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Running Head: SDT and Sedentary Behavior

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Abstract

Objectives. Evidence exists that independently of physical activity, a dose-response relationship exists between sedentary time and adverse health outcomes. However, little is known about motivations underlying sedentary behavior. The purpose of this study was to (i) examine the factor structure and composition of sedentary derived autonomous (identified and intrinsic) and controlled (external and introjected) motives within an Organismic Integration Theory (OIT) framework and (ii) determine whether these motivational constructs are related with overall sitting time as well as sitting for work/school and recreation/leisure on weekdays and weekends. **Method.** University students or staff (n = 571) completed an internet-based survey within a cross-sectional design. After completing a modified Sedentary Behavior Questionnaire, participants were randomized to one of five groups (general, weekday work/school, weekday recreation/leisure, weekend work/school, weekend recreation/leisure) and completed a sedentary derived 15-item modified Behavioral Regulation in Exercise Questionnaire (BREQ). **Results.** Factor analysis findings support the tenability of a four-factor model for weekday work/school, weekend work/school, and weekend leisure/recreation sedentary behavior and a three-factor model for general and weekday leisure/recreation behavior. Regression analyses showed the motivational constructs explained a significant amount of sedentary behavior variance for weekend work/school (10%), weekend leisure/recreation (9%), weekday work/school (4%), and weekday leisure/recreation (3%). General sedentary behavior was unrelated with the motivational constructs. In general, autonomous motives underlied leisure/recreational sitting while controlled motives were more strongly associated with work/school behavior. **Conclusions.** Our findings support the hypothesis that motivational constructs grounded in OIT have the potential to further our understanding of sedentary behavior.

Keywords: Sedentary behavior; Motivation; Self-determination theory; Organismic Integration Theory; Health psychology.

I sit because I have fun when I do so! Using self-determination theory to understand sedentary behavior motivation

The physical and mental health benefits of regular moderate-to-vigorous physical activity in the general population are well documented (Ehrman, Gordon, Visich, & Keteyian, 2008). However, a growing body of research demonstrates that even when individuals accumulate recommended amounts of physical activity, a dose-response relationship exists between sedentary time and adverse health outcomes. In an overview of systematic reviews on sedentary behavior and health outcomes, Rezende et al. (2014) found that independently of physical activity, time spent in sedentary behavior is related to all-cause mortality, fatal and non-fatal cardiovascular disease, type 2 diabetes and several types of cancers.

Sedentary behavior is defined as "any waking behavior characterized by an energy expenditure ≤1.5 METs while in a sitting or reclining posture" (Sedentary Behavior Research Network, 2012, p.540). Even though accelerometry-based research is unable to distinguish between standing and sitting, population-based objective data still indicate that Canadian and US adults spend an average of 9.7 and 7.7 hours per day, respectively, being sedentary (Colley et al., 2011; Matthews et al., 2008). These data highlight the need for a greater understanding of the determinants of sedentary behavior in order to inform the development of intervention strategies aimed at reducing excessive sedentarism.

Social cognitive and motivational theories have proven useful in furthering our understanding of numerous health behaviors including physical activity (Hagger & Chatzisarantis, 2005). As such, they have the potential to help explain sedentary behavior as well. However, only a handful of studies have sought to understand the cognitions underlying sedentary behavior (Rhodes, Mark, & Temmel, 2012). To the best of our knowledge, only the

Theory of Planned Behavior (TPB; Ajzen, 1985) and Protection Motivation Theory (PMT; Rogers, 1975) have been examined in the context of sedentarism. Smith and Biddle (1999) showed that TPB constructs were related to intentions to be sedentary, while Rhodes and Dean (2009) found that intentions to engage in television viewing, computer use, reading/listing to music, and social activities were consistently related to behavior and that attitude influenced behaviors through intention. Lowe et al. (2014) found that only instrumental and affective attitudes were related with time spent supine or sitting. Finally, Prapavessis, Gaston, and De Jesus (2015) found that subjective norms emerged as the strongest predictor of intention and intention emerged as the most consistent predictor of behavior. Mediation analyses also showed that only attitudes consistently affected behavior through intention. Models predicting work/school sedentary behavior explained a greater amount of variance than a general model or models explaining leisure/recreation behavior. In the only study to examine PMT, Wong, Gaston, De Jesus, and Prapavessis (in press), found that PMT items grouped into factors consistent with the theory threat and coping appraisal tenets and explained significant variance in goal intention, implementation intention, and sedentary behavior. In general, coping variables emerged as better predictors than threat variables.

These studies support the hypothesis that social cognitive theories of health behavior have the potential to advance our understanding of the cognitive processes underlying sitting behavior. However, these studies all conceptualized motivation as a unitary concept defined as ‘intention.’ In contrast, organismic integration theory (OIT), a sub-theory of self-determination theory (SDT; Deci & Ryan, 2002), posits that the type of motivation an individual possesses is more important than the amount. According to SDT, the types of motivation range from complete amotivation to intrinsic regulation, the most autonomous, or self-determined, type of

motivation. Amotivation represents a complete lack of motivation whereas intrinsic regulation refers to "doing an activity for its own sake" and is characterized by inherent enjoyment and interest (Ryan &Deci, 2007, p. 2). Between these two ends of the continuum lie four types of extrinsic regulation, two controlling and two autonomous: external regulation, introjected regulation, identified regulation, and integrated regulation (Ryan & Deci, 2002). The two controlling types of motivation are external regulation and introjected regulation. External regulation refers to motivation arising out of a desire to satisfy the demands of others. Introjected regulation refers to acting in order to avoid feelings of guilt or out of a psychological need to prove something. Identified regulation, which represents the lower end of autonomous motives, refers to motivation arising out of a desire to achieve an outcome which is personally valued by the individual. Integrated regulation, the most autonomous form of extrinsic regulation, occurs when the behavior has been integrated within one's values, goals, and needs.

