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I think therefore I Am? Examining the relationship between exercise identity and exercise behavior during behavioral weight loss treatment

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ABSTRACT

Objectives: Identification as an exerciser may promote physical activity. This study examined exercise identity (EI) and its relationship with demographic characteristics and exercise among adults participating in behavioral weight loss treatment, which is a key target population for increasing exercise.
Design: Longitudinal.
Method: Participants (N = 320) completed a measure of EI and exercise was assessed with accelerometers at baseline and 6 months.
Results: Baseline EI and exercise were positively related and EI and exercise increased over time. However, change in EI was not meaningfully related to change in exercise, baseline EI did not predict change in exercise, and 6-month EI was not related to 6-month exercise. Participants identifying as non-White reported greater EI but lower exercise.
Conclusions: Although EI and exercise may increase among weight loss participants, the two may not be meaningfully related during active weight loss treatment. The relationship between EI and exercise may also differ based on race.

1. Introduction

Many U.S. adults, especially those with body mass indexes (BMIs) in the overweight and obese range, do not engage in recommended levels of physical activity (PA) (Davis, Hodges, & Gillham, 2006; Tucker, Welk, & Beyler, 2011). Adherence to PA prescriptions remains challenging among those participating in behavioral weight loss (BWL) programs (Tate, Jeffery, Sherwood, & Wing, 2007), despite evidence that PA promotes weight loss maintenance (Jakicic, Marcus, Lang, & Janney, 2008). To improve weight loss outcomes and reduce the risk of weight regain, there is a critical need to identify factors that promote PA in individuals with overweight or obese BMIs enrolled in BWL treatment.

Exercise identity (EI), defined as the extent to which one views him or herself as an exerciser and incorporates exercise into his or her self-concept (Anderson & Cychosz, 1994), may be one factor relevant to PA promotion. Stronger EI may encourage PA by serving as a personal standard for behavior and facilitating self-regulation (Stryker & Burke, 2000). Identity and social identity theories posit that people are compelled to seek consistency between their current behaviors and their identity because discrepancies between behaviors and identity result in uncomfortable internal experiences, such as negative affect (Stets & Burke, 2000). When applied to EI, these theories suggest that those with strong EI may be particularly motivated to engage in and maintain exercise behaviors to avoid an uncomfortable discrepancy between their identity and behavior. Performing in accordance with a role or identity that one values is also thought to enhance self-efficacy and self-esteem, further encouraging consistency between one's identity and behavior (Stets & Burke, 2000). Results from a meta-analysis support a positive relationship between EI and PA (Rhodes, Kaushal, & Quinlan, 2016).

Although past research indicates that EI and PA are related, the EI literature is limited by use of self-reported PA, cross-sectional designs, and convenience samples (Rhodes et al., 2016). Despite the importance of identifying factors that promote PA during BWL in order to improve outcomes, only one study to our knowledge has examined EI during

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BWL treatment (West et al., 2011). In this prior study, adult women with overweight or obese BMIs and urinary incontinence were randomized to a 6-month BWL program or an education control condition; those in the BWL program were then further randomized to differentiated weight loss maintenance programs. All participants entered the study with low EI, and participants receiving treatment demonstrated greater EI at post-treatment assessments compared to the control group. Stronger EI was also associated with greater weight loss during the weight loss maintenance phase for treatment groups. While this study suggests that EI may promote weight control in adults participating in BWL, it did not answer key questions about the relationship of EI to PA during BWL. Stronger EI may promote PA adoption during the active weight loss phase of treatment, and/or increases in PA during BWL may strengthen EI, which may subsequently facilitate long-term maintenance of PA. Better understanding the possible relationship between EI and PA during BWL treatment can help to inform the development of PA promotion strategies in the context of BWL treatment.

