An Examination of the Psychometric Properties of the Exercise Identity Scale and its Adaptation to Physical Activity

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Abstract

Research has shown exercise identity is one of the strongest predictors of physical activity behavior. However, exercise is a subset of the broader construct of physical activity and therefore existing instruments such as the Exercise Identity Scale may underestimate the relationship between identity and physical activity behavior. This study investigated whether exercise and physical activity identity are conceptually distinct factors, the most appropriate factor structure of the Exercise Identity Scale, and the predictive utility of the best measurement model for understanding physical activity behavior. A total of 647 undergraduate students (M_{age}=19.54±1.86 years; 61% female, 3% other) completed an online survey that included the Exercise Identity Scale, a modified version of the Exercise Identity Scale specific to physical activity and the International Physical Activity Questionnaire – Short Form. Exploratory factor analysis largely indicated a two-factor structure that broke down not by exercise versus physical activity identity, but instead, by specific identity dimension (i.e., role identity and beliefs). Subsequently, we utilized Structural Equation Modeling to examine the unique effect of exercise/physical activity role identity and beliefs on physical activity. Results indicated role identity was positively associated with physical activity (β=0.553, p<.001) whereas the association between beliefs and physical activity was non-significant (β=-0.064, p=.338). Collectively, these findings suggest that exercise and physical activity identity largely represent a single identity domain with two factors. As such, the Exercise Identity Scale, and its modified physical activity version, can be used interchangeably without sacrificing our understanding of the strength of the identity – physical activity behavior relationship.

An Examination of the Psychometric Properties of the Exercise Identity Scale and its Adaptation to Physical Activity

It is well established that physical activity participation confers benefits for various facets of health such as reduced risk of depression and cardiovascular disease (Pearce et al., 2022; Warburton & Bredin, 2017), yet the prevalence of insufficient physical activity remains high globally (Guthold et al., 2018) and has become worse since the COVID-19 pandemic (Stockwell et al., 2021). For instance, meta-analytic evidence from studies conducted in 32 countries estimates that only 17.1% of adults meet the public health recommendations of 150 minutes of moderate-to-vigorous intensity aerobic exercise and two sessions of muscle strengthening activities (Garcia-Hermoso et al., 2022). Within the United States, even greater disparities in guideline adherence have been associated with certain sociodemographic factors (Bennie et al., 2019). Such rates of physical activity guideline adherence are a major public health concern (Trost et al., 2014) and place a considerable economic burden on societies (Ding et al., 2016). Collectively, mounting evidence supports the need for continued efforts to increase physical activity behavior and great strides have been made identifying correlates (Bauman et al., 2012), but how we measure these constructs may be a limiting factor in our current understanding of these relationships.

The field of exercise psychology has put forth several theoretical approaches that have been used to explain physical activity behavior and inform the development of physical activity interventions. Some of the most popular theories (e.g., Social Cognitive Theory, Theory of Planned Behavior, Transtheoretical Model) that have been applied to understand physical activity behavior are rooted within a social cognitive framework (Rhodes et al., 2019). The key shortcoming of social cognitive theories, however, is that they generally position intention

formation as the proximal determinant of physical activity behavior. Yet evidence has consistently shown that intentions to engage in physical activity are often not sufficient to facilitate action (Rhodes & de Bruijn, 2013; Rhodes & Dickau, 2012). This phenomenon is referred to as the intention-behavior gap (Sheeran & Webb, 2016) and has sparked the emergence of several action control theories that integrate post-intentional processes to help explain why people often fail to translate their physical activity intentions into action (Rhodes, 2017; Schwarzer, 2008).

Regulatory processes such as action planning and coping planning were integrated within initial action control models as key mechanisms underlying the intention-behavior gap (Schwarzer, 2008). More recently, Rhodes' (2017) Multi-Process Action Control framework has extended beyond regulatory processes to also include reflexive processes (i.e., automatic, less conscious) such as habit and identity, which develop as a consequence of repeated action control over time. Identity, specifically, is central to one's self-concept and refers to how one views themselves with regard to their values, roles and beliefs in a hierarchically organized manner (Stets & Burke, 2003). Individuals can have multiple identities (e.g., parent, teacher, athlete) of which the salience of each identity to their central self-concept is shaped through a dynamic interplay between the individual and their social environment. The construct of identity has shown promise as one of the strongest (r = 0.44) correlates of physical activity behavior according to meta-analytic evidence (Rhodes et al., 2016). These findings demonstrate what makes sense intuitively; the more salient one's identity, the more likely they are to act in accordance with it. Having a strong sense of identity related to physical activity is therefore expected to favorably shape future physical activity participation and lead individuals to seize opportunities to be physically active given that this identity aligns with their values, roles, and

beliefs. Although research investigating identity (or self-schemas) in a physical activity context dates back to the late 1980s (Kendzierski, 1988), this construct has received far less attention compared to constructs specified within social cognitive theories (e.g., attitudes, perceived behavioral control, intention) and knowledge gaps exist.