Cross-sectional studies have demonstrated that SDT is a useful model for understanding a number of health behaviors including physical activity (Wilson, Mack, & Grattan, 2008). With respect to physical activity, more autonomous motives appear to be more predictive of actual and intended behavior compared to controlled motives (Wilson et al.). In a systematic review, Teixeira, Carraça, Markland, Silva, and Ryan (2012) found that studies tend to show that identified regulation is more predictive of exercise adoption whereas intrinsic motivation is more predictive of long-term engagement. Evidence also exists that OIT behavioral regulations can account for variance in exercise behavior beyond that captured by other social cognitive theories (Hagger & Chatzisarantis, 2009; Pinto & Ciccolo, 2011).

Purpose and Hypotheses

Given the demonstrated utility of OIT for advancing our understanding of exercise, it may also represent a useful model for exploring the relationship between motivation and sedentary behavior. Thus, the purpose of this study was to (i) examine the factor structure and composition of sedentary derived autonomous (identified and intrinsic) and controlled (external and introjected) motives within an OIT framework (Deci & Ryan, 2002) and (ii) determine whether these motivational constructs are related with overall sitting time as well as sitting for work/school and recreation/leisure on weekdays and weekends. In line with prior evidence from the TPB domain on the importance of attitudes and subjective norms for sedentary behavior, our hypotheses were as follows: (i) sedentary derived motives will demonstrate tenable factor structure consistent with OIT; (ii) sitting time would be positively related with all four types of regulation such that stronger autonomous motives (i.e., identified and intrinsic) and controlled motives (i.e., external and introjected regulation) would be associated with increased sedentary behavior: with respect to specific types of sitting behavior and regulations, (iii) autonomous motives were expected to be the strongest predictors of leisure/recreational sedentary behavior, and (iv) controlling motives were expected to be stronger predictors of work/school sitting since this type of sedentary behavior is likely to be perceived as less within an individual's control compared with leisure/recreational sitting; finally, we (v) expected the four models which distinguished between weekday and weekend and work/school and leisure/recreational sitting to perform better than the general model due to their greater specificity to the behavior in question.

Methods

Participants

Eight hundred and eighty-seven students or staff from a university in Ontario, Canada responded to an email invitation to participate in this research by completing an online survey.

Eligibility criteria included the following: 18 to 64 years of age, fluent in English, and access to the internet. Of the 887 who responded to the invitation, 35 individuals were excluded because they indicated that they suffered from a medical condition prohibiting them from being physically active, 37 for providing implausible sedentary behavior data (i.e., their daily self-reported sedentary time exceeded 24 hours per day), and 244 for failing to complete the questionnaire. Thus, the final sample consisted of 571 individuals (416 females and 155 males; M_{age} = 23.93 years, SD = 6.18, Range = 18-54 years). With respect to ethnicity, 72.5% reported being 'Caucasian,' 10.3% Asian, and 17.2% self-identified as 1 of 36 other ethnic backgrounds. Most participants were undergraduate students (61.5%), 21.2% Masters level graduate students, 8.9% doctoral students, 3.2% post-doctoral fellows, 1.1% faculty members, 0.9% administrative staff, and 4.0% 'other staff'; 50.6% of participants indicated that they did not work for pay, 18.1% worked between 1 and 10 hours per week, 9.9% between 11 and 20 hours, 2.0% between 21 and 30 hours, 9.4% between 31 and 40 hours, and 9.9% worked more than 40 hours per week.

Instruments

Sedentary Behavior Questionnaire. Sedentary behavior was assessed using a 12-item version of Rosenberg et al.'s (2010) Sedentary Behavior Questionnaire (SBQ) previously modified by Prapavessis et al. (2015). Prapavessis et al. modified the original 9-item SBQ by adding two additional items (i.e., eating and sitting for religious or spiritual pursuits) as well as separating 'sitting driving in a car' into 2 items, one assessing leisure/recreation and the other work/school motorized transportation. In addition, Prapavessis et al. extended the response range from the original maximum of '6 hours or more' to '9 hours or more' in order to increase the instrument's sensitivity. Participants were asked to indicate the duration of time (none, 15 min or less, 30 min, 1 hr, 2 hrs, ..., 9 hours or more) that they spent per day in 12 different sedentary

pursuits. The questionnaire was completed twice: once referring to an average weekday and once referring to an average weekend. The SBQ included both work/school and leisure/recreation activities. Work/school sedentary time was assessed using two items: sitting for work or school (including using the computer for work or school) and sitting in a motor vehicle in order to get to work or school. Leisure/recreational time was assessed using ten items: watching TV, using the computer for recreational purposes, reading for pleasure, listening to music, playing a musical instrument, doing arts and crafts, sitting in a motor vehicle for leisure-related transportation purposes, eating, socializing; and sitting for religious or spiritual pursuits. Five separate sedentary behavior time scores were computed for each individual, an overall score (i.e., average time spent per day in sedentary activity) as well as time spent in leisure/recreational and work/school activities on weekdays and weekends, separately. Overall sedentary time was calculated using the following formula: $SBQ_{Overall} = [(\sum 12 \text{ weekday items x } 5) + (\sum 12 \text{ weekend items x } 2)]/7$. For the remaining four time scores, only items which referred to the time frame (weekday or weekend) and type (leisure/recreational or work/school) of interest were used. The original SBQ demonstrated good internal consistency and excellent test-retest reliability (Rosenberg et al., 2010).