Understanding if EI varies by participant characteristics may also help predict adherence to a PA prescription during BWL and provide directions for treatment tailoring. Prior research suggests that demographic and anthropometric factors, including gender, race, and BMI, are associated with PA beliefs, attitudes, and behaviors (Jones, Wen, Herring, & Evenson, 2016; Mathew, Ramaswamy, & Wang, 2018), but little research has explored the relation of participant characteristics to EI. Given cultural messages that exercisers are thin and muscular (Berry & Spence, 2009), individuals entering BWL with higher BMIs may be less likely to identify as exercisers, regardless of their PA level. Extant research in general community samples supports the hypothesis that higher BMI is associated with lower EI (Karr, Bauer, Graham, Larson, & Neumark-Sztainer, 2014). The limited research on the relationship of age, gender, and race to EI suggests that EI may be stronger in younger individuals (Anderson, Cychosz, & Franke, 2001), men (Karr et al., 2014), and certain racial groups, such as African Americans (Anderson, Cychosz, Panton, & Browder, 2003). However, data are mixed and have typically been collected in general community samples, which may differ considerably from a BWL sample.

The present study aimed to evaluate the relationships between EI and moderate-to-vigorous intensity physical activity (MVPA) among adults with overweight or obese BMIs engaged in a BWL program. Objective 1 was to identify anthropometric (BMI) and demographic (age, gender, race) correlates of EI among individuals enrolled in BWL treatment. Objective 2 was to examine the relationship between EI and MVPA, as measured by accelerometry, at treatment start (baseline). Objective 3 was to examine change in EI and MVPA from baseline to month 6 (during which time participants were instructed to increase MVPA to 250 min per week), and whether change in EI and MVPA were related. Objective 4 was to examine whether stronger EI at baseline predicted greater increases in MVPA. Lastly, objective 5 was to examine the relationship between EI and MVPA at month 6, once individuals had completed the active weight loss phase of treatment. Based on extant research, we hypothesized that greater baseline EI would be related to lower BMI and younger age, and that EI may be stronger in men versus women and in certain racial groups (objective 1). Given the documented relationship between EI and PA, we also hypothesized that greater EI would be related to greater MVPA at baseline and month 6 (objectives 2 and 5). Additionally, we hypothesized that EI and MVPA would increase from baseline to month 6 and that change in EI and change in MVPA would be positively related (objective 3). Finally, we hypothesized that stronger baseline EI would predict greater change in MVPA from baseline to month 6 (objective 4).

2. Method

2.1. Participants

Participants were recruited from the community using radio advertisements and flyers to participate in a BWL study. Eligible participants had a BMI between 27.0 and 45.0 kg/m^2, were between 18 and 70 years old, could safely engage in PA, and completed all recruitment procedures (attendance at a group information session, attendance at an individual eligibility assessment, completion of a 3-day food record, and completion of baseline assessment). Exclusion criteria included weight loss of ≥ 5% in the previous 6 months, recently starting or changing the dose of a medication known to impact weight, history of bariatric surgery, current or expected pregnancy or breastfeeding during the course of the study, or presence of a medical or psychiatric condition that could limit participation. Of the 1449 individuals assessed for eligibility, 320 were enrolled, 274 completed the first 6 months of treatment, and 286 completed the 6-month assessment. For additional details, please see Supplemental Materials for a CONSORT diagram.

2.2. Procedures

This study was a secondary analysis of data from an ongoing randomized controlled trial of three weight loss maintenance interventions.[1] The present analyses focus on change in EI and MVPA during the first phase of treatment (the 6-month active weight loss phase), prior to participant randomization to differentiated maintenance conditions. During the 6 months evaluated in the present study, all participants received identical standard BWL treatment based on Look AHEAD (Look AHEAD Research Group et al., 2013) and the Diabetes Prevention Program (Diabetes Prevention Program (DPP) Research Group, 2002). Participants were instructed to reduce their caloric intake via a standard deficit diet approach, to gradually increase their PA to 250 min of MVPA per week performed in bouts of at least 10 min, and to self-monitor their weight management behaviors. Participants also learned skills such as stimulus control and problem-solving; EI was not directly targeted. Treatment was delivered to groups of 10–15 participants over 16, 75-min, weekly or biweekly sessions. Participants completed study measures at a pre-treatment baseline visit and a 6-month assessment. The study was approved by the Institutional Review Board and all participants provided informed consent.

2.3. Measures

Participants self-reported their age, gender, race, and ethnicity at baseline.

