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Running Head: TIME DISPLACEMENT AND PHYSICAL ACTIVITY

Time Displacement and Confidence to Participate in Physical Activity

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ABSTRACT

Background: Time spent on sedentary behaviours is often blamed for low physical activity rates, but tests of time displacement are limited. **Purpose:** The purpose of this study was to examine time-graded assessments of self-efficacy to engage in physical activity compared to either high or low ranked sedentary leisure behaviours among a workplace sample. Several demographic factors were examined as moderators of time displacement. **Methods:** Participants were a worksite sample of 2009 men and women who completed measures of demographics, physical activity, and self-efficacy after performing a thought listing procedure to generate their most/least preferred sedentary leisure-time behaviours. **Results:** Repeated measures analysis of variance across four gradients of available leisure-time (20, 30, 60, 120 min) showed some evidence of displacement (20 min less confident than 120 min) when considering their most preferred sedentary behaviour but not their least preferred. These results, however, were moderated by age, occupational work hours, free time, education, and physical activity status. **Conclusion:** Targeted interventions for young professionals with high work hours and limited physical activity experience seem prudent in order to improve their self-efficacy to achieve regular physical activity through sedentary behaviour control.

Key Words: physical activity, exercise, self-efficacy, sedentary behaviours, behavioural choice theory

It has been well documented that physical activity (PA) has several short- and long-term health benefits. [1-3] While people recognize that regular PA is beneficial for health, [4, 5] general participation rates remain low. [5, 6] Therefore, an understanding of PA participation is prudent in order to develop effective interventions.

Interventions to promote PA are likely to be facilitated by a sound understanding of its correlates. Among these correlates, a strong sense of self-efficacy is generally the paramount predictor of behaviour. [7-9] Self-efficacy represents one's confidence in one's ability to self-regulate specific behaviors (such as physical activity) when confronted with various obstacles/barriers [10]. Because of this relationship between high levels of self-efficacy and behaviour, it is suggested that perceptions of capability to navigate the barriers of one's day are central to successful PA participation.

One conceptual aspect that has seen limited attention is the possibility of competing behaviours. Sedentary behaviours, activities that require < 1.5 METs during leisure time, [11] have very high prevalence. [12] Following the tenets of Behavioural Choice Theory, sometimes called behavioural economics, [13, 14] other behaviours compete in the behavioural choices made during free time. Specifically, under the limits of free time, investments of time spent on one behaviour may affect the time that can be spent on another behaviour. In this capacity, one behaviour can impede another in the form of time displacement. Preliminary evidence for time displacement in PA has been mixed with some support from lab-based research, [15] limited support among youth in surveys, [16-18] but more conclusive findings among adults [19-27] showing negative associations between sedentary behaviour constructs and PA. This difference

between youth and adult findings has been speculated from the absolute amount of leisure-time afforded to youth compared to adults. [28] The limited amount of time with adults may create more time displacement and result in larger correlations between sedentary activities and PA whereas youth may have high amounts of time to engage in a variety of activities.

Still, our understanding of sedentary behaviour displacement of PA among adults is fairly rudimentary. To test time displacement more directly, it would be helpful to compare graded assessments of leisure time. It would stand to reason that time displacement should occur under perceptions of less leisure-time. Second, characteristics of some adults should also offer more displacement than others. For example, young and middle-aged adults burdened with early career and family responsibilities may have more time displacement than adults in late middle age and older adults where these responsibilities have come to pass. Tests of these more specific time displacement factors would provide additional evidence and fidelity beyond bivariate correlations between sedentary constructs and behaviour.

Therefore, the purpose of this study was to examine time-graded assessments of self-efficacy to engage in PA compared to either high or low ranked sedentary leisure behaviours among a workplace sample. In the case of this study, self-efficacy was expected to correspond to people's confidence to incorporate physical activity when faced with the alternative attraction of sedentary behaviours. A secondary purpose was to examine whether age, gender, education, hours of work, leisure time, PA status, and commute time moderated these findings. It was hypothesized that people would be more confident to achieve PA under greater time options than lower for both highly ranked and lower ranked sedentary behaviours based on the displacement

hypothesis [16] and evidence that suggests that even low ranked sedentary behaviours are engaged-in before PA. [15, 29] It was subsequently hypothesized that younger adults and those who work more occupational hours would also show more confidence to achieve PA under greater time options than lower for both highly ranked and lower ranked sedentary behaviours than their counterparts due to greater time displacement.