Motivation. Motivation type was measured using the 15-item Behavioral Regulation in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997) adapted for sedentary behavior. The original BREQ scale has demonstrated good structural validity and internal consistency (Wilson, Rodgers, & Fraser, 2002; Mullan et al.) as well as criterion validity in relation to exercise (Edmunds, Ntoumanis, & Duda, 2007; Wilson, Rodgers, Fraser, & Murray, 2004). Five response options were provided for each BREQ item. The five options were scored as follows: ‘1’ (motivation type not relevant for sitting), ‘2’ (motivation type related to sitting

approximately one quarter of waking hours), ‘3’ (motivation type related to sitting approximately half of waking hours), ‘4’ (motivation type related to sitting approximately one three quarters of waking hours), and ‘5’ (motivation type related to sitting almost all of waking hours). The complete questionnaire is provided in Table 1. Depending on group assignment, the sedentary-derived BREQ items were preceded by a different introduction. Specifically, participants in the general group were instructed, “These questions refer to ANY and ALL sitting that you do, regardless of whether it is for work, school, or personal/recreation/leisure pursuits and whether it is on weekdays or weekends.” In contrast, participants in the other four groups were instructed that the questions refer only to their particular form of sitting (i.e., “Remember, these questions refer to sitting for WORK or SCHOOL on WEEKDAYS only” for the weekend work/school group). Of the 18 Cronbach alphas computed across the five models, 16 (88.9%) were equal to or above 0.68 and 2 were equal to 0.61. Cronbach alphas for all models and variables are provided as supplemental material along with the factor analysis results.

Data Collection Procedures

Ethical approval was granted by the Research Ethics Board of the host university prior to recruitment of participants. Participants were recruited between April and May 2014 through e-mail. A member of the research team contacted department heads across campus and asked them to share information about the study with students, faculty, and administrators within their department. The email contained a link to the study website (Survey Monkey, Palo Alto, CA, USA). Participation was voluntary and anonymous. After providing informed consent, participants completed a demographics questionnaire and the modified SBQ. Next, an internal computer-generated randomization scheme (via Survey Monkey) directed participants to one of

five groups: general, weekday work/school, weekday leisure/recreation, weekend work/school, and weekend leisure/recreation.

Data Analysis

Data analyses were conducted separately for each of the five groups. Preliminary analyses consisted of ANOVA and chi-square which were used to examine group equivalency with respect to demographic characteristics across groups and between participants with complete vs. incomplete data. Before submitting the BREQ items to psychometric analysis, the data were inspected for factorability, or suitability for factor analysis. Suitability was determined based on correlations ($r > .30$; Tabachnick and Fidell, 2007), Bartlett's test of sphericity ($p < .05$; Bartlett, 1954), and the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO; > .50; Kaiser, 1970, 1974). Exploratory factor analysis (EFA) using principal axis factor analysis with oblique rotation (Direct oblimin method) was chosen given the related nature of the constructs and the novel examination of SDT-based sedentary-derived motivation constructs. Exploratory factor analysis has been recommended for early exploratory work as it is less biased by researcher expectations (Schutz & Gessaroli, 1993; Thompson, 2004) and can be conducted with fewer than the 200-400 cases typically recommended for confirmatory factor analysis (Hoyle, 2000; Tanaka, 1998). Factors were retained based on eigenvalues (>1; Kaiser, 1960), visual inspection of Catell's scree test (Catell, 1966), and pattern matrix loadings. Cronbach's alphas (Nunnally, 1978) were then computed for each type of regulation in order to measure internal consistency. The results of the factor analysis and Cronbach's alphas are provided as supplementary material.

Pearson bivariate correlations were used to examine the relation between external, introjected, identified, and intrinsic motivations and sedentary behavior. Then, the regression

assumptions of linearity, homoscedasticity, and multicollinearity were examined. Constructs that were significantly related to behavior were then entered in a linear regression model. Regression models were evaluated based on the percent of variance accounted for (i.e., adjusted R^2 values), the standardized beta (β) associated with each individual item, and the effect size (Cohen's f^2) associated with each R^2. Cohen's f^2 was computed using the formula $R^2/(1 - R^2)$ and effect sizes of 0.02, 0.15, and 0.35 are considered small, medium, and large, respectively (Cohen, 1988). A pairwise comparison of the structure of the five models was conducted using Fisher's z. Fisher's z was computed using Garbin's (n.d.) FZT.exe program. All other statistical analyses were conducted using SPSS (Version 20) and the level of significance was accepted at $p < 0.05$.

Results

Group Equivalency

One-way ANOVA and chi-square procedures confirmed group equivalency through the randomization for all demographic variables (*p*s = .49 - . 86). For participants with complete versus incomplete data, there were no significant differences for age ($p = .22$), gender ($p = .20$), or ethnicity ($p = .12$). However, significant differences emerged for position ($p = .02$) and number of hours working for pay ($p = .03$). For position, those with complete data were more likely to be graduate students (29.0% vs. 14.5% of those with incomplete data) and were more likely to work fewer hours per week (9.8% worked 40+ hours per week compared to 16.6% of those with incomplete data).

