revealed that patterns of missing data in this sample were considered to be missing at random. A second missing values analysis was run indicating that no
more than 0.7% of the data was missing on any affective or instrumental judgement item. Little’s (1988) test for these variables (\( \chi^2 = 14.11, df = 23, p = .924 \)) revealed that patterns of missing data in this sample were also considered to be missing at random. A third missing values analysis revealed that no more than 2% of the data was missing across any BREQ-2R item, which was also deemed missing at random (\( \chi^2 = 179.16, df = 154, p = .081 \)). To safeguard against misleading estimates due to missing data, an expectation maximization algorithm was implemented to replace the missing values (Tabachnick & Fidell, 2019).

**Descriptive Statistics and Reliability Estimates**

As an exploratory procedure, data was analyzed to examine whether there were differences on outcome variables depending on whether Chris was presented as a male or female. No statistically significant differences (\( p \)'s > .05; Cohen’s \( d \) ranged from .00 - .62; \( M = .26; SD = .16 \)) emerged. Therefore, all eight conditions were retained for subsequent analyses, staying faithful to the original conceptualization of this study.

Descriptive statistics were analyzed (i.e., means and standard deviations) across all eight conditions for all outcome variables (see Table 2). All variables, except for the non self-determined forms of motivation (i.e., introjected and extrinsic regulation) obtained mean scores that were above the theoretical mid-point of the scale used, regardless of goal condition.

Reliability coefficients across each of the eight conditions were estimated using Cronbach’s (1951) coefficient alpha (\( \alpha \); see Table 3). Affective attitudes ranged from .75 to .93 (\( M_\alpha = .85; SD_\alpha = .07 \)). Instrumental attitudes ranged from .86 to .99 (\( M_\alpha = .94; SD_\alpha = .04 \)). External regulation ranged from .50 to .89 (\( M_\alpha = .77; SD_\alpha = .12 \)). Introjected regulation ranged from .46 to .84 (\( M_\alpha = .70; SD_\alpha = .13 \)). Identified regulation ranged from .36 to .85 (\( M_\alpha = .56; SD_\alpha = .13 \)).
= .17). Integrated regulation ranged from .35 to .85 (\(M_\alpha = .62; SD_\alpha = .16\)). Intrinsic regulation ranged from .75 to .92 (\(M_\alpha = .87; SD_\alpha = .06\)).

**Main Analyses**

**Short and Long-Term Physical Activity.** Prior to testing hypothesis one, statistical assumptions for ANOVAs were assessed: Assumptions a – c were adhered to given the study design, (d) homogeneity of variance met given Levene’s test for homogeneity of variance (\(p > 0.05\) for short and long-term physical activity), (e) four outliers were found in this data set for short- and long-term PA (\(z = |>3.00|\)), however these participants were not removed in subsequent analyses as \(p\)-values and effect size estimates did not change appreciably when statistical analyses were completed in the absence of outliers and (f) the Kolmogorov–Smirnov (K-S) test note statistically significant (\(p < 0.05\)) deviations from normality for short-term PA, with Skewness = -1.93 and Kurtosis = 5.86. Skewness and kurtosis values of -.48 and -.02 were found for long-term PA. Data transformations were not made given that ANOVAs are robust to these violations (Tabachnick & Fidell, 2019).

Two one-way ANOVAs were conducted using the 8 goal conditions as independent variables and short- and long-term PA as dependent variables. No statistically significant difference between goal condition and short- (\(F(7, 145) = 0.73, p = 0.650; \eta_p^2 = .034\)) and long-term PA (\(F(7, 145) = 0.84, p = 0.555; \eta_p^2 = .039\)) were found suggestive that PA for wearable activity monitor users did not differ by goal type.

**Attitudes and Motivational Regulations.** A priori, hypothesis two was to be testing using a MANOVA. Yet, the assumption of independence was violated given the high correlation (\(r = .82\)) between dependent variables (i.e., instrumental and affective attitudes). Consistent with recommendations advanced by Tabachnick and Fidell (2019) a composite score for attitudes was
created. Therefore, an ANOVA was used to test the second hypothesis as opposed to a MANOVA. Assumptions were subsequently tested for an ANOVA model. Assumptions a – c were adhered to given the study design, (d) homogeneity of variance was met (Levene’s test $p > 0.05$ for attitudes), (e) eight outliers found in this data set for attitudes ($z = |>3.00|$), however these participants were not removed in subsequent analyses as $p$-values and effect size estimates did not change appreciably when statistical analyses were completed in the absence of outliers, and (f) K-S outputs note statistically significant ($p < 0.05$) deviations from normality, however ANOVAs are robust to these violations (Tabachnick & Fidell, 2019) with a skewness value of -2.06 and a kurtosis value of 4.15 for attitudes.

A one-way ANOVA was conducted using the 8 goal conditions as independent variables and a composite score for attitudes as the dependent variable. No statistically significant difference between goal condition and attitudes ($F (7, 145) = 1.05, p = 0.399; \eta^2_p = .048$) were found indicating that attitudes for wearable activity monitor users did not differ by goal type.

Prior to testing hypothesis 3, statistical assumptions for the MANOVA were assessed. Assumptions a – c were adhered to given the study design, (d) the MANOVA was comprised of an adequate sample size where there were a greater number of cases in each group than the number of dependent variables, (e) visual inspection of the scatterplot matrices identified a linear relationship between each pair of dependent variables for the MANOVA, (f) interpretation of Pearson’s correlation revealed no multicollinearity between dependent variables, (g) the assumption of homogeneity of variance was met using Box’s $M (M = 165.68, p = .005$; Hair, Black, Babib, & Anderson, 2010), (h) 3 outliers were found in this data set for each dependent variable ($z = |>3.00|$) however, these participants were not removed in subsequent analyses as $p$-values and effect size estimates did not change appreciably when statistical analyses were
completed in the absence of outliers; Mahalanobis distance \((MD)\) was used to screen for multivariate outliers, 2 multivariate outliers were found in the dataset by which exceeding the critical value \((MD > 20.52; \text{Tabachnick & Fidell, 2019})\) however, no participants were removed in subsequent analysis as \(p\)-values and effect size estimates did not change appreciably when statistical analyses were completed when outliers were included/excluded and, (i) the Kolmogorov–Smirnov \((K-S)\) test note statistically significant \((p < 0.05)\) deviations from normality for motivational regulations.

A MANOVA was conducted using the 8 goal conditions as independent variables and the 5 motivational regulations as dependent variables. No statistically significant differences between goal condition and motivation regulations \((F (35, 725) = 1.42, p = 0.055; \eta^2_p = .064; \text{power} = .99)\) were found, demonstrating that motivation to engage in PA for users of wearable activity monitors do not differ based on goal type. Consistent with Hair et al., (2010) univariate tests were evaluated regardless of the significance of the multivariate results. Significant differences were noted for extrinsic regulation \((R_{adj}^2 = .06; F (1, 145) = 2.38, p = 0.025; \eta^2_p = .105; \text{power} = .85)\) only. Post-hoc analyses testing revealed significant differences \((p = < .05; \text{see Table 4})\). Specifically, the male no goal condition demonstrated higher extrinsic regulation than a) male affective, b) male PA, c) female affective, d) female PA, and e) female instrumental. Further, higher extrinsic regulation between the female no goal condition and a) male affective, b) female affective, and c) female PA goal condition was found.