Body weight was measured (in street clothes) at baseline and month 6 using a digital scale accurate to 0.1 kg and height was measured at baseline using the built-in height rod to calculate baseline BMI (kg/m^2). Physical activity was measured using waist-worn Actigraph GT3X + accelerometers, worn during waking hours for 1 week at each assessment point. Consistent with prior studies (Troiano et al., 2008), average weekly time in bouts of ≥10 min of MVPA (> 2019 counts/minute) was derived for participants who wore the accelerometer for at least four days for 10 or more hours per day. EI was assessed at baseline and month 6 using the Exercise Identity Scale (Anderson & Cychosz, 1994). There has been debate about whether this scale is comprised of one or two factors (Perras, Strachan, & Fortier, 2016). An exploratory factor analysis confirmed the presence of a single factor in the present study. Consistent with numerous recent studies (e.g., Perras, Strachan, & Fortier, 2016), a mean score was calculated, with higher scores indicating stronger EI. In the present study, $\alpha = 0.90$.

2.4. Statistical approach

Data were analyzed in RStudio (RStudioTeam, 2015) and SPSS

[1] Follow-up assessments for the parent study are ongoing and main outcomes forthcoming

version 24. The percentage of missing data ranged from 0 to 17.2%. Little's MCAR test revealed that data were not missing completely at random (MCAR), X^2 (67, $N = 320$) = 135.19, $p < .001$; data were assumed to be missing at random (MAR) (Little, 1988). Missing data were imputed five times using multiple imputation, which allows researchers to obtain approximately unbiased estimates of model parameters when data is missing at random, via the MICE package (van Buuren & Groothuis-Oudshoorn, 2011). Analyses were run in each of the five datasets and test statistics were obtained, and Rubin's rule (which uses sum approximation based on X^2 statistics) was then used in the miceadds package (Robitzsch, Grund, & Henke, 2017) to combine *t* and *F* statistics. For independent predictors in the models, unstandardized coefficients were averaged across the five imputed datasets to create a pooled *b* value; pooled *b* values are presented below with the results of the Rubin's rule analyses used to combine the *t* statistics. Of note, the same pattern of results was observed when using completers only. Data were tested for normality and tests that accommodate non-normal data were utilized where appropriate. Correlates of EI at baseline (objective 1) were examined using multiple linear regression. Compound Poisson generalized linear models (Zhang, 2013) were used to examine whether baseline EI predicted baseline MVPA (objective 2) and whether 6-month EI predicted 6-month MVPA (objective 5). Average daily accelerometer wear time was included as a covariate in analyses of MVPA to account for potential differences in accelerometer wear between participants, as were any demographic or anthropometric variables that were significantly related to baseline EI. Notably, the pattern of findings was consistent when not controlling for these covariates in MVPA analyses. Repeated measures ANOVA was used to examine the effect of time (baseline to 6 months) on EI scores and a permutation test in repeated measures ANOVA (Kherad-Pajouh & Renaud, 2015) was used to assess the effect of time (baseline to 6 months) on MVPA (objective 3). Multiple linear regression was used to assess the relationship between change in EI (difference score: 6-month EI score minus baseline EI score) and change in MVPA (difference score: 6-month MVPA minutes minus baseline MVPA minutes) (objective 3), and whether baseline EI predicted change in MVPA (difference score) (objective 4).

A power analysis conducted in G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) for bivariate correlation revealed a necessary sample size of 84–782 participants to have 80% power to detect a medium (0.30) or small (0.10) correlation, respectively, with a type I error rate of 0.05. A power analysis for a repeated measures ANOVA assessing change in EI from baseline to month 6 (objective 3) revealed a necessary sample size of 120 participants to have 80% power to detect a medium effect (West et al., 2011) given a moderate-to-large correlation between EI scores (Cardinal & Cardinal, 1997) and a type I error rate of 0.05. Based on published tables for determining sample size in zero-inflated Poisson models (Channouf, Fredette, & MacGibbon, 2014; Williamson, Lin, Lyles, & Hightower, 2007), the present study was adequately powered for models predicting MVPA (objectives 2 and 5). Thus, the study may have been underpowered to detect small correlations but was otherwise sufficiently powered.