One under investigated issue within the physical activity identity literature relates to limitations of current instruments. Specifically, existing identity instruments are all framed in the context of exercise behavior as opposed to the broader construct of physical activity: the Exercise Identity Scale (Anderson & Cychosz, 1994), Exercise Self-Definition Scale (Hays et al., 2005) and Exercise Schema Questionnaire (Kendzierski, 1988). The Exercise Identity Scale is the most commonly used of these three instruments having been employed in 12 of the 32 studies included in Rhodes et al.'s (2016) systematic review and meta-analysis. Initial research using the Exercise Identity Scale focused on understanding leisure time exercise behavior (Anderson et al., 1998, 2001; Anderson & Cychosz, 1994; Cardinal & Cardinal, 1997), however, it has since been commonly used to explain the broader construct of physical activity behavior (Barkley et al., 2020; Golaszewski et al., 2022; Liu et al., 2021; Strachan et al., 2005). This is problematic because exercise is defined as “a subset of physical activity that is planned, structured, and repetitive and has a final or an intermediate objective related to the improvement or maintenance of physical fitness” (Caspersen et al., 1985). Therefore, an instrument such as the Exercise Identity Scale may lack predictive utility when used to explain physical activity behavior because respondents are prompted to consider only one aspect of their identity related to physical activity despite multiple domains of physical activity having been established (i.e., transportation, occupation, household, leisure time). As a result of this limitation, our current

understanding of the strength of the relationship between identity and physical activity behavior may in fact be underestimated.

Some researchers have recognized the disconnect between using exercise identity to explain physical activity behavior. To circumvent this issue, items within the exercise identity scale have been modified (e.g., “I consider myself as someone who is physically active”) to capture the broader construct of physical activity (Haider et al., 2022; Huffman et al., 2022; Kwan et al., 2022; Rhodes et al., 2021; Strachan et al., 2010). However, to the best of our knowledge no attempts have been made to evaluate whether a modified physical activity version of the Exercise Identity Scale is conceptually distinct from the original instrument, and if so, whether the same 2-factor model consisting of role identity and beliefs exists (Wilson & Muon, 2008). Similar work has observed equivalent factor structure and loadings across the Psychological Need Satisfaction in Exercise Scale and a modified version specific to physical activity, although it should be noted that the authors caution against comparing scores from the different instruments (Gunnell et al., 2012). If the modified physical activity version of the Exercise Identity Scale is conceptually distinct from the original instrument, determining which instrument explains a greater amount of the variance in physical activity behavior is warranted.

To advance our understanding of the role identity plays for physical activity behavior, the aforementioned knowledge gaps need to be addressed. Thus, the aims of the present study were threefold. Akin to Gunnell et al.'s (2012) research investigating the Psychological Need Satisfaction in Exercise Scale, the first purpose of this study was to evaluate whether adapting the Exercise Identity Scale to refer to the broader construct of physical activity (i.e., physical activity identity) resulted in a conceptually distinct factor from the original Exercise Identity Scale. Moreover, although exercise identity was originally represented as a unidimensional

construct (Anderson & Cychosz, 1994), more recent work suggests exercise identity is best represented as a bidimensional construct consisting of role identity and exercise beliefs (Vlachopoulos et al., 2011; Wilson & Muon, 2008). Towards that end, we utilized exploratory factor analysis to examine the appropriate factor structure of the best measurement model identified in our first aim. Finally, after determining the best fitting model, we investigated its utility for predicting physical activity behavior. We hypothesized that physical activity identity would be conceptually distinct from exercise identity, would demonstrate a similar 2-factor model akin to previous findings of Wilson and Muon (2008) and lastly, would account for more variance in physical activity behavior than exercise identity given that physical activity identity would better align with a broad physical activity measurement instrument than exercise identity, which may only capture a single subdomain of physical activity behavior (Caspersen et al., 1985).