**Manipulation Check**

Given the absence of participant gender differences on study outcomes, this variable was collapsed in advance of the manipulation check. To whether the manipulation had its intended effect for when no goals were identified, the following item was used: “Chris did not have a
physical activity goal”. A one-way ANOVA was performed \( F(3, 149) = 19.86, p < .001 \). Higher scores were evident in the no goal vignette \( (M = 3.40, SD = 2.11) \) compared to the step \( (M = 1.29, SD = 0.84) \), instrumental \( (M = 1.36, SD = 1.11) \) or affective goal \( (M = 1.50, SD = 1.20) \) vignettes.

To ensure that the manipulation had its intended effect for Chris’ PA, the following item was used: “Chris has a physical activity goal to achieve 10,000 steps per day”. A one-way ANOVA was performed \( F(3, 149) = 51.14, p < .001 \). Higher scores were evident in the vignette where Chris’ goal was defined as achieving 10,000 steps per day \( (M = 6.97, SD = .16) \) compared to the no goal \( (M = 4.08, SD = 1.75) \), instrumental \( (M = 2.85, SD = 2.01) \) or affective goal \( (M = 2.84, SD = 2.05) \) vignettes.

To whether the manipulation had its intended effect for instrumental goals, the following item was used: “Chris has a physical activity goal to increase his(her) immune system functioning to prevent colds and flu through physical activity”. A one-way ANOVA was performed \( F(3, 149) = 70.71, p < .001 \). Higher scores were evident in the vignette where Chris’ goal was defined as an instrumental goal \( (M = 6.95, SD = .22) \) compared to the no goal \( (M = 3.79, SD = 1.61) \), step \( (M = 3.21, SD = 1.80) \) or affective goal \( (M = 2.39, SD = 1.69) \) vignettes. To whether the manipulation had its intended effect for affective goals, the following item was used: “Chris has a physical activity goal to enjoy and experience pleasure through physical activity”. A one-way ANOVA was performed \( F(3, 149) = 10.61, p < .001 \). Higher scores were evident in the vignette where Chris’ goal was defined as an affective goal \( (M = 6.63, SD = .79) \) compared to the no goal \( (M = 5.45, SD = 1.54) \), step \( (M = 5.84, SD = 1.20) \) or instrumental goal \( (M = 4.90, SD = 1.80) \) vignettes.

**Discussion**
The noted health benefits of PA, combined with low rates of Canadian adults meeting PA guidelines, renders the need for continued insights into strategies to support individuals to initiate and maintain activity levels. The use of technology has been promoted as one means to increase PA in the general population (Nasir & Yurder, 2015; USDHHS, 2018). Yet, despite their popularity, interventions involving wearable activity monitors in relation to increasing PA are equivocal (Jakicic et al., 2016; USDHHS, 2018; Wang et al., 2015). The use of goal setting in conjunction with wearable activity monitors to enhance PA in the general adult population has been recommended (McEwan et al., 2016; USDHHS, 2018, F11-49). Therefore, the main purpose of this study was to examine the difference in PA behavior, attitudes, and motivational regulations based upon different types of goals (i.e., affective, instrumental, step-count) for users of wearable activity monitors.

The National Institute for Health and Care Excellence (2014) indicated that goal setting should be a component of any health behavior change intervention. Researchers have examined the utility of different goal types including step count (Bravata et al., 2007; Lieffers et al., 2016), health (Rodearmel et al., 2006; Sibley & Bergman, 2016) and affective goals (Forster et al., 2017; Segar, Eccles, & Richardson, 2008) to support PA behavior. For example, research examining goal selection and PA participation has shown that adult women who endorsed more affective-laden goals (i.e., well-being, stress reduction) self-report greater levels of PA in comparison to other goal conditions (e.g., health, weight loss; Segar et al., 2008). Furthermore, affective messaging has been shown to enhance PA over 3-weeks (Conner et al., 2011) and for affective attitudes to predict PA at 6 months (Lowe et al., 2002). Grounded in previous research (Connor et al., 2011; Lowe et al., 2002; Segar et al., 2008), it was hypothesized that users of
wearable activity monitors who set affective goals would report greater PA than those who set either step goals, instrumental goals, or those in the no goal condition.

Significant differences were not found between short- and long-term PA based upon goal condition in the vignette depicted in the present investigation. The use of affective judgements for an app-related study to increase PA highlights the complexity of changing behavior (Forster et al., 2017). High frequency app users \((n = 4)\) self-reported small changes in PA behavior in comparison to the low frequency app users \((n = 3)\). Yet, low frequency users spent more time engaged in moderate and vigorous PA than high frequency users based on non-self-report. Swann and colleagues (2020) further highlighted the complexity of goal setting on behavior. Healthy adults were assigned to either an open, SMART or do your best goal setting condition. Across a six-minute walk test, no differences across goal conditions in the distance walked were noted.

Rationale for study findings may be explained through the phrasing of vignettes presented in this study. In all goal conditions, Chris is described as being active (i.e., “Chris is physically active 4 or 5 days a week....”; Lindwall and Martin Ginis, 2010) in opposition to an insufficiently active individual who is initiating PA. Goal-setting has shown its effectiveness towards promoting PA behavior for those who are insufficiently active as opposed to those who are active (McEwan et al., 2016; Segar, 2017). Further support comes from Swann et al., (2020) as the majority of participants were classified as moderate/active based on self-report scores. Therefore, goal setting may be particularly effective when initiating PA as opposed to maintaining involvement.

Consistent with (Connor et al., 2011; Ruissen et al., 2018) it was hypothesized that users of wearable activity monitors who set affective goals would report more positive attitudes for PA
than those who set either PA, instrumental, no goals. Similarly, users of wearable activity monitors who set instrumental goals would report more positive instrumental attitudes for PA that those in the PA, affective or no goal condition. A priori study hypotheses were not able to be tested given the magnitude of the correlation between the dependent variables. Therefore, differences between goal conditions were examined on a composite attitudinal variable. Across the manipulated goal conditions in this study, significant differences were not found. Reasoning for these findings may be reflected in the wording of the vignettes and the proximal outcomes that guided this study. First, consistent with (Lindwall & Martin Ginis, 2010), Chris was labelled as someone who “…enjoys playing pick-up basketball and tennis with his/her friends”. This may have led participants to perceive Chris as having positive attitudes towards PA, regardless of the goal condition the vignette depicted. Second, researchers have typically investigated instrumental and affective outcomes on distal health benefits (i.e., protection from heart disease and cancer; Conner et al., 2011; Evans et al., 2014; Gellert, Ziegelmann, & Schwarzer, 2012). This is in contrast to the proximal benefits of PA adopted in this study (e.g., immunization from colds and viruses) as recommended by Segar & Richardson (2014). The use of proximal health benefits for instrumental outcomes may have influenced participant responses, rendering the differences between goal conditions blurred.

Wearable activity monitors are designed to be attached to the body and subsequently provide an external, visible incentive for PA which utilizes the use of external rewards (Segar, 2017). Thus, wearable activity monitors may promote extrinsic reasons for PA (Attig & Franke, 2018; Dano, 2015; Farnell & Barkley, 2017), yet this supposition has been rarely tested with little clarification (Friel & Garber, 2020; Kerner & Goodyear, 2017). Consistent with OIT suppositions (Ryan & Deci, 2017) and existing research (Wilson et al., 2012), Goodyear and
colleagues (2017) found that users of wearable activity monitors frequently found value in their PA pursuits when monitoring their activity. Although some found increased motivation when using these devices, users also displayed reductions in motivation associated with guilt and internal pressure when using wearable activity monitors. Therefore, it was hypothesized that there would be no difference in motivational regulations between goal conditions for users of wearable activity monitors. Results of the multivariate model supported this contention as no significant differences between motivational regulations based upon goal conditions were found.