Factor Analysis

The factor analysis pattern matrices for the five groups are available as supplementary material. Item communalities were adequately related for all models. The KMO measure of sampling adequacy ranged from 0.71 for the general model to 0.76 for weekday work/school and

weekend leisure/recreation. For all groups, the sets of variables were adequately related as indicated by Bartlett's Test of Sphericity which was significant for all five models (all *p*s < .001). Analyses of eigenvalues, scree plots, and factor loadings revealed two three-factor models (general model and weekday leisure/recreation) and three four-factor models (weekday work/school, weekend work/school, and weekend leisure/recreation). For both the general model and the weekday leisure/recreation model, identified regulation items failed to load together into a coherent and interpretable factor. In general, intrinsic, external, and introjected items loaded together and formed clear factors. However, there were a few exceptions. In the general model, one external regulation item (Pressure from friends/family) loaded separately from the other 3 items and was excluded. In the weekday work/school model, two intrinsic items (satisfaction and enjoyment) loaded separately from the remaining two items and were excluded. In addition, one external item (What my friends/family/partner say) loaded separately from the remaining three external items and was excluded. In the weekday leisure/recreation model, one external item (Pressure from friends/family) loaded separately from the others and was excluded. In the weekend work/school model, one identified regulation item (Benefits of sitting) and one external regulation item (Pleasing others) loaded separately and were both excluded. Finally, in the weekend leisure/recreation model, one identified regulation (Benefits of sitting) and one intrinsic regulation (Satisfaction) item loaded separately and were excluded. The final five models explained between 46.05% (weekday leisure/recreation) and 50.74% (weekend leisure/recreation) of the total variance.

Correlation Analyses

Bivariate (Pearson) correlations between study variables for all five models are presented in Table 2. Sedentary time was correlated with external regulation in one model (weekend

work/school), introjected regulation in one model (weekday work/school), and intrinsic regulation in three models (weekday leisure/recreation, weekend work/school, and weekend leisure/recreation). There were no significant relations between identified regulation and behavior.

[Insert Table 1 here]

Linear Regression Analyses

A linear regression was conducted for each model with behavior serving as the criterion variable. Scatterplots of the standardized residuals showed that points were randomly scattered indicating that the assumptions of linearity and homoscedasticity were met for each regression model. Inspection of Variance Inflation Factor (Range = 1.00 – 1.049) and Tolerance (Range = 0.95 - 1.00) values indicated that multicollinearity was not an issue (Menard, 1995).

The results for each regression model predicting behavior are presented in Table 3. External regulation was a significant contributor in only one model (weekend work/school), introjected regulation was the sole significant predictor in one model (weekday work/school), and intrinsic motivation was the sole significant predictor in two models (weekday leisure/recreation and weekend leisure/recreation), and a significant contributor in a third model (weekend work/school). The percent of variance explained ranged from 3% (weekday leisure/recreation) to 10% (weekend work/school). Post-hoc analyses using Fischer's Z revealed that there were no significant differences between the respective R^2 values of any of the four models (i.e., weekday work/school vs. weekday leisure/recreation, $Z = 0.20$, $p = .84$; weekday work/school vs. weekend work/school, $Z = -0.99$, $p = .32$; weekday work/school vs. weekend leisure/recreation, $Z = -0.73$, $p = 0.47$; weekday leisure/recreation vs. weekend

work/school, $Z = -1.18$, $p = .24$; weekday leisure/recreation vs. weekend leisure/recreation, $Z = -0.91$, $p = .36$; weekend work/school vs. weekend leisure/recreation, $Z = 0.20$, $p = .84$).

[Insert Table 3 here]

Discussion

Largely consistent with our hypotheses, our findings demonstrate that motivational constructs grounded in Organismic Integration Theory have the potential to contribute to our understanding of sedentary behavior among university students and staff. The factor analysis findings support the tenability of a four-factor model for weekday and weekend work/school and weekend leisure/recreation sedentary behavior and a three-factor model for general and weekday leisure/recreation behavior. The constructs represented were in line with Organismic Integration Theory and consisted of external regulation, introjected regulation, identified regulation, and intrinsic motivation in the four-factor model while the three-factor models were comprised of the same constructs minus identified regulation. Only 1-3 rogue items emerged in each factor analytical model. An examination of these items revealed little consistency among models indicating that the applicability of individual BREQ items to sedentary behavior varies depending on the type of behavior examined (i.e., leisure/recreational vs. work/school and weekday vs. weekend). While our results suggest that OIT is a feasible and useful framework for understanding sedentary behavior, it is recommended that the emerging factor structure and composition of this measurement tool be cross-validated using different samples with confirmatory factor analysis (Pedhazur & Schmelkin, 1991).

Consistent with our hypotheses, significant relationships emerged between weekday and weekend leisure/recreational and work/school sedentary behavior and one or more of the following three motivation types: external regulation, introjected regulation, and intrinsic

motivation. The greatest amount of variance was explained for weekend work/school (10%) followed by weekend leisure/recreation (9%), weekday work/school (4%), and weekday leisure/recreation (3%). No significant relationships emerged between general sedentary behavior (i.e., average daily sedentary time) and any motivational constructs. While we hypothesized that this model would show the weakest association, we did not expect a null finding. This finding suggests that specificity is especially important for linking motivational constructs and behavior. Although our effect sizes indicate small to small-medium effects (Cohen, 1988), they are in line with findings from the domain of exercise, where the direct effects of motivation type on intentions and behavior are generally small (Hagger & Chatzisarantis, 2005). With the exception of identified regulation, which did not show any association with sedentary behavior, our results are also not that far off when it comes to the percent of samples demonstrating significant associations between motivation and behavior. In our study, sedentary behavior was related with intrinsic motivation in 3 models (60%), introjected regulation in one (20%), and external regulation in one (20%). In a review of 66 studies, Texeira et al. (2012) found that significant relationships emerged between exercise and intrinsic motivation, identified regulation, introjected regulation, and external regulation in 62%, 74%, 35%, and 43% of studies, respectively.