Methods

Study sample and data collection

A total of 647 undergraduate students (Mean age = 19.54 ± 1.86 years; 61% female, 36% male, 3% other) participated in the present study during the Spring 2022 semester. Participants were recruited from a diverse psychology participant pool at a large Hispanic-Serving Institution in the Southwestern United States with a student body that consists of 45% first-generation post-secondary education attendees and over 40% of students who are Pell Grant eligible (awarded only to students who display exceptional financial need). All participants received credit towards their grade for completing an online survey hosted on Qualtrics. The demographics component of the survey was presented first, after which, all instruments were presented in random order and participants were unable to backtrack. The study protocol was

approved by an institutional review board and all participants provided informed consent prior to participation. Within the sample, participants identified as the following race/ethnicities: 35% Hispanic, 24% Multiracial, 19% White, 11% Black, 9% Asian, and 2% Other. According to the Centers for Disease Control and Prevention (2022) adult body mass index definitions, 6% of the sample was classified as underweight, 53% as normal weight, 22% as overweight, 18% as obese, and 1% of values were missing. As per the Physical Activity Guidelines for Americans (US Department of Health and Human Services, 2018), 56% of participants were considered physically active based on their self-reported physical activity behavior (i.e., ≥150 min of weekly moderate-to-vigorous physical activity), whereas 12% were considered insufficiently active and 32% were inactive.

Measures

Demographics. Participants reported demographic variables assessing their age, gender, race/ethnicity, height (m) and weight (kg). Height and weight values were used to calculate each participant's body mass index (BMI; weight/(height^2)), which was then coded into underweight, normal weight and overweight/obese based on established BMI classification cut points as per the Centers for Disease Control and Prevention (2022).

Exercise Identity. Exercise identity was measured using the Exercise Identity Scale (Anderson & Cychosz, 1994). This scale consists of nine items that were rated on a 7-point Likert scale with responses ranging from 1 (strongly disagree) to 7 (strongly agree). Although exercise identity was originally understood to be a unidimensional construct (Anderson & Cychosz, 1994), work since its development has suggested that a 2-factor model consisting of role identity and exercise beliefs provides a more accurate representation of this construct

(Wilson & Muon, 2008). All items and their corresponding factor from the 2-factor model are presented in Table 1.

Physical Activity Identity. Physical activity identity was measured using an adapted version of Anderson and Cychosz's (1994) Exercise Identity Scale. All items from the Exercise Identity Scale were modified to replace “exercise” with “physical activity”. These modified items have been used in previous studies (e.g., Haider et al., 2022; Kwan et al., 2022; Rhodes et al., 2021; Strachan et al., 2010). Like the Exercise Identity Scale, the modified version of the Exercise Identity Scale, hereafter referred to as the Physical Activity Identity Scale, consisted of nine items that were rated on a 7-point Likert scale with responses ranging from 1 (strongly disagree) to 7 (strongly agree). All items and their corresponding factor from the 2-factor model are presented in Table 1.

Physical activity behavior. Physical activity behavior was assessed using the International Physical Activity Questionnaire Short Form (IPAQ-SF) (Booth, 2000; Craig et al., 2003). The IPAQ-SF consists of seven items, six of which assess the frequency (days) and duration (hours and/or minutes on an average day) of their moderate and vigorous physical activity as well as walking performed in bouts of greater than 10-minutes over the past seven days and a seventh item which assesses how much time an individual spends sitting during an average weekday. The six physical activity-related items were used to calculate metabolic equivalent minutes per week (weekly MET min) by multiplying the MET value for a given activity (walking = 3.3, moderate-intensity physical activity = 4, vigorous-intensity physical activity = 8; Ainsworth et al., 2000) by the minutes the activity was carried out and the number of days that the participant indicated engaging in that activity (e.g., 3.3 MET [walking] X 30 min X 3 days = 297 weekly MET min) and summing the MET minutes per week for walking,

moderate-, and vigorous-intensity physical activity. As per the scoring rules for the IPAQ-SF, daily activity times were capped to 180 minutes for any participants who exceeded 3 hours or 180 minutes of walking, moderate or vigorous physical activity per day.

Data analysis

The analytic process was conducted in Mplus v8.6 (Muthén & Muthén, 1998-2017) using a Robust Maximum Likelihood estimator. Missing data was minimal (0% to 1%) and handled with full-information maximum likelihood estimation (FIML; Collins et al., 2001). Model fit was evaluated using the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). According to values suggested by Little (2013), good fit is represented as RMSEA ≤ .06, CFI ≥ .95, and SRMR ≤ .06; adequate fit is represented as RMSEA = .06-.08, CFI = .90-.95, and SRMR = .06-.08; and mediocre fit is represented as RMSEA = .08-.10, CFI = .85-.90, and SRMR = .08-.10. It should be noted, although we report the chi-square, we did not use it to gauge model fit because it tests a null hypothesis of perfect fit, which is rarely plausible with large samples or complex models (Davey & Savla, 2010).