Results of the overall analyses on motivational regulations may be linked to the nature of the scenario. The length of Chris’ involvement in PA was never reported. Yet, Chris was depicted as engaging in a range of activities multiple times a week. Therefore, it is reasonable to suggest that participants perceived PA for Chris as being a regular part of his/her week—in other words habitual. Nafus & Sherman (2014) speak to wearable activity monitors and habit formation, stating that once a behavior has stuck, the disuse of the device may consequently occur. Gardner and Rebar (2019) noted that habitual tendencies to be dominant over motivational tendencies and are therefore resilient to changes (either positively or negatively) in motivation. Further, while goals may be important in the establishment of a behaviour becoming habitual (Lally & Gardner, 2013), habitual behaviour should persist even when the goal that initiated behaviour change is no longer relevant or where motivation has eroded (Wood & Neal, 2007).

Univariate significance testing did show differences for extrinsic regulation. These results (generally) indicated that having a goal (regardless of type) may be associated with lower extrinsic regulation then an individual using a wearable activity monitor without a goal. In addition, a moderate to large effect size was found between these variables, highlighting the impact goal setting may have on the reduction of extrinsic regulation levels for users of wearable
activity monitors generally when goals are set. These results may therefore suggest that with the addition of commonly integrated BCT’s (i.e., goal setting) in wearable activity monitors, the effects of extrinsic regulation for PA may be reduced.

Previous research may offer insight as to why no significant differences were found between goal conditions and other motivational regulations for PA examined in this study. For example, researchers have found contrasting emotional responses for users of wearable activity monitors, where these devices may offer both positive and negative reactions (Toner, 2018). With regards to introjected regulation and wearable activity monitors, users may be engaging in PA to avoid negative emotional states such as guilt or shame or to maintain feelings of self-worth (Ryan & Deci, 2017). Researchers have provided evidence on both sides of the introjected regulation spectrum as wearable activity monitor users have felt both empowered by accomplishing their goals and in contrast, felt pressured and guilty when unsuccessful in goal attainment (Duus & Cooray, 2015; Goodyear, Kerner, & Quennerstedt, 2017). This may aid in the reasoning as to why findings in this study showed no significant differences with respect to introjected regulation.

The use of wearable activity monitors has also resulted in unintended negative motivational consequences. Eakin (2016) reported some participants increased enjoyment (a component of intrinsic motivation) when monitoring their activity (i.e., running goals). Conversely others found these devices to have a negative impact on enjoyment levels, as measuring activities were linked to work, and consequently less enjoyable. In addition, Kerner and Goodyear (2017) demonstrated a significant decrease in autonomous motivation after 8 weeks for adolescent users of wearable activity monitors. These results suggest that the use of monitoring one’s PA may be linked to reductions in autonomous motivation, regardless of
whether goal setting was adopted at a BCT. This may also aid in the reasoning as to why findings in this study showed no differences with respect to intrinsic regulation.

**Limitations**

There are three main limitations of this study that should be taken into consideration. These limitations include, but are not limited to, research design, multi-collinearity, and the sample used to collect data for this study.

This study was conducted as a cross-sectional post-test only randomized experimental design with the utilization of vignettes. This type of research design limits the researcher to see change over time and causal inference. In addition, the phrasing of vignettes may have affected participant responses, where Chris was described as an active individual who enjoys PA in all goal conditions despite the manipulation. Criticisms of vignette-based research have been forthcoming in relation to internal validity and relevance to participants (Hughes & Huby, 2004). Internal validity refers to the degree to which change in the dependent variable can be attributed to changes in the independent variable (Evans et al., 2015), where alternative explanations for findings can generally be ruled out. With respect to vignette-based research, this refers to the degree to which the content being presented accurately depicts the research question under review (Hughes & Huby, 2004). The internal validity of these vignettes may be weakened if participants did not find high relevance to scenarios presented and further, if scenarios presented did not seem realistic enough to the participant completing the study. It should be noted that although vignettes employed in this study were supported by previous research in the field of exercise/health psychology (Lindwall & Martin Ginis, 2010; Morris et al., 2016) and sport psychology (Deck et al., 2018), there is still potential that goal conditions were not formulated to
be specific enough for participants to differentiate between. However, results of the manipulation check did show that participants were able to differentiate between goal conditions.

Hughes and Huby (2004) advanced that if participants do not find relevance to the vignette the data quality is likely to decrease. While relevance may be one limitation advanced, the goals adopted across vignettes were empirically grounded. For example, step count is the most common feedback offered for users of wearable activity monitors (Alley et al., 2016). Further, university students endorse pleasure/enjoyment as a common motive for PA (Cerar et al., 2017; Kilpatrick et al., 2005) and university students and adults demonstrate interest in exercise during the process of building immunity against influenza (or to protect from colds and viruses; Grande, Reid, Thomas, Nunan, & Foster, 2016). However, Morris and colleagues (2016) found that health-oriented messaging displayed as long-term was more effective for increasing self-reported PA levels in opposition to that of the short-term, which was demonstrated in this study. In addition, Simpson and colleagues (2020) argue that immunity enhancing effects of exercise may aid those who generally have lower immune systems (i.e., older population) more beneficially than that of other populations. Use of wearable activity monitors may be further linked to relevance. University students were the targeted sampling frame, regardless of whether the individual used wearable technology to monitor his/her PA. Arguments could be raised that those who monitored their PA using wearable activity monitors may see the vignettes as more relevant. Analyses revealed that those who were active users of wearable activity monitors believed that Chris would continue PA in both the short (p = .03) and long-term (p = .01) to a greater degree than non-users of wearable activity monitors. Differences in attitudes or behavioural regulations were not found between current users and those who were not currently monitoring their PA. This may have influenced the results presented in this study, where it seems
that those who were currently using these devices may see Chris to further benefit from the use of wearable activity monitors for PA as well. With respect to those who participated in the study and familiarity with wearable activity monitors, it should be noted that inclusion/exclusion criteria did not limit the participants to only those who had experience with these devices. This in turn may have impacted participant responses due to a lack of representativeness within our sample population. Last, Schoenberg and Ravdal (2000) speak to hypothetical scenarios, where participant responses/perspectives may not accurately reflect participant’s future activities, making it difficult for researchers to confidently interpret results utilizing vignette-based research.

Another limitation observed was the atypically high correlation ($r = .82$) that existed between both affective and instrumental attitudes presented in this study. Similarly, previous research focused upon instrumental and affective attitudes and PA behavior has displayed moderate correlations with respect to both variables ($r = 0.53$; Lowe et al., 2002). For this reason, both instrumental and affective attitudes were combined to create a composite score for attitudes in this study.

The final limitation of this study is with respect to the sample of participants that responded. This study surveyed a relatively homogeneous sample of participants based on demographic characteristics. Therefore, findings may not be generalizable to the general public or other specific subsets of individuals, limiting the external validity of study findings.