Method

Participants and Procedure

A cross-sectional survey was administered electronically in April, 2006 by a hired vendor (Questar Data Systems, Inc.) to members of a large non-profit organisation in the United States. A total of 5000 email addresses were obtained from the organizations national directory, however, an initial announcement indicated that only 4527 (90.54%) valid addresses were available at the time of data collection for this study. Individual emails were sent to all valid addresses inviting employees to participate in an internet-based survey examining their experiences with PA participation. Each email was comprised of a description of the study, the web address containing the survey, and a personal login identification code that allowed employees access to their survey and complete the instrument incrementally rather than in a single session. Additionally, a follow-up e-mail was sent out one-week later. Each employee who completed the survey was entered into a draw to win a \$500 air travel voucher. An overall response rate of 44.5% (n = 2022) was observed based on the initial survey administration, however, an additional 13 participants had missing data and were removed from the analyses leaving N = 2009.

Measures

Physical activity was defined using the moderate and vigorous intensity, frequency (most days of the week), and duration (30 min or more) criteria advocated by the CDC position stand on recommended PA. [30] Specifically, participants were asked to keep this definition in mind when answering PA-related questions.

Confidence appraisals with consideration to sedentary leisure-time behaviour and time displacement were created for this study. First, participants were asked to list sedentary activities that they intend to engage in on a worksheet provided. This thought-listing procedure [31] was conducted to create a subset of individual modal behaviours that each participant typically engages in during a week.

After this procedure, participants were asked to indicate their most preferred sedentary behaviour and their least preferred sedentary behaviour from the list. These behaviours were then used for the subsequent questions. For the most preferred sedentary behaviour, participants were asked to answer the item “On a typical day in the next week, how confident are you that you will choose to engage in physical activity instead of engaging in your MOST preferred SEDENTARY activity when you have....” The options provided included a) 20 minutes of free time, b) 30 minutes of free time, c) 60 minutes of free time, and d) 120 minutes of free time. All of these were scored from extremely unconfident (1) to extremely confident (7) on seven-point scales. For the least preferred sedentary activity, the set of questions were phrased exactly the same except “LEAST” was substituted for “MOST.” This item is common in generalized self-efficacy assessment. [10, 32-34]

Physical activity was measured using the Godin Leisure Time Exercise Questionnaire. [35, 36] Moderate and Strenuous intensity categories were then aggregated to correspond to CDC recommendations [30] and the phrasing of the other questions. This questionnaire has demonstrated good reliability and validity when compared to physical fitness, direct measures of PA and other questionnaires used to assess PA. [37]

Analysis

Following an analysis of descriptives, a univariate repeated measures analysis of variance was conducted for both the most and least preferred sedentary behaviour conditions of time displacement and confidence to choose PA. Follow-up tests included Tukey HSD and effect size *d*. [38]

Potential demographic moderators of these means were subsequently analyzed by including these as between-group fixed factors one at a time. The demographics used for this analysis were age categories based on prior research by Rhodes et al. [4] (1 = 18-24 yrs, 2 = 25-34 yrs, 3 = 35-44 yrs, 4 = 45-54 yrs, and 5 = 55+ yrs), gender, education (1 = high school, 2 = some college, 3 = college, 4 = grad school or professional school), ethnicity (1 = hispanic, 2 = black, 3 = Caucasian, and 4 = Asian), marital status (1= married or common-law, 2 = single or widowed), hours of weekly occupational work (1 = <21 hours, 2 = 21 to 35 hours, 3 = 36 to 40 hours, and 4 = 41+ hours per week), estimated daily minutes of leisure time (1 = 20 min or less, 2 = 21 to 30 min, 3 = 31 to 60 min, 4 = 61 to 120 min, 5 = >120 min), PA status (1 = not meeting public health guidelines, 2 = meeting public health guidelines) and commute to work distance (1 = < 16 min, 2 = 16 to 30 min, 3 = 31 to 45 min, and 4 = 46+ min). Follow-up analyses were conducted

with subsequent univariate repeated analyses of variance at each level of the fixed factor and Tukey post hoc and effect size d criterion. Analyses were conducted in 2009 using SPSS 18. [39]