The analytic strategy proceeded in three steps. First, to establish a baseline understanding of the interconnection between exercise and physical activity role identity and beliefs, we report bivariate correlations and descriptive. Next, to establish whether exercise and physical activity identity represent distinct identity domains and determine whether role identity and beliefs represent distinct dimensions, we tested a one- to five-factor model utilizing exploratory structural equation modeling (ESEM) with an oblique Geomin rotation to minimize factor complexity by reducing cross-loadings and increasing interfactor correlations. ESEM serves as an overarching integration of confirmatory factor analysis (CFA) and exploratory factor analysis

(EFA; Marsh et al., 2014), allowing for items to freely load on all factors (Asparouhov & Muthén, 2009) while providing access to all the usual CFA parameters (e.g., residual correlations, etc.). To compare solutions with differing numbers of factors, we relied on the ΔCFI (>.010) and ΔRMSEA (>.010) criteria to determine significant change in model fit (Little, 2013)[1]. Specifically, models were considered a significant improvement in model fit if change in both the CFI and RMSEA were above .10. Moreover, in interpreting the factors, a cutoff of ≥.40 was used to determine salient loadings (Fabrigar et al., 1999). Subsequently, building on the championed model, we utilized structural equation modeling to examine the association between the extracted dimensions of exercise and physical activity role identity and beliefs and weekly MET min. Given well-established associations with physical activity behavior (Bauman et al., 2012), gender, age, ethnicity/race, and BMI were included as covariates.

Results

Bivariate Correlations Between Physical Activity and Exercise Identity

As indicated in Table 1, correlations between physical activity and exercise role identity and beliefs were relatively high, providing preliminary support for a lack of multidimensionality. Indeed, exercise and physical activity role identity were highly correlated (r = .901). Similarly, correlations between exercise and physical activity beliefs were fairly strong as well (r = .844). To a lesser degree, role identity and beliefs, across both identity domains (exercise and physical activity), were positively correlated (r = .724-844). As a whole, these correlations emphasize the need to more closely examine the dimensionality of exercise and physical activity identity.

Establishing the Dimensionality of Physical Activity and Exercise Identity

[1] Although we report the Satorra-Bentler $\Delta\chi^2$ difference test, because it tests the null hypothesis that two paths or models are exactly equivalent (Meade et al., 2008), we did not rely on the $\Delta\chi^2$ difference test in our interpretations.

As a next step, we tested a 1- to 5-factor model utilizing ESEM. Although the 3- to 5-factor models provided significantly better fit (see Table 2), closer examination of the factor structures indicated 3rd, 4th, and 5th factors largely defined by 1-2 salient items with factor loadings ≥.40 (see Table 1S in Supplemental Materials). Given the 2-factor model was associated with mediocre-to-adequate fit [$\chi^2(118) = 874.084$, $p < .001$; CFI = .904; RMSEA = .100; SRMR = .060], we proceeded to examine modification indices to improve fit. Specifically, modification indices recommended residual correlations between exercise and physical activity items 2 and items 5, respectively. Given that these items made up the two salient factor loadings for the 3rd and 4th factor identified in the respective models, residuals correlations were added, and the ESEM was estimated anew.

Upon adding these residual correlations between exercise and physical activity items 2 ($r = .527$) and items 5 ($r = .418$), as indicated in Table 2, the 2-factor model was associated with mediocre-to-good fit [$\chi^2(116) = 644.201$, $p < .001$; CFI = .933; RMSEA = .084; SRMR = .029]. That said, it is worth noting that the 3-factor [$\Delta\chi^2(16) = 213.836$, $p < .001$; ΔCFI = .026; ΔRMSEA = .035] model represented a significant improvements in model fit (see Table 2S in Supplemental Materials). However, there were no salient loadings on the 3rd factor. As such, the 2-factor model was championed as the preferred model. However, item 4 of both the physical activity and the exercise identity measures differentially loaded between the two factors. Although cross-loading did not reach the set threshold, they were both relatively high (.378-.384). As such, these items were dropped, and the E-SEM model was estimated one last time. As indicated in Table 2, the 2-factor model was associated with mediocre-to-good fit [$\chi^2(87) = 480.145$, $p < .001$; CFI = .942; RMSEA = .084; SRMR = .027] and, once again, although the 3-factor mode provided significantly better fit [$\Delta\chi^2(14) = 199.579$, $p < .001$; ΔCFI = .019;

ΔRMSEA = .033], the 3rd factor did not have salient factor loadings (see Table 3S in Supplemental Materials). As such, the 16-item 2-factor model was put forth as the final championed model.