**Future Directions**

As of yet, it is unclear as to whether differences exist between instrumental and affective proximal goals on psychological and/or behavioral outcomes. However, Segar and Richardson (2014) suggested that the immediate effects of PA (i.e., post-walking) may in fact foster the
facilitation of decision making, motivation, and self-regulation that underlie behavioral sustainability. Future researchers may look to further evaluate the effectiveness of instrumental and affective proximal goals on users of wearable activity monitors to facilitate PA engagement in individuals.

The use of vignettes is particularly useful when control of independent variables to gather evidence regarding causation is desired by researchers (Cavanaugh & Fritzsche, 1985). In the present investigation, a between person’s design was adopted whereby each participant responded to the outcomes of interest based on exposure to a single scenario. Researchers may want to adopt a conjoint analysis design that offers each participant exposure to multiple scenarios to demonstrate the effects of a manipulation within one individual (Aguinis & Bradley, 2014).

It should be noted that results of this study may have occurred due to the nature of the manipulation of affective and instrumental ‘goal setting’ present in this study. Minimal information currently exists with respect to instrumental or affective goal setting, especially in the short-term (e.g., daily) for PA. The bulk of the current literature has examined instrumental and affective attitudes (Conner et al., 2011; Lowe et al, 2002), judgements (Forster et al., 2017; Rhodes et al., 2009), and messaging (Morris et al., 2016; Sirriyeh et al., 2015), which were implemented to form study hypotheses. Future researchers should consider formulating additional research topics around the idea of affective and instrumental goal setting to aid in the interpretation of these concepts with respect to PA engagement. Formative research may be conducted to determine the proximal outcomes meaningful for targeted sample prior to testing differences between goal conditions. Researchers may benefit from implementing a similar study in the future by applying a pre- and -post test intervention research designed to evaluate the
effectiveness of affective goal setting for users of wearable activity monitors.

With respect to inclusion/exclusion criteria associated within this research, this study did not limit participants to only those who had previous experience with wearable activity monitors. To accommodate for this limitation, researchers may look to modify this inclusion criteria by utilizing a sample population that has previous experience with these devices to further increase the representativeness of the cohort of interest.

Future researchers should also look to further evaluate individuals and their current levels of PA (e.g., those who are initiating PA) prior to using wearable activity monitors, and if this variable plays an integral role on short- and long-term PA participation. Swann and colleagues (2020) have queried whether current goal setting practices are best suited for PA engagement. Finally, researchers may look to study what combination of BCTs common in wearable activity monitors may best translate into sustained behaviour, attitudinal and motivational benefits. While goal setting should be a component of any health behaviour change intervention (National Institute for Health and Care Excellence, 2014), it might best be paired with social support, competition, or some other combination of BCTs. With additional research committed to variables surrounding wearable activity monitors, individuals may become more knowledgeable upon the benefits these devices may hold, ultimately supporting PA engagement in users of wearable activity monitors.

Conclusion

Wearable activity monitors are widely used devices that offer a host of applications for users to utilize for their individual goal attainment (Duus & Cooray, 2015; Farnell & Barkley, 2017). The purpose of this study was to examine the difference in PA, attitudes, and motivational regulations associated with various goal types (i.e., affective, instrumental, step count) for users
of wearable activity monitors. The significance of this research was linked to the recognition for
the importance of affect on behaviour with a focus upon proximal goal setting for users of
wearable activity monitors. The results of this study showed that goal type for users of wearable
activity monitors did not influence PA, attitudes or motivational regulations. Yet, adopting a
proximal goal may offset deficits in extrinsic regulation linked to the use of wearable activity
monitors. These results may suggest that users of wearable activity monitors looking to enhance
PA, positive attitudes or motivation towards PA may benefit further by experimenting with other
goals (e.g., learning, do your best, etc.) or perhaps by using alternative techniques associated
with these devices. More research needs to be completed with respect to the use of wearable
activity monitors to determine their effectiveness for PA and for whom. Further insight should be
generated to understand individual variability in user response to wearable technology. Finally,
further investigation examining whether goal setting in combination with other BCTs could
enhance PA for users of wearable activity monitors. It is hopeful that with a more in-depth
evaluation of wearable activity monitors and their relevance to PA engagement, future
researchers may work to further assist individuals who use these devices to meet PA guidelines
and ultimately increase their health.
Table 1

Demographics of Study Participants

<table>
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<tr>
<th>Characteristic</th>
<th>Percent (N = 153)</th>
<th>p</th>
</tr>
</thead>
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<td>Female</td>
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<td>Part-time Employed</td>
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<td></td>
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<tr>
<td><strong>Ethnicity</strong></td>
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<tr>
<td>White</td>
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<td></td>
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<td>Black</td>
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<td></td>
</tr>
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<td>South Asian</td>
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<td></td>
</tr>
<tr>
<td>Filipino</td>
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<td></td>
</tr>
<tr>
<td>Arab</td>
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<td></td>
</tr>
<tr>
<td>Korean</td>
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<tr>
<td>Latin American</td>
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<tr>
<td>Southeast Asian</td>
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<tr>
<td>Other</td>
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</tr>
<tr>
<td><strong>Have you ever used a wearable activity monitor?</strong></td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>74.3</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>25.7</td>
<td></td>
</tr>
<tr>
<td><strong>Do you currently use a wearable activity monitor to track PA?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>35.9</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>64.1</td>
<td></td>
</tr>
<tr>
<td><strong>If current use, how many days per week do you monitor PA with your wearable activity monitor?</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td>7</td>
<td>52.7</td>
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</table>

Note. *p*-values are representative of differences between conditions.

Note. Data displayed on table is not fully representative of all participants due to missing data.
Table 2

Means and SD for Goal Condition and Outcome Variables

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Male Affective Goal</th>
<th>Male Instrumental Goal</th>
<th>Male Step Goal</th>
<th>Male No Goal</th>
<th>Female Affective Goal</th>
<th>Female Instrumental Goal</th>
<th>Female Step Goal</th>
<th>Female No Goal</th>
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<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
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<td>PA Short-Term</td>
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<td>5.26</td>
<td>1.15</td>
<td>5.00</td>
<td>1.49</td>
</tr>
<tr>
<td>Affective Attitude</td>
<td>5.57</td>
<td>1.58</td>
<td>5.84</td>
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<td>5.87</td>
<td>1.09</td>
<td>5.68</td>
<td>1.09</td>
</tr>
<tr>
<td>Instrumental Attitude</td>
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<td>1.58</td>
<td>6.29</td>
<td>.86</td>
<td>5.85</td>
<td>1.37</td>
<td>5.88</td>
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<tr>
<td>Integrated Regulation</td>
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<td>.90</td>
<td>2.88</td>
<td>.75</td>
<td>2.79</td>
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<tr>
<td>Identified Regulation</td>
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<td>2.90</td>
<td>.66</td>
<td>3.00</td>
<td>.52</td>
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<td>Introjected Regulation</td>
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<td>.58</td>
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<td>1.16</td>
<td>.92</td>
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<tr>
<td>Extrinsic Regulation</td>
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<td>.49</td>
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<td>.47</td>
<td>.58</td>
<td>.93</td>
<td>.82</td>
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Table 3