3. Results

Table 1 displays means, standard deviations, and correlations among variables of interest. The majority of the sample identified as female (78%), White (70%), and non-Hispanic (95%). Mean age was 52.72 years ($SD = 10.35$) and mean BMI was 35.14 kg/m^2 ($SD = 4.76$).

A multiple linear regression model containing BMI, race (dichotomized as White = 1 and non-White = 0, due to the to the modest percentage of non-White participants), gender, and age significantly predicted baseline EI, $F(3, 60614.85) = 4.45$, $p = .004$, accounting for 4.19% of the variance in EI (objective 1). Body mass index was a significant predictor in the model ($b = -0.05$, $F(1, 140861.66) = 8.46$, $p = .004$), as was race ($b = -0.40$, $F(1, 4823.67) = 4.87$, $p = .03$), indicating that lower baseline BMI and identifying as non-White predicted stronger EI at baseline. Gender ($b = -0.14$, $F(1, 1820.14) = 0.41$, $p = .52$) and age ($b = 0.01$, $F(1, 34111.3) = 1.74$, $p = .19$) did not significantly predict baseline EI.

Examination of the distribution of baseline MVPA data revealed a non-normal, zero-inflated distribution, with 120 (38%) participants exhibiting no MVPA. A compound Poisson generalized linear model (Zhang, 2013) containing baseline EI, as well as BMI, race, and accelerometer wear time as covariates, revealed that EI ($b = 0.20$, $F(1, 1641.24) = 13.33$, $p < .001$), BMI ($b = -0.05$, $F(1, 1127.30) = 6.40$, $p = .01$), and race ($b = 0.48$, $F(1, 533.78) = 6.21$, $p = .01$) each significantly predicted MVPA, such that stronger EI, lower BMI, and identifying as White predicted greater MVPA at baseline (objective 2). Accelerometer wear time was not a significant predictor ($b = 0.001$, $F(1, 807.61) = 1.79$, $p = .18$).

A repeated measures ANOVA revealed a significant increase in EI from baseline to 6 months, $F(1, 7.6) = 8.92$, $p < .001$, partial eta-squared = 0.15 (objective 3). A permutation test in repeated measures ANOVA revealed MVPA also increased from baseline to 6 months, $F(4, 12.70) = 69.981$, $p < .001$ (objective 3). A multiple linear regression model containing change in EI, as well as BMI, race, and wear time as covariates, accounted for 1.41% of the variance in MVPA change and was not statistically significant, $F(4, 102.10) = 1.47$, $p = .22$ (objective 3). Similarly, a multiple regression model containing baseline EI, BMI, race, and wear time accounted for only 1.22% of the variance in change in MVPA and was not statistically significant, $F(4, 111.53) = 1.39$, $p = .25$ (objective 4).

Examination of 6-month MVPA data revealed a zero-inflated distribution, with 39 (12%) participants exhibiting no MVPA. A compound Poisson generalized linear model containing 6-month EI, as well as BMI, race, and wear time as covariates, revealed that 6-month EI did not significantly predict 6-month MVPA ($b = 0.03$, $F(1, 30.41) = 0.14$, $p = .71$) (objective 5). Baseline BMI ($b = -0.03$, $F(1, 134.62) = 6.77$, $p = .01$), greater wear time (b = 0.002, $F(1, 27.96) = 8.12$, $p = .008$), and (at trend level) race ($b = 0.25$, $F(1, 138.48) = 3.86$, $p = .05$) predicted greater 6-month MVPA.

4. Discussion

This was the first study to our knowledge to assess the relationship between EI and PA among adults with overweight or obese BMIs enrolled in BWL treatment. Given the importance of PA for long-term weight management and the difficulty many individuals in BWL programs experience with sufficiently increasing PA, there is need to examine novel factors related to PA in this population. Overall, the findings of the present study suggest that, while EI and MVPA are positively related at the outset of BWL treatment, EI and MVPA may not be meaningfully related after treatment begins.