Standardized factor loadings for the championed model are presented in Table 3. There were no cross-loadings greater than |0.7| indicating a simple factor structure or one with no complex items (i.e., items with salient loadings on multiple factors) (Sass & Schmitt, 2010). The two-factor model largely consisted of items, irrespective of the differentiation between exercise and physical activity, that correspond to role identity and beliefs, respectively. Thus, and consistent with bivariate correlations, the ESEM largely indicated a lack of differentiation between exercise and physical activity. Moreover, inter-factor correlations between role identity and beliefs (r = .726) were similar to those extracted in our bivariate correlations. The Cronbach's alphas for were .95 and .92 for role identity and beliefs, respectively.

Incremental Validity

Next, building on the championed model, we examine the unique association between exercise/physical activity role identity and beliefs with weekly MET min, controlling for ethnicity, gender, BMI, and age. The SEM model was associated with adequate-to-good model fit [$\chi^2(165) = 614.744$, $p < .001$; CFI = .940; RMSEA = .066; SRMR = .037]. As indicated in Table 4, exercise/physical activity role identity was significantly and positively associated with weekly MET min (β = .553, p<.001, 95% CI = .449-.657). In contrast, after controlling for all other variables in the model, there was no significant association between exercise/physical activity beliefs and weekly MET min (β = -.064, p = .338, 95% CI = -.196-.067).

Discussion

The results from the present study help to clarify some of the existing measurement and conceptual issues within the literature examining the relationship between identity and physical activity behavior. Perhaps most importantly, and contrary to our predictions, was the finding that physical activity and exercise identity may not be conceptually distinct factors. From an application standpoint this suggests that researchers could use the original Exercise Identity Scale and the modified physical activity version interchangeably when investigating physical activity behavior. However, considering the psychometric properties of the Physical Activity Identity Scale have not been extensively tested, it may be most advisable to use the original instrument.

The conceptual overlap observed across these factors also indicates that participants may view the term "exercise" as representative of the broader concept of physical activity. This may be due to individuals struggling to recall less consistent bouts of physical activity that last fewer than 10 minutes (Matthews et al., 2012) and instead basing their estimates on planned or structured bouts of physical activity (i.e., sport or exercise). It is also possible that individuals consider physical activity bouts occurring outside of their leisure time as exercise. For instance, someone who cycles to and from work may view this activity as their daily exercise as opposed to active transportation. Taken together, this study calls into question whether there is a conceptual distinction between exercise identity and physical activity identity.

Our findings also lend insight into the factor structure of physical activity and exercise identity. In line with our predictions, we found exercise/physical activity identity could be differentiated into a 2-factor measurement model as originally observed by Wilson and Muon (2008). Previous research that has examined the factor structure of the Exercise Identity Scale has employed samples that would be more likely to have stronger exercise identities:

undergraduate physical education and kinesiology students (Wilson & Muon, 2008) and adults who exercised at fitness clubs (Vlachopoulos et al., 2011). Therefore, the present study provides further support for the 2-factor model among a more diverse (see Study Sample) and generalizable (i.e., recruited from a setting with a lower probability of finding physically active individuals; 44% were insufficiently active or inactive) sample. While it would have been reasonable to postulate that aspects of exercise/physical activity identity would have been less differentiated in individuals with less experience, investment, and/or knowledge, our results suggest this is not the case. The 2-factor model fits intuitively within identity theory and these findings suggest that the 2-factor structure originally observed by Wilson and Muon, and later Vlachopoulos et al. (2011), may not have been susceptible to restriction of range issues among samples that would be more likely to report higher scores on the Exercise Identity Scale. Nevertheless, future research should continue to investigate the most appropriate factor structure of the Exercise Identity Scale among diverse samples from lower income countries in which the constructs of physical activity and exercise may be viewed differently.

Our results also contribute to the literature investigating the predictive utility of exercise/physical activity identity for physical activity behavior. To date, most studies have examined associations between exercise/physical activity identity and physical activity behavior using the original unidimensional construct (Anderson & Cychosz, 1994), with meta-analytic evidence demonstrating a medium effect size (r = 0.44; Rhodes et al., 2016). In contrast, far fewer studies have employed the subscales identified within Wilson and Muon's (2008) 2-factor model. Our findings align with the only other study we are aware of that has distinguished between the two factors of identity within a model predicting physical activity behavior (Berry et al., 2014); role identity, but not exercise/physical activity beliefs, was a significant predictor of

weekly MET mins. Replication of these effects is needed, yet initial evidence suggests views about exercise/physical activity tied to one's identity strength (i.e., beliefs factor) may be less important than an individual's self-perceptions and relation-inferred beliefs of being physically active or an exerciser (i.e., role identity factor). We would be remiss to not acknowledge that one item from the beliefs subscale ("physical exercise/activity is central to my self-concept") was dropped from the championed model due to differential loading onto both factors. Upon closer inspection, this may be attributable to its paralleled salience to one's self-held views of being an active individual alongside the beliefs that inform the strength of this identity. It is also possible that this item is understood different by individuals who are knowledgeable, capable and have experience with exercise/physical activity compared to those who do not. Nevertheless, as more evidence emerges it will become clearer whether behavior change techniques that map onto role identity may hold more promise for informing effective intervention development than those targeting beliefs.