*Estimates of Internal Consistency by Condition*

<table>
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<tr>
<th>Condition</th>
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<th>Instrumental</th>
<th>Composite</th>
<th>External</th>
<th>Introjected</th>
<th>Identified</th>
<th>Integrated</th>
<th>Intrinsic</th>
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</thead>
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<tr>
<td>Male No Goal</td>
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<td>.93</td>
<td>.88</td>
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<td>.85</td>
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<td>.89</td>
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<tr>
<td>Male Instrumental</td>
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<td>.90</td>
<td>.85</td>
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<td>.69</td>
<td>.71</td>
<td>.91</td>
</tr>
<tr>
<td>Male Affective</td>
<td>.91</td>
<td>.94</td>
<td>.96</td>
<td>.74</td>
<td>.65</td>
<td>.58</td>
<td>.85</td>
<td>.92</td>
</tr>
<tr>
<td>Male PA</td>
<td>.86</td>
<td>.95</td>
<td>.95</td>
<td>.76</td>
<td>.62</td>
<td>.48</td>
<td>.35</td>
<td>.87</td>
</tr>
<tr>
<td>Female No Goal</td>
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<td>.96</td>
<td>.95</td>
<td>.82</td>
<td>.84</td>
<td>.60</td>
<td>.58</td>
<td>.75</td>
</tr>
<tr>
<td>Female Instrumental</td>
<td>.93</td>
<td>.97</td>
<td>.96</td>
<td>.75</td>
<td>.62</td>
<td>.37</td>
<td>.63</td>
<td>.91</td>
</tr>
<tr>
<td>Female Affective</td>
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<td>.86</td>
<td>.92</td>
<td>.89</td>
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<td>.34</td>
<td>.47</td>
<td>.87</td>
</tr>
<tr>
<td>Female PA</td>
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<td>.99</td>
<td>.98</td>
<td>.50</td>
<td>.78</td>
<td>.54</td>
<td>.60</td>
<td>.83</td>
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</table>

*Note:* Reliability scores are calculated using Cronbach (1951) α.
Table 4

Descriptive Statistics for Extrinsic Regulation by Goal Condition

<table>
<thead>
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<th>Goal Condition</th>
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<tr>
<td>Male Affective Goal</td>
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</tr>
<tr>
<td>Male Instrumental Goal</td>
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<tr>
<td>Male Step Goal</td>
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<td>.58</td>
</tr>
<tr>
<td>Male No Goal</td>
<td>.93</td>
<td>.82</td>
</tr>
<tr>
<td>Female Affective Goal</td>
<td>.34</td>
<td>.57</td>
</tr>
<tr>
<td>Female Instrumental Goal</td>
<td>.57</td>
<td>.65</td>
</tr>
<tr>
<td>Female Step Goal</td>
<td>.32</td>
<td>.36</td>
</tr>
<tr>
<td>Female No Goal</td>
<td>.76</td>
<td>.82</td>
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References


doi:10.1145/2851581.2892495


doi:10.1093/acrefore/9780190236557.013.216


https://doi.org/10.1348/135910710X486889


https://www.statista.com/topics/1556/wearable-technology/


Appendices

Appendix A: Recruitment Poster

Wearable activity monitors and goal selection

Purpose: To examine the relationship between physical activity engagement and the goals individuals set for themselves with those who use wearable activity monitors. Examples of wearable activity monitors include, but are not limited to, common devices such as the Fitbit and Apple Watch (Segar, 2017).

Requirements: You will be asked to read a short narrative followed by completing questionnaires. This study is estimated to take approximately 30 minutes. Data will be collected individually in our Behavioural Health Science Research Lab (WH 141).

This project has been reviewed and received ethics clearance through the REB at Brock University (File #XXXX-XXX). If you have questions pertaining to this study, or would like a copy of the study’s major findings, please feel free to contact the investigators using the information provided above. If you have questions pertaining to the nature of this study or your rights as a participant please contact Brock University’s Research Ethics Office at (905) 688 5550 Ext. 3035. Thank you for your interest in our research project.

More information can be obtained by using the contact information provided below

Dr. Diane E. Mack/ E. Mack/ E. Mack/ Connor Connor Connor
Bell Bell Bell
cb12us@ brocku.ca cb12us@ brocku.ca cb12us@ brocku.ca
Appendix B: Sakai Posting

“The Wearable activity monitors and goal selection”

The Behavioral Health Sciences Research Lab at Brock University is conducting a new study entitled “Wearable activity monitors and goal selection”. The purpose of the study is to better understand the link between wearable activity monitors and physical activity engagement and motivation in university students. Wearable activity monitors are becoming a popular means for individuals to set goals for themselves and subsequently increase their physical activity engagement. Currently, there is limited evidence about the possible benefits of wearable activity monitors and physical activity engagement reported by university students.

We are posting this message to advertise our research study to Brock University students (aged ≥ 17 years). Participation is voluntary and all data are provided anonymously and retained confidentially. For further details concerning this study, please email cb12us@brocku.ca.

This study has been reviewed and received ethics clearance from the Brock University Research Ethics Board (File #19-039).
Appendix C: Email Script

Good Morning/Evening <insert name of course instructor about here>

My name is Connor Bell and I am a graduate student in the Faculty of Applied Health Sciences at Brock University. I am conducting a research study entitled ‘Wearable activity monitors and goal selection’ for my MSc thesis under the supervision of Dr. Diane E. Mack (Department of Kinesiology, Brock University). Briefly, this research study is designed to address the following questions: a) Do the goals set by wearable activity monitor users influence positive attitudes and motivation? b) Do different types of goals set by users of wearable activity monitors influence physical activity engagement?

I am writing to request your assistance in advertising this research study to the students in your classes who may be interested in participating. Specifically, I am writing to ask if you would place an announcement on Sakai for your courses to advertise this research study. If willing, please e-mail me and I will send you a copy of the script to be posted that is being used in this study. You are welcome to contact me if you have any questions about this research study or my request for your assistance in participant recruitment. If you prefer, I am also available to make a short (< 5 mins) presentation to your class about this research study.

Thank you very much for your time and consideration,

Connor Bell,
cb12us@brocku.ca

This study has been reviewed and received ethics clearance from the Brock University Research Ethics Board (File #19-039).
Appendix D: Verbal Presentation

Hello, my name is Connor Bell and I am a Graduate Student in the Faculty of Applied Health Sciences at Brock University. I am pursuing my Graduate degree under the guidance of Dr. Diane Mack (Co-Director of the Behavioral Health Sciences Research Lab). I am here today to present a project that we are currently recruiting participants for entitled “Wearable activity monitors and goal selection”. I am the Principal Student Investigator for this project.

I am studying wearable activity monitors and their impact on an individual’s behavior and motivation. Wearable activity monitors, such as the FitBit or Apple Watch are designed to be worn on an individual’s body to track movement and/or biometric data. This research is designed to help us understand more about the link between wearable activity monitors and physical activity engagement in university students.

If you volunteer as a participant in this study, you will be asked to attend one session in Welsh Hall Room 141. During this time, you will be asked to read a short narrative then answer some questions using an online survey about what you read. The questions contained within the survey will ask about physical activity behavior, motivation, as well as demographic questions like age and program of study at Brock University. Your involvement should take no longer than 30 minutes on a single occasion. Your participation is voluntary and all of the information that you provide will remain confidential. This means that we will not be sharing your personal data with any other person or party in such a manner that you could be identified as a consequence of participating in this study.