Results

Descriptives of the sample can be found in Table 1. Overall, the sample consisted of primarily middle-aged Caucasian females who were working full-time. The main repeated measures analyses of variance for confidence to choose PA compared to one's most preferred leisure-time sedentary behaviour was significant (see Table 2). Post-hoc assessment showed that participants were more confident they would choose PA under 120 minutes of time than 20 minutes. By contrast, the analysis of confidence to choose PA compared to one's least preferred leisure-time sedentary behaviour had a significant main effect but no significant post-hoc effects upon follow-up.

Examination of potential demographic and descriptive moderators of confidence to choose PA compared to one's most and least preferred leisure-time sedentary behaviour showed significant interactions for age (Most $F_{12,5442} = 10.69$; $p < .01$; $\eta^2 = .02$; see Figure 1. Least $F_{12,5388} = 11.37$; $p < .01$; $\eta^2 = .03$), education (Most $F_{9,5505} = 12.48$; $p < .01$; $\eta^2 = .02$. Least $F_{9,5451} = 10.24$; $p < .01$; $\eta^2 = .02$), hours of occupational work (Most $F_{9,5052} = 4.24$; $p < .01$; $\eta^2 = .01$. Least $F_{9,4998} = 3.85$; $p < .01$; $\eta^2 = .01$), meeting PA guidelines (Most $F_{3,5412} = 15.07$; $p < .01$; $\eta^2 = .01$. Least $F_{3,5373} = 18.65$; $p < .01$; $\eta^2 = .03$), and minutes of free time (Most $F_{12,2829} = 2.65$; $p < .01$; $\eta^2 = .01$. Least $F_{12,2844} = 3.44$; $p < .01$; $\eta^2 = .01$). Follow-up analyses for age showed that adults 18 to 24 yrs (Most $F_{3,255} = 11.74$; $p < .01$; $\eta^2 = .12$. Least $F_{3,126} = 7.85$; $p < .01$; $\eta^2 = .09$), 25 to 34 yrs (Most $F_{3,1956} = 44.27$; $p < .01$; $\eta^2 = .06$. Least $F_{3,372} = 36.33$; $p < .01$; $\eta^2 = .05$), and 35 to 44 yrs old (Most $F_{3,1365} = 16.17$; $p < .01$; $\eta^2 = .03$. Least $F_{3,685} = 10.01$; $p < .01$; $\eta^2 = .02$) showed

differences in confidence increasing across 20 min to 30 min to 60 min and to 120 min of leisure-time, while adults aged 45 to 54 yrs and 55+ yrs old were not significantly different across confidence appraisals. Follow-up analyses of education showed that confidence appraisals were not different for high school graduates and participants who reported some college education. By contrast, college educated employees (Most $F_{3,2772} = 29.59$; $p < .01$; $\eta^2 = .04$. Least $F_{3,911} = 16.07$; $p < .01$; $\eta^2 = .02$), and graduate degree professionals (Most $F_{3,1206} = 36.37$; $p < .01$; $\eta^2 = .08$. Least $F_{3,394} = 24.74$; $p < .01$; $\eta^2 = .06$) displayed differences in their confidence to choose PA with a linear difference increasing from 20 to 120 minutes. Those who worked less than 35 hours per week showed no difference by confidence appraisals, however, employees working 36 to 40 hours ($F_{3,690} = 5.74$; $p < .01$; $\eta^2 = .01$) showed differences between 20 and 30 min to 60 minutes of free time among their most preferred sedentary activity. Those employees reporting over 40 hours per week (Most $F_{3,568} = 32.23$; $p < .01$; $\eta^2 = .05$. Least $F_{3,561} = 20.27$; $p < .01$; $\eta^2 = .04$) showed a complete linear difference in confidence from 20 to 120 minutes on both the least and most preferred sedentary activities. Meeting or not meeting PA guidelines in follow-up analyses showed that participants who were not meeting guidelines (Most $F_{3,1222} = 5.08$; $p < .01$; $\eta^2 = .01$. Least $F_{3,1209} = 4.49$; $p < .01$; $\eta^2 = .01$) showed no differences in confidence to be active under 20 and 30 min conditions, but these were subsequently lower than 60 min and this was lower than 120 min confidence appraisals. Those meeting guidelines, however, had a much stronger displacement effect (Most $F_{3,578} = 32.18$; $p < .01$; $\eta^2 = .14$. Least $F_{3,578} = 21.61$; $p < .01$; $\eta^2 = .10$) in the opposite direction of displacement. In this case, there was less confidence to be active under the 20 min condition compared to all other conditions. Finally, there were no significant differences across the confidence appraisals for those who had less than 120 min of free time, but those who had more than 120 minutes reported (Most $F_{3,261} = 11.58$; p