Considering the difference in effects observed for role identity and beliefs in relation to physical activity behavior, it is interesting to note that several existing studies examining correlates of physical activity behavior have used only the role identity subscale as an index of exercise/physical activity identity (e.g., Rhodes et al., 2020; Rhodes & Lim, 2016; Rhodes & Lithopoulos, 2022; Wierts et al., 2022). Given the overall lack of research that has contrasted the two factors of exercise/physical activity identity, it is reasonable to postulate that this may be due to brevity (i.e., 3 items vs. 6 items for the exercise beliefs subscale) as researchers attempt to minimize participant burden. Moving forward, researchers are encouraged to collect data for all 9 items from the Exercise Identity Scale so that further inferences can be made regarding which

factor of exercise/physical activity identity explains the most variance in physical activity behavior.

Although this study addresses critical knowledge gaps surrounding the measurement of exercise identity, it is not without limitations. First, we employed a convenience sample of post-secondary students and therefore our results may lack generalizability to other populations. It is possible that post-secondary students may struggle to differentiate between exercise versus other types of physical activities and therefore these findings may not hold among other populations. However, it should be noted that our sample is likely more generalizable than those recruited from physically active contexts (e.g., gyms and recreational facilities, kinesiology or exercise science programs) in previous studies given the diversity in our psychology participant pool. With replication becoming an increasingly important aspect of the scientific process (Nosek et al., 2022), it would be advisable to determine whether these findings are consistent among age groups across the life cycle given that physical activity engagement, awareness of the benefits and physical limitations may be more prominent in certain life stages. Another limitation relates to the modified physical activity identity items used in the present study. It is not outside the realm of reasoning that exercise identity and physical activity identity are distinct constructs given that we simply modified the Exercise Identity Scale items to represent physical activity behavior instead. Research using an inductive (i.e., bottom up) approach to develop new items specific to physical activity identity is warranted and could verify whether these items also load onto a single factor that includes the original Exercise Identity Scale items. Nevertheless, the purpose of the present study was to examine differences in two existing measures as opposed to the creation of a novel physical activity identity measure. Finally, physical activity behavior was self-reported using the IPAQ-SF, which may introduce recall errors and/or social desirability

bias (Sallis & Saelens, 2000). Furthermore, the IPAQ-SF asks individuals to report all bouts of physical activity lasting at least 10 minutes in duration, which is no longer consistent with many physical activity guidelines that have removed minimum bout requirements. Nevertheless, research has shown physical activity estimates with and without the 10 minute bout requirement are relatively equivalent from a guideline adherence standpoint (Ussery, 2020). Future studies should consider using research- or consumer-grade wearable devices to overcome this limitation and examine whether physical activity identity correlates more strongly with volume and/or intensity of all movements captured throughout the day than exercise identity.

In conclusion, this study provides some important insight into the measurement of exercise identity, with implications for understanding physical activity behavior. Namely, it appears that the Exercise Identity Scale and modified version related to physical activity identity may be used interchangeably to predict physical activity behavior. Findings support previous work in that the 2-factor structure of exercise/physical activity identity appears to be most appropriate among a more diverse sample. Finally, our results underscore the predictive utility of exercise identity as one of the strongest psychological constructs for understanding physical activity behavior, yet suggest that role identity may be driving this effect. While the focus of this work was to address key knowledge gaps in the identity - physical activity relationship, future work should consider the development of novel identity instruments specific to the broader construct of physical activity behavior.

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Tables

Table 1

Bivariate Correlations Between Dimensions of Exercise and Physical Activity Identity

Identity Dimension	1	2	3	4
1. Exercise Role Identity	--	.738	.901	.724
2. Exercise Beliefs		--	.729	.844
3. Physical Activity Role Identity			--	.824
4. Physical Beliefs				--

Table 2

Model Fit for Estimated Exploratory Structural Equation Models (ESEM)