If you are interested in participating, please email me at cb12us@brocku.ca where I will then send you a Letter of Invitation and answer any questions you may have about the study.

This study has been reviewed and received ethics clearance from the Brock University Research Ethics Board (File # 19-039).
Appendix E: Letter of Invitation

<Date will be inserted here>

Title of Study: Wearable activity monitors and goal selection
Student Principal Investigator: Mr. Connor Bell
Principal Investigator: Dr. Diane E. Mack

I, Connor Bell, Graduate Student, from the Faculty of Applied Health Sciences, Brock University, invite you to participate in a research project entitled ‘Wearable activity monitors and goal selection’.

The purpose of this study is to determine if affective goals confer unique benefits on physical activity, attitudes and motivation compared to other types of goals among university students who use wearable activity monitors. Wearable activity monitors are designed to be worn on an individual’s body to track movement and/or biometric data and include, but are not limited to, the Fitbit and Apple Watch. Should you choose to participate, you will be asked to read a short narrative/script then complete a survey designed specifically for this study in a research lab (WH 141). The questions contained within the survey will ask about the narrative/script, physical activity and perceived motivation. Demographic questions about you such as age, sex and employment status will also be asked.

The expected duration of your involvement should take no longer than 30 minutes. We ask that you provide us with all information on a single occasion. Please note that you are free to participate in this study, not participate in this study, or withdraw your participation from this study even after you have consented to be involved at any time. There will be no impact to your academic standing at Brock University should you choose to withdraw.

This research should benefit professionals working to improve physical activity engagement for university students by highlighting the role of goal setting with the use of wearable activity monitors.

If you have any questions about your rights as a research participant, please contact the Brock University Research Ethics Officer (905 688-5550 ext. 3035, reb@brocku.ca)

If you have any questions about this research project, please feel free to contact me (see below for contact information).

Thank you,

Diane E. Mack, PhD
Professor
Email: dmack@brocku.ca
Tel: 905 688 5550 Ext. 4360

Connor Bell
Graduate Student
Email: cb12us@brocku.ca
Tel: 905 688 5550 Ext. 5564
This study has been reviewed and received ethics clearance through Brock University’s Research Ethics Board [File #19-039].
Appendix F: Informed Consent

Date: <Will be inserted here>
Study Title: Wearable activity monitors and goal selection

Principal Investigator (PI): Dr. Diane E. Mack
Department of Kinesiology
Brock University
905 688 5550 Ext. 4360
dmack@brocku.ca

Student Principal Investigator (SPI): Mr. Connor Bell
Faculty of Applied Health Sciences Brock University

(905) 688-5550 Ext. 5564
cb12us@brocku.ca

INVITATION
You are invited to participate in a study that involves research. The purpose of this study is to determine if affective goals confer unique benefits on physical activity, attitudes and motivation compared to other types of goals among university students who use wearable activity monitors. Wearable activity monitors are designed to be worn on an individual’s body to track movement and/or biometric data and include, but are not limited to, the Fitbit and Apple Watch.

WHAT’S INVOLVED?
As a participant, you will be asked to come to Welch Hall (WH) Room 141 on the campus of Brock University (St. Catharines), where after giving consent you will be asked to read one of eight narratives/scripts. Using a computer, you will then be asked to complete a series of questions within a survey designed specifically for this study. The questions will ask about the narrative/script, perceived motivation, and some demographic questions about you such as age, sex, and employment status. Your participation should take ~30 minutes of your time on a single occasion.

POTENTIAL BENEFITS AND RISKS
Possible benefits of participation to you may include, but not be limited to, the following: (a) Greater insight regarding the role of wearable activity monitors, and (b) Greater awareness of goal selection and physical activity engagement in university students. Additional benefits may include, but are not limited to, the following: (a) Greater awareness of the type and nature of research being conducted at Brock University, and (b) Greater awareness of motives and attitudes as a result of using wearable activity monitors, and (c) Greater awareness of the opportunities to participate in research as a student at Brock University.

There are no known risks to you associated with participation in this study. It is important to note, however, that if you participate in this study the data you provide will be collected using a web-based interface (www.surveymonkey.com) that collects and stores your data electronically.
However, your data are collected anonymously in this study without the use of personal identifiers.

**ANONYMITY AND CONFIDENTIALITY**

All the information you provide is confidential and anonymous; your name will not be included or, in any other way, associated with the data collected in the study. As our interest is in the average responses of the entire group of participants, you will not be identified individually in any reports that stem from this research.

**DATA STORAGE AND ACCESS**

Data collected during this study will be stored on a password-protected server and/or in a locked filing cabinet in the Behavioral Health Sciences Research Lab (Welch Hall Room 141). Any printed materials (e.g., the list of participants requesting feedback) will be destroyed using a paper shredder upon completion of the study.

Access to this data will be restricted to those involved in the study, exclusively the Principal Investigator (Dr. Diane E. Mack, co-director of the Behavioral Health Sciences Research Lab, Brock University) and the Principal Student Investigator (Connor Bell, Graduate Student, Faculty of Applied Health Sciences, Brock University).

**VOLUNTARY PARTICIPATION**

Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study. Further, you may decide to withdraw from this study at any time and may do so without any penalty. You can withdraw from this study at any time by (a) informing any member of the research team overseeing this study, and/or (b) closing the internet browser on the computer in the data collection site (Welch Hall Room 141). Any participant that elects to withdraw their participation while completing the survey online will have his/her data classified as incomplete once all data have been collected. Incomplete data will be excluded from the final data analysis and will be confidentially deleted. Data, once completed, cannot be identified, therefore withdrawal at this time is not possible due to the anonymous nature of the data collection protocol used. Please note that you are free to participate, not participate, or withdraw your participation from this study even after you have consented to be involved at any time without impacting your academic standing at Brock University.

**PUBLICATION OF RESULTS**

Results of this study will be published as the student PI’s Masters thesis. Results of this study may be published in professional/academic journals and/or presented at academic/professional conferences that can be attended by members of the academic community (e.g., university faculty, students). Feedback about this study will be available once all data has been collected and/or analyzed. It is anticipated that this may take 6 months to complete after the final set of participants have finished their involvement. Summary results may be obtained for the purposes of feedback by providing contact details to the study investigators using a separate form that will be offered to you once you provide informed consent and data for this study.

**CONTACT INFORMATION AND ETHICS CLEARANCE**
If you have any questions about this study or require further information, please contact Dr. Diane E. Mack or Mr. Connor Bell using the contact information provided in the Letter of Invitation. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University 19-039. If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at (905) 688-5550 Ext. 3035, reb@brocku.ca.

Thank you for your assistance in this project. Please keep a copy of this form for your records.

CONSENT FORM
I agree to participate in this study described above. I have made this decision based on the information I have read in the Letter of Invitation and the information provided herein the Informed Consent form. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions now or at any time in the future. I understand that I may withdraw this consent and/or my participation at any time and I understand how to do so.

Please check only one of the following options:

☐ I consent to participate in this study
☐ I do not consent to participate in this study

Date: ___________________
Appendix G: Participant Debriefing Form

Participant Debriefing Form: Request for Summary Results

Thank you for participating in this study. If you wish, you have the opportunity to receive summary feedback in terms of the main findings that result from conducting this study. The summary results will present main findings only in such a way as not to identify anyone personally in the presentation of the information.