The variability between the predictive utility of our five models is in line with our hypothesis and Prapavessis' et al.'s (2015) finding that specifying 'when' *and* 'what' when it comes to sedentary behavior is indeed important. The predictive utility of our models, however, fell short of the variance reported by Prapavessis et al. In our study, the two weekend models performed best whereas Prapavessis et al. found that TPB variables best explained weekday work/school (43%), followed by weekend leisure/recreation (26%), weekend work/school (22%),

general (20%), and weekday leisure/recreation (8%). Although the difference in variance explained suggests that rational processes may underlie sedentary behavior to a greater extent than motivation type, more research is needed before any conclusions can be drawn regarding the usefulness of cognitive versus motivational models of sedentary behaviour. Furthermore, it must not be overlooked that the questionnaire used in this study represents a first step in the creation of sedentary-derived BREQ items. As the BREQ's structure and composition becomes more robust and more reliable ways of measuring sedentary behavior are used, it is likely that the amount of variance explained will increase.

In line with our hypothesis regarding the relationship between autonomous motives and leisure/recreation behavior, intrinsic motivation was the sole significant predictor of sedentary behavior in two models – weekday and weekend leisure/recreation. In both models, higher levels of intrinsic motivation were associated with greater leisure/recreation sedentarism. This suggests that individuals who engaged in more leisure/recreational sitting did so at least partially because they enjoy sitting and consider it fun, pleasant, and satisfying. This is not surprising given that leisure/recreation activities are, by definition, more autonomous than work/school activities. Since individuals are, by and large, free to choose the leisure activities they engage in, our results support the notion that those who enjoy sitting may choose sedentary activities over more active ones (e.g., going for a walk, playing sports).

Intrinsic motivation, along with external regulation, was also a significant predictor of weekend work/school sedentary time. In this model, however, greater external motivation and lower intrinsic motivation was associated with increased sedentarism. These findings are in line with our hypotheses and suggest that in contrast to leisure/recreational sitting, more controlled motives underlie work/school sitting on weekends. This in understandable since in Western

society weekdays are typically reserved for work, school, and/or family responsibilities whereas weekends are seen as ‘free time’ during which one can engage in the activities he/she chooses and enjoys. Thus, individuals who engaged in more work/school on weekends did so because they felt they *had to* rather than because they enjoyed doing so. In fact, the inverse relationship between sitting time and intrinsic motivation suggests that most individuals in our study may actually dislike sitting for work/school on weekends.

Introjected regulation emerged as a significant, albeit modest, predictor in only one model. It explained, on its own, approximately 4% of the variance in weekday work/school behavior. Extending beyond simple feelings of guilt, introjected regulation includes contingent self-esteem, which leads people to behave in socially accepted ways in order to feel worthy and protect their fragile egos (Gagné & Deci, 2005). Our findings suggest that individuals who could sit for longer before starting to feel guilty, ashamed, or like a failure, also spent more time sitting for work or school on weekdays, indicating that our sample were still somewhat motivated by these negative feelings. While the relation between introjected regulation and work/school was consistent with our hypothesis and is not surprising in light of societal expectations, controlled motives are not the ideal or desired form of motivation in either domain. Research has shown that autonomous motives (rather than controlled) are associated with greater job satisfaction and well-being, better attendance and lower turnover, more effective performance on complex tasks, and increased flexibility, creativity, and heuristic problem solving (Gagné & Deci). Fortunately, there are numerous strategies that employers and educators can use in order to promote more autonomous forms of motivation among their staff or students and ultimately improve performance, job satisfaction, and psychological well-being.

Contrary to our hypotheses, identified regulation showed no significant relationships with sedentary behavior. Identified regulation occurs when an individual recognizes that a behavior is beneficial for achieving a personally valued goal and then adopts that behavior as their own. The items used in the current study assessed the importance of sitting, needing to sit, and the benefits of sitting. Given that sitting is typically engaged in not for its own sake but as a means to an end (e.g., to watch a valued television program or accomplish one's work), it is surprising that this type of regulation failed to show a relationship with sedentary behavior. Although the questionnaire did clearly state that the sedentary-derived BREQ items pertain only to a particular type of sitting (e.g., sitting for work or school on weekends, etc.), it is possible that our participants interpreted them to refer to sitting per se, especially since it may be possible to accomplish one's work without sitting (e.g., students could pace or ride a stationary bike while studying). If that was indeed the case, then it is not surprising that this type of regulation did not hold up since sitting for the sake of sitting is unlikely to make much sense among an undergraduate population.

Our participants reported sitting for work/school an average of 6.67 and 4.17 hours per day on weekdays and weekends, respectively, and for leisure/recreation 6.44 and 9.72 hours per day on weekdays and weekends, respectively. The average overall daily sitting time was 12.15 hours per day which indicates that our sample is highly sedentary. However, from a practical standpoint, it is positive to find that leisure/recreational sitting exceeded work/school sitting. By definition, individuals have a greater degree of autonomy (i.e., choice) when it comes to engaging in leisure/recreational activities. Thus, if effective, interventions aimed at reducing leisure/recreational sedentary time could potentially and substantially reduce university students' overall sitting time.

While the results of this study are both novel and informative, this work is not without limitations. Firstly, sedentary behavior was assessed through self-report. To reduce recall bias, it is recommended that future studies incorporate objective measurement (e.g., accelerometers/inclinometers). Secondly, the cross-sectional design also precluded us from making causal inferences regarding the relation between motivation type and sedentary behavior. Thirdly, our sample was comprised primarily of university students, a large proportion of whom did not work for pay. Thus, it is difficult to draw conclusions regarding the generalizability of these findings to a general population.

Conclusion

In summary, this study explored motivational constructs grounded in OIT for understanding sedentary behavior. Evidence now exists for the tenability of a 3 and 4 factor motivational model that is consistent with OIT. Furthermore, our findings indicate that autonomous motives underlie leisure/recreational sitting while controlled motives are more strongly associated with work/school behavior. More research is needed before these motivational constructs can be used as a framework to inform intervention to reduce sedentarism in the general population.