Estimated Model	χ^2(df)	$\Delta\chi^2$(Δdf)	CFI	ΔCFI	RMSEA	ΔRMSEA	SRMR
Initial Model							
1-Factor Model	1605.297(135)*		.813		.130		.064
2-Factor Model	874.084(118)*	601.897(17)*	.904	.091	.100	.030	.034
3-Factor Model	608.754(102)*	268.059(16)*	.935	.031	.088	.012	.029
4-Factor Model	459.690(87)*	133.241(15)*	.953	.018	.083	.005	.023
5-Factor Model	299.699(73)*	155.975(14)*	.971	.018	.070	.013	.017
Residual Correlations							
1-Factor Model	1338.202(133)*		.847		.119		.059
2-Factor Model	644.201(116)*	574.096(17)*	.933	.086	.084	.035	.029
3-Factor Model	418.034(100)*	213.836(16)*	.959	.026	.070	.014	.023
4-Factor Model	314.286(85)*	89.595(15)*	.971	.012	.065	.005	.019
5-Factor Model[1]	--	--	--	--	--	--	--
Reduced Items & Residuals							
1-Factor Model	1182.319(102)*		.840		.129		.065
2-Factor Model	480.145(87)*	591.525(15)*	.942	.102	.084	.045	.027

3-Factor Model	270.650(73)*	199.579(14)*	.971	.029	.065	.019	.021
4-Factor Model[1]	--	--	--	--	--	--	--
5-Factor Model[1]	--	--	--	--	--	--	--

Note. * p-value < .001; [1] These models failed to converge.

Table 3

Standardized Factor Loadings for Championed 2-Factor Model

Item	Role Identity	Beliefs
Exercise Identity		
Item 1 - I consider myself an exerciser.	**.755**	.219
Item 2 - When I describe myself to others, I usually include my involvement in exercise.	**.625**	.205
Item 3 - I have numerous goals related to exercising.	-.048	**.863**
Item 4 - Physical exercise is a central factor to my self-concept.*	-	-
Item 5 - I need to exercise to feel good about myself.	.029	**.724**
Item 6 - Others see me as someone who exercises regularly.	**.864**	.077
Item 7 - For me, being an exerciser means more than just exercising.	.239	**.622**
Item 8 - I would feel a real loss if I were forced to give up exercising.	.325	**.577**
Item 9 - Exercising is something I think about often.	-.035	**.854**
Physical Activity Identity		
Item 1 - I consider myself someone who is physically active	**.908**	-.017
Item 2 - When I describe myself to others, I usually include my involvement in physical activity	**.750**	.040
Item 3 - I have numerous goals related to being physically active	.023	**.736**
Item 4 - Physical activity is a central factor to my self-concept.*	-	-
Item 5 - I need to be physically active to feel good about myself	.190	**.524**
Item 6 - Others see me as someone who engages in physical activity regularly	**.967**	-.078
Item 7 - For me, being physically active means more than just engaging in physical activity	.184	**.464**
Item 8 - I would feel a real loss if I could not engage in physical activity	.249	**.499**
Item 9 - Physical activity is something I think about often	-.004	**.755**

Note. Loadings in bold represent significant and salient (>.40) loadings. *Item 4 was dropped due to differential loading between the two factors.

Table 4

Incremental Validity for Championed 2-Factor Model

Predictor	**Estimate[1]**	***p*-value**	**95% CI**
Exercise/Physical Activity Role Identity	.548	<.001	.137 to .210
Exercise/Physical Activity Beliefs	-.071	.282	-.063 to .019
Body Max Index	.047	.155	-.007 to .042
Ethnicity (1=Hispanic)	-.010	.769	-.052 to .039
Gender (1 = Male)	.094	.009	.015 to .107
Age	.009	.790	-.010 to .013

Note. [1]Standardized estimates are reported.