Please click the box next to each statement that applies to you:

☐ I would like to receive a brief summary of the final results from this study
☐ I would not like to receive a brief summary of the final results from this study

If you wish to receive a copy of the summary results from this study, a member of our research team will need to contact you directly in the future to provide a single file via email. Please provide the following details:

Name (please print):

e-mail (please print):

This study has been reviewed and received ethics clearance from the Brock University Research Ethics Board (File #19-039).
Appendix H: Procedural Flow Chart

Participants
(N = 153) randomly assigned to one of eight conditions

<table>
<thead>
<tr>
<th></th>
<th>Male No Goal</th>
<th>Female Instrumental</th>
<th>Male Affective</th>
<th>Male PA</th>
<th>Female PA</th>
<th>Female Affective</th>
<th>Male Instrumental</th>
<th>Female No Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 19)</td>
<td>(n = 19)</td>
<td>(n = 19)</td>
<td>(n = 19)</td>
<td>(n = 19)</td>
<td>(n = 20)</td>
<td>(n = 19)</td>
<td>(n = 19)</td>
</tr>
</tbody>
</table>

Participants read vignette twice

Order of questionnaire completion:
1. PA questionnaire
2. Attitudes questionnaire
3. BREQ – 2R
4. Manipulation check
5. Demographics
Appendix I: Study Questionnaires

Overview: The survey is comprised of two sections.

Section A: This section is comprised of questions that ask you about the narrative that you just read about CHRIS. There are no right or wrong answers to these questions. Please respond as openly and honestly as possible to each question presented.

Section B: This section is comprised of questions that ask for more information about YOU so we can describe the people who took part in this study.

All responses will remain anonymous and confidential. Information will not be disclosed to others in any way that identifies you.
Section A: Physical Activity, Attitudes, and Behavioral Regulations

**Instructions:** The following statements describe CHRIS’ expectations about physical activity engagement. Using the scale below, please indicate the level of agreement to which each statement describes how CHRIS feels about physical activity. Read each statement carefully and answer as truthfully as possible as it pertains to CHRIS’ physical activity behavior. Please circle the best answer.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHRIS will continue to engage in physical activity four to five times per week for the next 3 weeks</strong></td>
<td>1  2  3  4  5  6  7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CHRIS will continue to engage in physical activity four to five times per week for the next 6 months</strong></td>
<td>1  2  3  4  5  6  7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Instructions:** The following question asks you about CHRIS’ attitudes toward physical activity.

For each of the following statements, please circle the point on the scale that you feel is most appropriate in describing CHRIS’ attitudes toward physical activity:

In general, CHRIS finds physical activity….

<p>| | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>unenjoyable</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>2.</td>
<td>useless</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>3.</td>
<td>unpleasant</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>4.</td>
<td>worthless</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>1.</td>
<td>boring</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>2.</td>
<td>harmful</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>3.</td>
<td>unsatisfying</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>8.</td>
<td>unimportant</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>9.</td>
<td>not worthwhile</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>
Instructions: This scale consists of a number of statements about why CHRIS engages in physical activity. Using the scale below, please indicate to what extent each of the following items is true for CHRIS. Read each statement carefully and answer as truthfully as possible as it pertains to CHRIS’ physical activity behavior. Please circle the best answer.

CHRIS engages in physical activity because…

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not true for me</th>
<th>Sometimes true for me</th>
<th>Moderately true for me</th>
<th>Often true for me</th>
<th>Very true for me</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. he(she) feels like a failure when he(she) hasn’t been physically active in a while.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. other people say he(she) should</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. he(she) thinks being physically active is a waste of time</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. it is consistent with his/her values</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. he(she) thinks it is important to make the effort to be physically active regularly</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. he(she) finds being physically active a pleasurable activity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. it has become a fundamental part of who he(she) is</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. he(she) can’t see why he(she) should bother being physically active</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. he(she) gets pleasure and satisfaction from participating in physical activity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. it is an important part of his/her identity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. he(she) feels under pressure from his/her friends/family to be physically active</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. it is fun</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. he(she) get restless if not physically active regularly</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Number</td>
<td>Statement</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>14.</td>
<td>he(she) feels ashamed when he(she) misses a physical activity session</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>he(she) doesn’t see why he(she) should have to be physically active</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>he(she) enjoys his(her) physical activity sessions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>he(she) feels guilty when he(she) is not physically active</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>his(her) friends/family/spouse say he(she) should</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>he(she) values the benefits of physical activity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>he(she) doesn’t see the point in physical activity</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21.</td>
<td>it is consistent with his(her) life goals</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>others will not be pleased with him(her) if he(she) doesn’t</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>23.</td>
<td>it is important to him(her) to be physically active regularly</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
### Section B: Manipulation Check and Demographics

**Instructions:** The following questions pertain to the narrative that you read about CHRIS. Based on your recollection of the information provided in the narrative YOU read, please rate YOUR level of agreement with each item presented below on the scale provided:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>...CHRIS had a physical activity goal to achieve 10,000 steps per day</td>
<td>Strongly Disagree</td>
<td>Neutral</td>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...CHRIS had a goal to enjoy and experience pleasure through physical activity</td>
<td>Strongly Disagree</td>
<td>Neutral</td>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...CHRIS had a goal to increase his immune system functioning to prevent colds and flu through physical activity</td>
<td>Strongly Disagree</td>
<td>Neutral</td>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...CHRIS did not have a physical activity goal</td>
<td>Strongly Disagree</td>
<td>Neutral</td>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
This section contains questions that ask you to provide information that will be used to describe the participants who take part in this study.

Section 1: Study Participants

These questions are about YOU – the study participants. They will be used to describe in general terms who participated in this research study.

What is your age: (years)

What is your:

- Height: ft/inches or cm/m
- Weight: lbs or kgs

What is your sex (please check one of the following options)?

- Male
- Female
- Transgender Female
- Transgender Male
- Gender variant/Non-Conforming
- Prefer Not to Answer
- Not listed – Specify: _____________________

How would you describe your ethnic origin (please check one of the following options)?

- White
- South Asian
- Chinese
- Black
- Filipino
- Arab
- Korean
- Latin American
- West Asian
- Japanese
- Aboriginal
- Southeast Asian
- Other - Specify: _____________________

What is your current marital status (please check one of the following options)?

- Married or Common-Law
- Widowed
- Single
- Separated or Divorced

What is your current employment status (please check one of the following options)?

- Full-Time Employed
- Part-Time Employed
- Unemployed
Have you ever used a wearable activity monitor such as a Fitbit, Apple Watch, pedometer or mobile application to monitor your physical activity?

☐ Yes  ☐ No

Do you currently use a wearable activity monitor such as a Fitbit, Apple Watch, pedometer or mobile application to monitor your physical activity?

☐ Yes  ☐ No

If you answered yes to the previous question, how many days per week do you monitor your physical activity with your wearable activity monitor?

☐ 1  ☐ 2  ☐ 3  ☐ 4  ☐ 5  ☐ 6  ☐ 7

---

THANK YOU

Thank you for taking the time to participate in our study. If you have any questions about this study please do not hesitate to ask a member of our research team at any time.
Appendix J: Experimental Stimulus

INSTRUCTIONS

This study is investigating **CHRIS**. You will be asked to read a short story about events that occurred in a university student’s life.

Carefully read the story to yourself ‘TWICE’. Try to vividly imagine each event that is happening as it is portrayed in the story.