Consistent with prior literature, EI was positively related to PA at baseline (Rhodes et al., 2016). Importantly, this finding expands on previous knowledge by using accelerometers to assess PA and examining EI among a key target population with especially low PA (Davis et al., 2006). As hypothesized and consistent with prior work (Karr et al., 2014), lower BMI was related to greater EI at baseline. Interestingly, identifying as non-White was also related to greater baseline and 6-month EI (consistent with prior research suggesting racial differences in EI; Anderson et al., 2003), but lower MVPA. Cultural differences in beliefs about PA and BMI may help to explain these findings. For example, African Americans, who were the majority of non-White participants in the present study, tend to report greater acceptance of higher BMIs (Ard et al., 2013) and may therefore be less susceptible to beliefs or stereotypes about the relationship between weight status and PA (i.e., that heavier individuals engage in less PA and are lazy; Berry & Spence, 2009; Puhl & Heuer, 2009). In turn, African Americans may more strongly identify as exercisers compared to their White counterparts, regardless of PA levels. Future research is

Table 1
Means, standard deviations, and correlations among variables of interest.

Measure	M *(SD)*	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Baseline BMI (kg/m^2)	35.14 *(4.76)*	.11	-.06	-.17**	-.17**	-.11**	-.06	-.09	-.07	.08
2. Gender	–	–	.21***	.03	-.08	.10*	.01	-.04	.03	.04
3. Race (White vs. non-White)	–		–	.06	-.12*	.13**	-.01	-.14*	.11*	.08
4. Age (years)	52.72 *(10.35)*			–	.09	-.04	.02	.11	-.05	-.14*
5. Baseline EI	3.33 *(1.44)*				–	.16***	-.04	.68***	.10*	.03
6. Baseline MVPA (minutes/week)	58.56 *(83.83)*					–	.03	.08	.28***	.06
7. Baseline accelerometer wear time (minutes/day)	868.63 *(83.63)*						–	-.06	.10*	.39***
8. 6-month EI	3.84 *(1.60)*							–	.04	0.05
9. 6-month MVPA (minutes/week)	135.94 *(121.35)*								–	.14**
10. 6-month accelerometer wear time (minutes/day)	839.72 (*108.87*)									–

Note. BMI = body mass index, EI = exercise identity, MVPA = moderate-to-vigorous physical activity. *$p < .05$, **$p < .01$, ***$p < .001$. Values are presented for completers only. Due to the non-normal zero-inflated distribution of baseline and 6-month MVPA, Kendall's tau was used when examining the relation between MVPA and other variables. Pearson correlation was used for all other variables. For gender, 0 = female, 1 = male. For race, 0 = non-White, 1 = White.

needed to clarify the relations between racial identity, PA, and EI. Contrary to past literature (Anderson et al., 2001), age and gender were not associated with EI, perhaps due to limited variability in age and the small number of men in the present sample.

Although both MVPA and EI increased during treatment, mean change in EI was modest and not meaningfully related to change in MVPA. Moreover, individuals with stronger baseline EI did not exhibit greater increases in MVPA, and—perhaps most surprisingly—EI and MVPA were no longer meaningfully related 6 months into treatment. There are several potential explanations for these findings, all of which warrant additional research. First, it is possible that the program prescription provided external motivation for PA and was sufficient for fostering short-term PA adoption among some participants, even if EI did not strengthen. For example, some participants may have engaged in PA during treatment primarily to satisfy the external demands placed on them by the BWL program (e.g., to be able to report at group sessions that they had successfully met the PA goal, to avoid guilt around not achieving the PA prescription), while experiencing very limited intrinsic or self-driven motivation for PA. In line with past research suggesting a stronger relationship between EI and self-determined (rather than prescribed) forms of behavior regulation, these individuals may have thus experienced limited shifts in EI despite becoming more active (Vlachopoulos, Kaperoni, & Moustaka, 2011). However, as previously noted, EI may be important for long-term PA maintenance, when external motivators for PA are likely reduced (Rhodes et al., 2016).