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Table 1

BREQ items adapted for sedentary behavior

Item #	Motivation type	Question heading	Response options
1	External	What other people say	• What other people say has nothing to do with how much time I sit during my waking hours (1) • What other people say leads me to sit approximately one quarter of my waking hours (2) • What other people say leads me to sit approximately half of my waking hours (3) • What other people say leads me to sit approximately three quarters of my waking hours (4) • What other people say leads me to sit almost all of my waking hours (5)
2	Introjected	Feeling guilty	• I don't feel guilty, no matter how much I sit during my waking hours (1) • I feel guilty if I sit approximately one quarter of my waking hours (2) • I feel guilty if I sit approximately half of my waking hours (3) • I feel guilty if I sit approximately three quarters of my waking hours (4) • I feel guilty if I sit almost all of my waking hours (5)
3	Identified	Benefits of sitting	• I don't value the benefits of sitting during my waking hours (1) • I value the benefits of sitting approximately one quarter of my waking hours (2) • I value the benefits of sitting approximately half of my waking hours (3) • I value the benefits of sitting approximately three quarters of my waking hours (4) • I value the benefits of sitting almost all of my waking hours (5)
4	Intrinsic	Fun	• I don't consider sitting even for a short time during my waking hours fun (1) • It's fun to sit approximately one quarter of my waking hours (2) • It's fun to sit approximately half of my waking hours (3) • It's fun to sit approximately three quarters of my waking hours (4) • It's fun to sit almost all of my waking hours (5)

5	External	What my friends/family/partner say	• What my friends/family/partner say has nothing to do with how much time I sit during my waking hours (1) • What my friends/family/partner say leads me to sit approximately one quarter of my waking hours (2) • What my friends/family/partner say leads me to sit approximately half of my waking hours (3) • What my friends/family/partner say leads me to sit approximately three quarters of my waking hours (4) • What my friends/family/partner say leads me to sit almost all of my waking hours (5)
6	Introjected	Feeling ashamed	• I don't feel ashamed, no matter how much time I sit during my waking hours (1) • I feel ashamed if I sit approximately one quarter of my waking hours (2) • I feel ashamed if I sit approximately half of my waking hours (3) • I feel ashamed if I sit approximately three quarters of my waking hours (4) • I feel ashamed if I sit almost all of my waking hours (5)
7	Identified	Importance of sitting to me	• Sitting during my waking hours is not important to me (1) • It's important to me to sit approximately one quarter of my waking hours (2) • It's important to me to sit approximately half of my waking hours (3) • It's important to me to sit approximately three quarters of my waking hours (4) • It's important to me to sit almost all of my waking hours (5)
8	Intrinsic	Enjoyment	• I don't enjoy sitting during my waking hours (1) • I enjoy sitting approximately one quarter of my waking hours (2) • I enjoy sitting approximately half of my waking hours (3) • I enjoy sitting approximately three quarters of my waking hours (4) • I enjoy sitting almost all of my waking hours (5)
9	External	Pleasing others	• How much time I sit during my waking hours has nothing to do with pleasing others (1) • Others will be pleased with me if I sit approximately one quarter of my waking hours (2)

			• Others will be pleased with me if I sit approximately half of my waking hours (3) • Others will be pleased with me if I sit approximately three quarters of my waking hours (4) • Others will be pleased with me if I sit almost all of my waking hours (5)
10	Introjected	Feeling like a failure	• How much time I sit during my waking hours has nothing to do with whether I feel like a failure (1) • I feel like a failure when I sit approximately one quarter of my waking hours (2) • I feel like a failure when I sit approximately half of my waking hours (3) • I feel like a failure when I sit approximately three quarters of my waking hours (4) • I feel like a failure when I sit almost all of my waking hours (5)
11	Identified	Importance of sitting	• I don't think it is important to sit (1) • I think it is important to sit approximately one quarter of my waking hours (2) • I think it is important to sit approximately half of my waking hours (3) • I think it is important to sit approximately three quarters of my waking hours (4) • I think it is important to sit almost all of my waking hours (5)
12	Intrinsic	Sitting for pleasure	• I don't find sitting during my waking hours pleasurable (1) • I find sitting approximately one quarter of my waking hours pleasurable (2) • I find sitting approximately half of my waking hours pleasurable (3) • I find sitting approximately three quarters of my waking hours pleasurable (4) • I find sitting almost all of my waking hours pleasurable (5)
13	External	Pressure from friends/family	• I don't feel pressure from my friends/family to sit during my waking hours (1) • I feel pressure from my friends/family to sit approximately one quarter of my waking hours (2) • I feel pressure from my friends/family to sit approximately half of my waking hours (3) • I feel pressure from my friends/family to sit approximately three quarters of my waking hours (4) • I feel pressure from my friends/family to sit almost all of my waking hours (5)
14	Identified	Needing to sit	• I don't feel a need to sit during my waking hours (1)

			• I feel a need to sit approximately one quarter of my waking hours (2) • I feel a need to sit approximately half of my waking hours (3) • I feel a need to sit approximately three quarters of my waking hours (4) • I feel a need to sit almost all of my waking hours (5)
15	Intrinsic	Satisfaction	• I do not get satisfaction from sitting during my waking hours (1) • I get satisfaction from sitting approximately one quarter of my waking hours (2) • I get satisfaction from sitting approximately half of my waking hours (3) • I get satisfaction from sitting approximately three quarters of my waking hours (4) • I get satisfaction from sitting almost all of my waking hours (5)