After you read the story, you will answer some questions about the content of the story. Even though the story is short and doesn’t contain a lot of information, try to vividly imagine everything that you read about the university student and fill in all the details of the story as you read them in your own mind.

Remember, this study is interested in how YOU understand the story and how YOU vividly imagine the details contained within (and omitted from…) the story.

**SHOULD YOU HAVE ANY QUESTIONS, PLEASE ASK THE RESEARCHER NOW**

**IF THERE ARE NO QUESTIONS, PLEASE:**

- TURN TO THE NEXT PAGE THEN READ THE STORY TWICE
- EACH TIME YOU READ THIS STORY PLEASE TRY TO VIVIDLY IMAGINE ALL THE DETAILS
Experimental Condition #1: Control Condition (Male)

Please hand this paper back the researchers once you have completed the questionnaire.

Chris is 20 years old and a full-time university student in Ontario. This term Chris is taking a variety of required and elective courses. Chris has not yet decided on a major. Chris is of average height and average weight. Chris has brown eyes and short dark hair. In his spare time, Chris listens to music, reads, watches TV, and regularly gets together with his friends. Chris is physically active 4 or 5 days a week which consists of walking, jogging, and some resistance training. Chris enjoys playing pick-up basketball and tennis with his friends. Chris wears a FitBit every day to track his physical activity. Chris is the oldest of three children and his parents are both school teachers. Last summer, Chris worked at a movie theater. Next summer, Chris hopes to tour Canada for a few weeks with his friends.
Experimental Condition #2: Physical Activity Condition (Step Count; Male)

Please hand this paper back the researchers once you have completed the questionnaire.

Chris is 20 years old and a full-time university student in Ontario. This term Chris is taking a variety of required and elective courses. Chris has not yet decided on a major. Chris is of average height and average weight. Chris has brown eyes and short dark hair. In his spare time, Chris listens to music, reads, watches TV, and regularly gets together with his friends. Chris is physically active 4 or 5 days a week which consists of walking, jogging, and some resistance training. Chris enjoys playing pick-up basketball and tennis with his friends. Chris wears a FitBit every day to track his physical activity. Chris’ goal is to achieve 10,000 steps per day. Chris is the oldest of three children and his parents are both school teachers. Last summer, Chris worked at a movie theater. Next summer, Chris hopes to tour Canada for a few weeks with his friends.
Experimental Condition #3: Instrumental Judgement Condition (Male)

Please hand this paper back the researchers once you have completed the questionnaire.

Chris is 20 years old and a full-time university student in Ontario. This term Chris is taking a variety of required and elective courses. Chris has not yet decided on a major. Chris is of average height and average weight. Chris has brown eyes and short dark hair. In his spare time, Chris listens to music, reads, watches TV, and regularly gets together with his friends. Chris is physically active 4 or 5 days a week which consists of walking, jogging, and some resistance training. Chris enjoys playing pick-up basketball and tennis with his friends. Chris wears a FitBit every day to track his physical activity. Chris’ goal is to bolster his immune system through physical activity and protect against colds and viruses. Chris is the oldest of three children and his parents are both school teachers. Last summer, Chris worked at a movie theater. Next summer, Chris hopes to tour Canada for a few weeks with his friends.
Experimental Condition #4: Affective Judgement Condition (Male)

Please hand this paper back the researchers once you have completed the questionnaire.

Chris is 20 years old and a full-time university student in Ontario. This term Chris is taking a variety of required and elective courses. Chris has not yet decided on a major. Chris is of average height and average weight. Chris has brown eyes and short dark hair. In his spare time, Chris listens to music, reads, watches TV, and regularly gets together with his friends. Chris is physically active 4 or 5 days a week which consists of walking, jogging, and some resistance training. Chris enjoys playing pick-up basketball and tennis with his friends. Chris wears a FitBit every day to track his physical activity. Chris’ goal is to bolster his enjoyment and pleasure through physical activity. Chris is the oldest of three children and his parents are both school teachers. Last summer, Chris worked at a movie theater. Next summer, Chris hopes to tour Canada for a few weeks with his friends.
Experimental Condition #5: Control Condition (Female)

Please hand this paper back the researchers once you have completed the questionnaire.

Chris is 20 years old and a full-time university student in Ontario. This term Chris is taking a variety of required and elective courses. Chris has not yet decided on a major. Chris is of average height and average weight. Chris has brown eyes and short dark hair. In her spare time, Chris listens to music, reads, watches TV, and regularly gets together with her friends. Chris is physically active 4 or 5 days a week which consists of walking, jogging, and some resistance training. Chris enjoys playing pick-up basketball and tennis with her friends. Chris wears a FitBit every day to track her physical activity. Chris is the oldest of three children and her parents are both school teachers. Last summer, Chris worked at a movie theater. Next summer, Chris hopes to tour Canada for a few weeks with her friends.
Experimental Condition #6: Physical Activity Condition (Step Count; Female)

Please hand this paper back the researchers once you have completed the questionnaire.

Chris is 20 years old and a full-time university student in Ontario. This term Chris is taking a variety of required and elective courses. Chris has not yet decided on a major. Chris is of average height and average weight. Chris has brown eyes and short dark hair. In her spare time, Chris listens to music, reads, watches TV, and regularly gets together with her friends. Chris is physically active 4 or 5 days a week which consists of walking, jogging, and some resistance training. Chris enjoys playing pick-up basketball and tennis with her friends. Chris wears a FitBit every day to track her physical activity. Chris’ goal is to achieve 10,000 steps per day. Chris is the oldest of three children and her parents are both school teachers. Last summer, Chris worked at a movie theater. Next summer, Chris hopes to tour Canada for a few weeks with her friends.
Experimental Condition #7: Instrumental Judgement Condition (Female)

Please hand this paper back the researchers once you have completed the questionnaire.

Chris is 20 years old and a full-time university student in Ontario. This term Chris is taking a variety of required and elective courses. Chris has not yet decided on a major. Chris is of average height and average weight. Chris has brown eyes and short dark hair. In her spare time, Chris listens to music, reads, watches TV, and regularly gets together with her friends. Chris is physically active 4 or 5 days a week which consists of walking, jogging, and some resistance training. Chris enjoys playing pick-up basketball and tennis with her friends. Chris wears a FitBit every day to track her physical activity. Chris’ goal is to bolster her immune system through physical activity and protect against colds and viruses. Chris is the oldest of three children and her parents are both school teachers. Last summer, Chris worked at a movie theater. Next summer, Chris hopes to tour Canada for a few weeks with her friends.
Experimental Condition #8: Affective Judgement Condition (Female)

Please hand this paper back the researchers once you have completed the questionnaire.

Chris is 20 years old and a full-time university student in Ontario. This term Chris is taking a variety of required and elective courses. Chris has not yet decided on a major. Chris is of average height and average weight. Chris has brown eyes and short dark hair. In her spare time, Chris listens to music, reads, watches TV, and regularly gets together with her friends. Chris is physically active 4 or 5 days a week which consists of walking, jogging, and some resistance training. Chris enjoys playing pick-up basketball and tennis with her friends. Chris wears a FitBit every day to track her physical activity. Chris’ goal is to bolster her enjoyment and pleasure through physical activity. Chris is the oldest of three children and her parents are both school teachers. Last summer, Chris worked at a movie theater. Next summer, Chris hopes to tour Canada for a few weeks with her friend.