< .01; $\eta^2 = .12$. Least $F_{3,262} = 9.23$; $p < .01$; $\eta^2 = .10$) less confidence to choose exercise under subsequent 20 min to 30 min compared to 60 min and 120 min conditions. Effect sizes for these interaction effects ranged from small to medium using standardized criteria [38].

Discussion

Our hypothesis that people would be more confident to choose PA under greater time options than lower time for both high and lower ranked sedentary behaviours had partial support. For the high ranked sedentary behaviour, more perceived time resulted in higher efficacy to choose PA than less perceived time, but no difference was found for low ranked sedentary behaviours. This finding provides some evidence for the time displacement hypothesis, [16] but suggest that the type of sedentary behaviour may affect confidence to choose PA. Prior research has supported this notion in adult samples. For example, screen viewing has more association with PA than other leisure behaviours such as socializing, reading and hobbies. [20-22] Unfortunately, this activity is the most pervasive sedentary behaviour among the population and thus the most likely to be implicated in time displacement. [12] In the current study, 63% of the sample chose TV viewing as their most preferred sedentary behaviour and an additional 7% chose computer-based activities supporting this notion.

The complexity of sedentary behaviours and time displacement was furthered by the presence of demographic moderators. As hypothesized, those who reported working more occupational hours showed more confidence to achieve PA under higher time options than lower time options for both high and low ranked sedentary behaviours compared to those who worked less hours. It is interesting to note that the threshold for work hours in this study was >40 hours per week. Thus, those individuals working overtime hours or with occupational demands over and above the

standard work week appear to have more time displacement than employees working more standard hours. This finding is complementary with prior research. [40, 41] Self-reported free time, arguably the flip-side of work hours, was also a moderator of the findings, but differences in confidence to choose PA only occurred among those with greater than 120 minutes of daily leisure. The finding requires further attention but we speculate that people with higher leisure hours may become less efficient in their capability to complete PA.

There was also support for age as a moderator of time displacement. In these cases, young and early-middle-aged adults reported more time displacement than older adults. Prior literature has shown greater PA barriers for young adults compared to older adults [4, 42, 43] due to factors such as early parenthood, co-habitation and work/professional demands. [44, 45] It would stand to reason that similar effects are responsible for the time displacement found in this study.

In terms of education, more educated participants in the sample reported greater time displacement than the less educated. Higher educated individuals tend to show positive correlations with PA, [46] presumably due to better knowledge of its benefits and access to resources, yet time displacement for PA and sedentary behaviour showed a positive effect with education in this study. The oppositional finding here may reflect the demands placed on highly educated professionals. Education had a modest correlation with occupational hours worked ($r = .21, p < .01$) which provides some support for this conjecture. Professional occupations are associated with the highest number of work hours per week. [47, 48] The other possibility may surround how educated professionals work. Many managerial-type jobs operate outside the workplace structure and work can be performed from home at all hours. In this case,

professionals may face greater sedentary leisure-time displacement because the presence of work, sedentary leisure, and PA are all available options. This is merely speculation at this point but future research could examine this possibility.