Alternatively, some individuals may have over-endorsed EI due to the nature of BWL treatment and/or experienced modest increases in EI that were not sufficient to translate into behavior change. Given that BWL treatment included weekly group discussions about PA, there was likely value tied to PA in the social context of treatment. Because EI endorsement is partially related to social context and how one believes others perceive him or her (Stryker & Burke, 2000), the BWL treatment setting and social value placed on PA may have contributed to overreporting of EI by individuals who, in fact, were engaging in limited PA and not experiencing meaningful shifts in their internalized identity. Additionally, as there is no established cutoff score on the Exercise Identity Scale for viewing oneself as an "exerciser," it is possible that some observed increases in EI scores were not clinically significant, thus limiting the effect of EI change on PA behavior. Lastly and relatedly, while participating in PA is likely necessary to view oneself as an exerciser, PA engagement may not be sufficient for EI. Past research suggests that factors outside of PA behavior, such as commitment to PA and PA enjoyment, also influence EI (Kendzierski & Morganstein, 2009), and that viewing oneself as an exerciser involves more than just exercising (Strachan, Perras, Forneris, & Stadig, 2017). For instance, exercisers report that their EI permeates areas of their life outside of PA practice, including social activities and relationships (Strachan et al., 2017). Because the BWL program did not explicitly target these broader aspects of and correlates of EI, it is possible that the observed, small increases in EI resulted only from modest modifications in PA behavior and that changes in EI were insufficient to meaningfully relate to changes in MVPA.

Notably, this study is one of few to assess the relationship between EI and PA utilizing accelerometers for PA assessment (Rhodes et al., 2016), which is crucial given that self-report measures often yield inflated PA estimates (Troiano et al., 2008). Importantly, while accelerometry provides device-assessed raw PA data, those data are then processed using normed cutpoints. Although these cutpoints are validated, research increasingly indicates that they may not apply universally across different populations (Raiber, Christensen, Randhawa, Jamnik, & Kuk, 2018). In particular, individuals with overweight or obese BMIs may reach a MVPA threshold at lower intensities of movement than the identified cutpoints, such that accelerometery data and the cutpoints used may label their PA level inaccurately. Additionally, some types of PA are not captured by accelerometers (e.g., swimming), and accelerometers only capture PA that occurs when the device is being worn. Thus, use of accelerometer-based (versus self-reported) PA assessment and potential PA assessment imprecision in the present study may have contributed to the lack of an observed relationship between EI and MVPA at 6 months, when most individuals were more active compared to baseline.

Study strengths include assessment of PA via accelerometry (as this is generally agreed to be less biased than self-report, despite imperfections), assessment of the relation between EI and PA over 6 months, and examination of EI in an important population for PA promotion. A key limitation is lack of a control group. Because the current study did not examine PA and EI among participants who were *not* receiving BWL treatment, we cannot directly attribute the observed changes in EI and PA to BWL treatment. The lack of control group also leaves open the possibility that the current findings would be observed outside the context of BWL (although such large increases in MVPA without structured intervention would be unexpected in this population). Without a control group, it is also possible that reactivity to assessment may have contributed to observed changes in PA and EI, as documented for EI in some prior studies (Perras, Strachan, Fortier, & Dufault, 2016). Additional limitations include measurement of PA and EI at only two time points, and lack of assessment of psychological variables that may influence EI and its relation to PA (e.g., weight bias, motivation for MVPA). Directions for future research thus include assessing PA in different ways (e.g., concurrent assessment by self-report and accelerometry, individually-defined thresholds of MVPA), assessing PA and EI over a longer time frame to determine if EI predicts PA maintenance, assessing theoretical constructs that may clarify the observed results, and examination of the effect of interventions that explicitly seek to alter EI in this population.

In conclusion, this study examined the relationship between PA and EI among individuals with overweight and obesity participating in BWL treatment. Greater MVPA was significantly associated with stronger EI at baseline. EI and PA were not related after baseline, however. Results suggest that there may be demographic differences in the relationship between EI and PA that should be examined further. Future research should attempt to better understand how EI is related to MVPA in this population, particularly as it relates to long-term maintenance of MVPA.

Declarations of interest

Dr. Butryn reports royalties from books on acceptance-based approaches, published by New Harbinger and Oxford University Press. The other authors declare no conflict of interest.

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Appendix A. Supplementary data

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