Table 2

Pearson correlations for sedentary behavior and regulation type

Variable	Mean	SD	1	2	3	4	5
Model: General (n = 109)							
1. Average daily sedentary time (hours)	12.15	3.88	-	.02	.16	.00	
2. External regulation	1.24	0.60		-	.21*	-.04	
3. Introjected regulation	2.35	1.22			-	.01	
4. Intrinsic motivation	1.88	0.76				-	
Model: Weekday work/school (n = 117)							
1. SBQ – Weekday work/school sedentary time (hours)	6.67	2.20	-	.02	.22*	.10	-.06
2. External regulation	1.39	0.65		-	.28***	.10	.17
3. Introjected regulation	2.28	1.27			-	.22*	.10
4. Identified regulation	1.98	0.67				-	.40**
5. Intrinsic motivation	1.84	0.66					-
Model: Weekday leisure/recreation (n = 114)							
1. SBQ – Weekday leisure/recreation sedentary time (hours)	6.64	3.49	-	.06	-.02	.19*	
2. External regulation	1.29	0.49		-	.27***	.08	
3. Introjected regulation	2.36	1.29			-	.06	
4. Intrinsic motivation	2.11	0.86				-	
Model: Weekend work/school (n = 123)							
1. SBQ – Weekend work/school sedentary time (hours)	4.17	2.59	-	.18*	-.08	.04	-.27***
2. External regulation	1.27	0.46		-	.20*	.09	.10
3. Introjected regulation	2.35	1.19			-	.17	.12
4. Identified regulation	1.87	0.74				-	.46***
5. Intrinsic motivation	1.94	0.75					-
Model: Weekend leisure/recreation (n = 108)							
1. SBQ – Weekend leisure/recreation sedentary time (hours)	9.72	4.09	-	.08	.02	.13	.31***
2. External regulation	1.26	0.52		-	.27**	.25**	.11
3. Introjected regulation	2.37	1.18			-	.09	.06
4. Identified regulation	1.93	0.78				-	.51***
5. Intrinsic motivation	2.05	0.74					-

Note: SBQ = Sedentary behavior questionnaire; SD = Standard deviation.
$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 3

Linear regression analyses predicting sedentary behavior

	General (n = 109)		Weekday work/school (n = 117)		Weekday leisure/recreation (n = 114)		Weekend work/school (n = 123)		Weekend leisure/recreation (n = 108)	
Variable	*B* (SE *B*)	β	*B* (SE *B*)	β	*B* (SE *B*)	β	*B* (SE *B*)	β	*B* (SE *B*)	β
External regulation	NE		NE	-	NE	-	1.14** (0.49)	0.20	NE	-
Introjected regulation	NE		0.37** (0.16)	.22	NE	-	NE	-	NE	-
Identified regulation	NE		NE	-	NE	-	NE	-	NE	-
Intrinsic motivation	NE		NE	-	0.78* (0.38)	.19	-0.99*** (0.30)	-0.29	1.76** (0.55)	0.31
R^2	-		.05*		.04*		.11***		.10**	
Adjusted R^2	-		.04*		.03*		.10***		.09**	
Effect Size (f^2)	-		.05		.04		.13		.11	

Note: Only motivational variables which were significantly correlated with behavior were entered in each regression model.
*$p < .05$; **$p < .01$; *** $p < .001$; NE = Not entered into model; SE = Standard error.

Supplementary material

Factor analysis pattern matrix for self-determination theory motivation regulation items

Model, items, variables of interest	Construct 1	Construct 2	Construct 3	Construct 4
Model: General				
Construct name	Intrinsic	External	Introjected	-
[INT] Sitting for pleasure	**0.915**	-0.06	-0.113	0.082
[INT] Satisfaction	**0.903**	-0.007	-0.042	-0.078
[INT] Enjoyment	**0.804**	-0.239	0.094	0.136
[INT] Fun	**0.751**	0.049	0.103	-0.057
[ID] Importance of sitting	0.675	0.101	-0.209	0.035
[ID] Benefits of sitting	0.518	0.265	0.094	-0.068
[EXT] Pleasing others	-0.193	**0.763**	-0.019	0.41
[EXT] Pressure from friends/family	-0.055	**0.655**	0.065	0.156
[ID] Importance of sitting to me	0.475	0.512	-0.018	-0.261
[ID] Needing to sit	0.222	0.356	0.064	-0.102
[IJ] Feeling guilty	0.052	0.057	**0.883**	-0.105
[IJ] Feeling ashamed	-0.124	0.041	**0.656**	0.011
[IJ] Feeling like a failure	0.025	-0.091	**0.43**	0.312
[EXT] What other people say	-0.043	0.104	-0.05	0.596
[EXT] What my friends/family/partner say	0.109	0.053	0.092	0.301
Eigenvalues	4.544	2.477	1.621	-
Variance explained (%)	27.942	13.598	8.155	-
Cumulative variance explained (%)	27.942	41.54	49.695	-
Cronbach's alpha (α)	0.89	0.77	0.70	-

Model: Weekday work/school

Construct name	Identified	Introjected	External	Intrinsic
[ID] Benefits of sitting	**0.753**	0.038	-0.002	0.098
[ID] Importance of sitting	**0.703**	0.074	0.038	-0.14
[ID] Importance of sitting to me	**0.61**	0.037	0.038	-0.072
[INT] Satisfaction	0.584	-0.202	0.076	-0.166
[ID] Needing to sit	**0.58**	0.115	-0.021	0.097
[INT] Enjoyment	0.569	-0.137	-0.038	-0.269
[IJ] Feeling ashamed	-0.069	**0.792**	-0.016	-0.045
[IJ] Feeling guilty	0.108	**0.778**	-0.003	0.109
[IJ] Feeling like a failure	0.056	**0.561**	0.09	-0.128
[EXT] Pleasing others	-0.105	0.051	**0.733**	0.004
[EXT] What other people say	0.1	-0.019	**0.72**	0.136
[EXT] Pressure from friends/family	0.045	0.013	**0.554**	-0.135
[INT] Sitting for pleasure	0.186	0.102	-0.105	**-0.705**
[INT] Fun	0.082	-0.064	0.045	**-0.637**
[EXT] What my friends/family/partner say	-0.065	0.103	0.255	-0.323
Eigenvalues	4.116	2.422	1.637	1.097
Variance explained (%)	24.116	12.961	7.569	3.887
Cumulative variance explained (%)	24.116	37.078	44.647	48.534
Cronbach's alpha (α)	0.76	0.76	0.68	0.70