Supplemental Materials

Table 1S

Standardized Factor Loadings Across Initial Factor Models

Items	2-Factor		3-Factor			4-Factor				5-Factor				
	F1	F2	F1	F2	F3	F1	F2	F3	F4	F1	F2	F3	F4	F5
Exercise Identity														
Item 1	**.773**	.189	**.720**	.259	-.022	**.651**	**.362**	-.081	.047	.164	**.796**	.033	.024	-.041
Item 2	**.704**	.143	**.792**	.007	**.631**	.040	.145	-.012	**.889**	.011	-.008	**.934**	.060	-.005
Item 3	-.009	**.816**	-.026	**.825**	.017	-.047	**.903**	-.043	-.026	**.787**	.068	-.024	.038	-.110
Item 4	**.419**	**.506**	**.389**	**.525**	.115	.221	**.447**	.134	.229	.203	.231	.289	.306	-.008
Item 5	-.006	**.783**	-.021	**.787**	.046	-.043	**.475**	**.418**	.096	.099	.026	.065	**.752**	-.030
Item 6	**.893**	.040	**.831**	.111	.029	**.678**	.209	-.065	.155	.005	**.739**	.196	.046	.004
Item 7	.279	**.579**	.251	**.596**	.083	.115	**.729**	-.103	.113	**.614**	.185	.161	-.037	-.091
Item 8	**.332**	**.570**	.296	**.612**	-.028	**.303**	**.601**	.032	-.013	**.464**	**.354**	-.002	.119	.006
Item 9	-.009	**.828**	-.023	**.827**	.076	-.088	**.798**	.065	.080	**.680**	-.048	.104	.156	-.055
Physical Activity Identity														
Item 1	**.896**	-.013	**.859**	.060	-.125	**.899**	-.005	.086	-.029	-.009	**.770**	.010	.041	.267
Item 2	**.803**	.001	**.816**	-.027	.273	**.408**	-.032	.073	**.518**	.006	.099	**.716**	-.014	.259
Item 3	.042	**.713**	.034	**.723**	-.029	.077	**.692**	.056	-.059	**.768**	.011	-.040	-.012	.094
Item 4	**.481**	**.368**	**.461**	**.387**	.061	**.360**	.208	.231	.186	.173	.168	.271	.232	.225
Item 5	.111	**.631**	.094	**.659**	-.081	.215	.041	**.777**	.003	-.009	.005	-.014	**.775**	.342
Item 6	**.971**	-.093	**.927**	-.019	-.077	**.879**	-.009	.017	.048	.018	**.711**	.130	-.057	.265
Item 7	.196	**.444**	.185	**.463**	-.041	.219	**.441**	.039	-.045	**.607**	.075	-.008	-.110	.180
Item 8	.235	**.513**	.208	**.556**	-.101	**.322**	**.421**	.152	-.107	**.436**	.244	-.103	.127	.168
Item 9	-.003	**.757**	-.003	**.756**	-.010	.042	**.588**	.196	-.009	**.828**	-.228	.053	.017	.274

Note. Significant and meaningful loadings (>.40) are highlighted in bold whereas all other loadings in reduced font to facilitate interpretation.

Table 2S

Standardized Factor Loadings Across Revised Factor Model with Residual Correlations

Items	2-Factor		3-Factor		
	F1	**F2**	**F1**	**F2**	**F3**
Exercise Identity					
Item 1	**.746**	.225	.071	**.870**	.012
Item 2	**.610**	.233	.001	**.789**	.134
Item 3	-.045	**.849**	**.751**	-.005	.257
Item 4	.384	**.538**	.384	**.485**	.168
Item 5	.006	**.755**	**.608**	.089	.276
Item 6	**.854**	.087	-.128	**1.038**	.001
Item 7	.227	**.632**	**.479**	.323	.219
Item 8	.312	**.590**	**.542**	.326	.092
Item 9	-.045	**.860**	**.760**	-.004	.273
Physical Activity Identity					
Item 1	**.909**	-.017	.047	**.872**	-.278
Item 2	**.746**	.053	.064	**.740**	-.160
Item 3	.030	**.722**	**.798**	-.063	.070
Item 4	**.468**	.378	**.415**	**.425**	-.053
Item 5	.178	**.546**	**.713**	.022	-.089
Item 6	**.969**	-.081	-.049	**.959**	-.268
Item 7	.190	**.451**	**.574**	.073	-.055
Item 8	.245	**.500**	**.621**	.128	-.059
Item 9	-.004	**.751**	**.977**	-.221	-.015

Note. Significant and meaningful loadings (>.40) are highlighted in bold whereas all other loadings in reduced font to facilitate interpretation.

Table 3S

Standardized Factor Loadings Across Revised Factor Model with Reduced Items and Residual Correlations

Items	2-Factor		3-Factor		
	F1	**F2**	**F1**	**F2**	**F3**
Exercise Identity					
Item 1	**.755**	.219	**.859**	.088	.008
Item 2	**.625**	.205	**.788**	.019	-.102
Item 3	-.048	**.863**	-.009	**.808**	-.200
Item 5	.029	**.724**	.104	**.634**	-.207
Item 6	**.864**	.077	**1.038**	-.122	.001
Item 7	.239	**.622**	.322	**.520**	-.163
Item 8	.325	**.577**	.317	**.563**	-.029
Item 9	-.035	**.854**	.003	**.803**	-.208
Physical Activity Identity					
Item 1	**.908**	-.017	**.841**	.024	.289
Item 2	**.750**	.040	**.716**	.052	.190
Item 3	.023	**.736**	-.073	**.821**	-.015
Item 5	.190	**.524**	.012	**.690**	.162
Item 6	**.967**	-.078	**.929**	-.066	.276
Item 7	.184	**.464**	.057	**.581**	.092
Item 8	.249	**.499**	.117	**.617**	.109
Item 9	-.004	**.755**	-.234	**.981**	.092

Note. Significant and meaningful loadings (>.40) are highlighted in bold whereas all other loadings in reduced font to facilitate interpretation.