PA status showed that confidence was only lower for the 20 min condition for active people. By contrast, confidence was higher under high time conditions in the inactive. The difference by PA status highlights time displacement in the presence of other leisure behaviours. Those who are active presumably choose to be active in all but the most limited leisure-time (i.e., 20 min) but those who are inactive are only confident they will choose PA when high volumes of leisure time are available (e.g., 120 min) probably because it would displace other activities. This conjecture is supported by evidence that inactive people place lower value on PA [8] and more importance on sedentary activities. [21]

In these moderation analyses, it is also interesting that the findings were very similar regardless of whether the most or least preferred sedentary behaviour was used as a referent for ones confidence to choose PA. This finding appears similar to work by Epstein and colleagues [15, 29] who have sometimes demonstrated that even less preferred choices for sedentary behaviour may be preferred over PA.

From a practical standpoint, these findings highlight the complexity of PA choices, free time, and sedentary behaviour and illuminate that simple bivariate approaches to understanding these relationships may not capture their relationships. [49] These results suggest that PA interventions with a sedentary control component (i.e., problem solving around making choices in leisure time)

may be important among younger adults, professionals, and those who work occupational hours beyond the standard work week due to the potential limitations of time displacement.

Despite these interesting findings, the study had limitations. First, we assessed confidence to choose PA as a proxy for what is likely to occur if one were to experience limited time and high/low ranked sedentary behaviour options. Second, our measurements were single item responses and may contain measurement error. Third, we defined PA as leisure-time behaviour to coincide with the behavioural choice aspect of sedentary behaviours in the study; PA behaviour can be accumulated via other times (e.g., occupational activity, housework) and thus our assessment is restricted. Finally, our sample of work place employees is limited in representation and consisted primarily of female, Caucasian participants.

In summary, our results showed some overall evidence of time displacement in physical activity self-efficacy (20 min less confident than 120 min) when participants were asked to consider their most preferred sedentary behaviour but not their least preferred. More interesting, however, the results were moderated by age, occupational work hours, free time, education, and physical activity status suggesting that confidence to overcome sedentary behaviour under greater time displacement is partially contingent upon socio demographic factors. Targeted interventions for young professionals with high work hours and limited physical activity experience seem prudent in order to improve their self-efficacy to achieve regular physical activity through sedentary behaviour control.

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Figure Caption:

1. Figure 1 Moderating effect of age on the self-efficacy and time displacement relationship, United States, 2006.

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Table 1
Demographic, and Physical Activity Profile (United States, 2006)

Characteristic	(n = 2009)
<u>Demographic Profile</u>	
Age Mean (SD)	40.3(11.4)
Percent Female	85.3
Percent Caucasian	81.5
Percent Married/Common-Law	65.1
Percent Completed University	71.0
Percent Currently Employed Full-Time	94.6
Hours worked Mean (SD)	41.6 (13.7)
Commute to work time (min)	32.4 (30.1)
Mean years worked at the company	5.8 (5.7)
<u>Past Physical Activity</u>	
Percent Meeting Guidelines	42.3

Table 2

Mean Differences among confidence to perform physical activity under variable free time compared to either one's most or least preferred sedentary activity (United States, 2006)

	20 min	30 min	60 min	120 min	<i>p</i>	η^2	Post-hoc
Most Preferred	3.6 (2.2)	3.7 (2.1)	3.9 (2.0)	4.0 (2.3)	< .01	0.0	20 < 120
Least Preferred	3.9 (2.2)	4.00 (2.1)	4.1 (2.1)	4.2 (2.3)	< .01	0.0	
<i>p</i>	< .01	< .01	< .01	< .01			
<i>d</i>	0.2	0.1	0.1	0.1			

Note: Post hoc tests conducted using Tukey HSD and Cohen's *d* > .2.

Note: *d* = Cohen's (1992) *d* effect size

Note: η^2 = Eta-squared effect size