Model: Weekday leisure/recreation

Construct name	Intrinsic	Introjected	-	External
[INT] Enjoyment	**0.886**	-0.033	-0.062	-0.001
[INT] Sitting for pleasure	**0.858**	0.059	0.051	0.017

[INT] Satisfaction	**0.853**	0.04	0.169	-0.12
[INT] Fun	**0.747**	-0.003	-0.112	0.134
[ID] Importance of sitting to me	0.578	-0.066	0.109	-0.029
[ID] Benefits of sitting	0.52	0.015	0.046	-0.022
[IJ] Feeling ashamed	0.036	**0.968**	-0.004	-0.003
[IJ] Feeling like a failure	0.045	**0.674**	0.133	0.088
[IJ] Feeling guilty	-0.053	**0.558**	-0.106	0.017
[ID] Needing to sit	0.099	0.106	0.746	-0.209
[EXT] Pressure from friends/family	0.004	-0.08	0.575	0.22
[EXT] What my friends/family/partner say	0.078	-0.005	-0.005	**0.654**
[EXT] What other people say	0	0.076	-0.043	**0.521**
[EXT] Pleasing others	-0.105	0.06	0.316	**0.505**
[ID] Importance of sitting	0.112	-0.011	0.089	0.109
Eigenvalues	4.477	2.432		1.22
Variance explained (%)	27.589	13.563		4.894
Cumulative variance explained (%)	27.589	41.151		7.249
Cronbach's alpha (α)	0.90	0.77		0.61

Model: Weekend work/school

Construct name	Intrinsic	External	Introjected	Identified
[INT] Sitting for pleasure	**0.885**	-0.037	-0.006	0.06
[INT] Enjoyment	**0.711**	0.002	0.037	-0.066
[INT] Satisfaction	**0.638**	0.184	0.017	0.024
[INT] Fun	**0.593**	-0.038	-0.028	-0.211
[ID] Benefits of sitting	0.33	-0.078	-0.171	-0.221
[EXT] What my friends/family/partner say	0.064	**0.71**	-0.033	0.022

[EXT] What other people say	0.073	**0.699**	0.053	0.121
[EXT] Pressure from friends/family	0.008	**0.615**	-0.067	-0.04
[EXT] Pleasing others	-0.115	0.31	-0.071	-0.238
[IJ] Feeling ashamed	0.086	-0.193	**-0.975**	0.17
[IJ] Feeling guilty	-0.06	0.117	**-0.563**	-0.103
[IJ] Feeling like a failure	-0.024	0.123	**-0.489**	-0.012
[ID] Importance of sitting	0.004	-0.056	0.043	**-0.786**
[ID] Importance of sitting to me	0.141	-0.026	0.06	**-0.702**
[ID] Needing to sit	0.183	0.06	-0.11	**-0.484**
Eigenvalues	3.873	2.276	1.568	1.33
Variance explained (%)	22.583	11.644	7.774	5.885
Cumulative variance explained (%)	22.583	34.227	42.001	47.886
Cronbach's alpha (α)	0.81	0.61	0.69	0.75

Model: Weekend leisure/recreation

Construct name	Intrinsic	External	Introjected	Identified
[INT] Enjoyment	**0.88**	-0.038	0.018	0.121
[INT] Sitting for pleasure	**0.687**	0.111	-0.032	-0.081
[INT] Fun	**0.664**	-0.095	0.137	-0.108
[ID] Benefits of sitting	0.426	0.023	0.004	-0.218
[EXT] What other people say	0.065	**0.779**	-0.009	0.172
[EXT] What my friends/family/partner say	0.016	**0.746**	0.078	0.022
[EXT] Pressure from friends/family	-0.119	**0.519**	0.151	-0.376
[EXT] Pleasing others	-0.184	**0.468**	0.028	-0.467
[IJ] Feeling guilty	0.033	-0.008	**0.778**	0.152
[IJ] Feeling ashamed	-0.031	-0.035	**0.727**	-0.075
[IJ] Feeling like a failure	0.06	0.103	0.384	-0.068

[ID] Importance of sitting to me	0.15	-0.038	-0.019	**-0.697**
[ID] Importance of sitting	0.167	0.024	0.041	**-0.686**
[ID] Needing to sit	0.049	-0.084	0.029	**-0.511**
[INT] Satisfaction	0.357	0.193	-0.205	-0.38
Eigenvalues	4.18	2.494	1.677	1.116
Variance explained (%)	24.709	13.673	8.064	4.291
Cumulative variance explained (%)	24.709	38.381	46.446	50.737
Cronbach's alpha (α)	0.8	0.78	0.69	0.72

Note: EXT = External regulation; ID = Identified regulation; IJ = Introjected regulation; INT = Intrinsic regulation. Extraction Method: Principal Axis Factoring; Rotation Method: Oblimin with Kaiser Normalization. Dominant factor loadings shown in boldface. General model converged in 14 iterations; Weekday work/school model converged in 7 iterations; Weekday leisure/recreation model converged in 9 iterations; Weekend work/school model converged in 7 iterations; Weekend leisure/recreation model converged in 19 iterations.