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# Predicting implicit and explicit exercise identity from descriptive social norms regarding exercise

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[AQ0](#)



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## ABSTRACT

### Objectives

Exercise identity may promote exercise maintenance. However, less is known about factors that affect exercise identity. Whether descriptive social norms are potential intervention targets for identity development was evaluated.

### Design

A cross-sectional design using data from the Attitudes, Identities, and Individual Differences (AIID) study ([Hussey et al., 2018](#)) was employed – with additional cases collected to increase sample size and power – to evaluate whether descriptive social norms regarding exercise are related to implicit and explicit exercise identities.

## Main Outcome Measures

Participants completed measures of proximal and distal descriptive social norms regarding exercise, explicit and implicit exercise identity, physical activity behavior, and demographics. Multiple regression was used to assess whether social norms regarding exercise predict exercise identities.

## Results

Only proximal descriptive social norms were significantly associated with explicit exercise identity, whereas neither proximal nor distal descriptive social norms were associated with implicit exercise identity. The slopes for explicit and implicit identity differed when predicted by distal (but not proximal) descriptive social norms.

## Conclusions

Proximal descriptive social norms may be associated with explicit exercise identity and may be a worthy intervention targeting alongside identity to influence change in exercise behavior. More research is needed to further understand these relationships. [AQ1](#)

## KEYWORDS

social norms; descriptive norms; identity; exercise; exercise identity



Less than a quarter of Americans meet health recommendations for physical activity (PA) engagement (i.e. 75 min of vigorous or 150 min of moderate activity per week; U.S. Department of Health & Human Services, 2018). This is a public health problem, as meeting PA guidelines is a protective factor against several poor health outcomes, including chronic illnesses (e.g. cardiovascular disease, obesity, and Type 2 Diabetes; Centers for Disease Control & Prevention, 2019; Reeves & Rafferty, 2005). Despite the importance of PA for general health and illness management, many individuals are either uninterested in becoming more active or revert back to near-baseline levels within three to six months after an intervention (Marcus et al., 1998; Murray et al., 2017; Wood & Neal, 2016; Woodard & Berry, 2001). It is known that engaging in exercise is associated with development of an exercise identity (Anderson & Cychosz, 1995; Cardinal & Cardinal, 1997; Gillman et al., 2021). One factor that may contribute to effective long-term maintenance of PA is the development of an exercise identity. Long-term maintenance of PA tends to be challenging and development of an exercise identity may support engagement maintenance (Rhodes & Sui, 2021). However, relying on exercise identity poses a cyclical issue such that engagement in exercise is needed to develop an exercise identity, which then fosters greater exercise engagement. Thus, it is important to investigate other factors that may contribute to exercise identity development, and could be intervened upon, beyond simply engaging in exercise. Therefore, the purpose of the current study is to evaluate social norms as a mechanism of exercise identity development. Importantly, social norms are targetable factors that may facilitate PA engagement, subsequent exercise identity development, and, consequently, PA

maintenance (Okun et al., 2002; Okun et al., 2003).

Identities are critical as they provide meaning for past behavior and act as a guide for future behavior (Anderson & Cychosz, 1994). As such, individuals may develop an exercise identity to explain past exercise behavior and use this identity to propagate future engagement in exercise. Once an identity is established, it tends to remain stable over time as people tend to protect images of how they view themselves (Robinson & Smith-Lovin, 1992). Acting incongruently with an identity (e.g. not exercising despite holding an exercise identity) means that someone is not acting consistently with how they see themselves. Consequently, dissonance associated with acting incongruently with an existing identity may motivate individuals to act to re-align their behavior. Indeed, individuals with stronger (vs. weaker) exercise identities are more likely to regularly engage in exercise and have higher self-efficacy for overcoming barriers to exercising (Anderson & Cychosz, 1995; Anderson et al., 1998; Storer et al., 1997; Strachan & Brawley, 2008). Thus, having an exercise identity may be an important maintenance factor for regular PA, which requires time and physical exertion (Rhodes & Sui, 2021).

According to Identity Theory, the self-concept is comprised of a hierarchy of identities with those at the top of the hierarchy holding the most value, which also makes them the most likely to be acted upon (McCall & Simmons, 1978; Stryker, 1980). Each identity is shaped by socially constructed expectations of how someone with such an identity is supposed to behave, and individuals tend to be motivated to act in congruence with the socially constructed expectations that come along with an identity (Anderson & Cychosz, 1994). Thus, individuals incorporate these socially-based meanings and expectations into their self-concept when adopting any identity (Stets & Burke, 2000). Given that identities are informed by, and formed within, social contexts, it is possible that identities that are adopted by individuals are shaped by existing social norms within that person's environment.

Thus, social norms regarding PA may play an important role regarding the likelihood that individuals will adopt an exercise identity. First, social norms have been shown to predict intentions to be physically active and actual leisure-time PA behavior (Okun et al., 2002; Okun et al., 2003), and this engagement may contribute to exercise identity formation and strengthening. Beyond fostering engagement, social norms should promote exercise identity development as identities are developed in social contexts. Values and self-perceptions are embedded within the fabric of social environments, which increases the likelihood of developing identities that are supported within a particular social context than in contexts that do not provide scaffolding for that identity (Leach et al., 2008; Oyserman et al., 2012). That is, how individuals see others has implications for how they see themselves and how they want to see themselves. Lastly, social norms provide 'rules of behavior' that should provide specificity in action and can constitute an identity (Ball et al., 2010; Oyserman et al., 2012).

It is important to note that social norms can vary by their relative distance from an individual. Proximal social norms are norms with little distance (e.g. norms of close friends, family members), whereas distal social norms have greater distance (i.e. norms of someone your age). Additionally, social norms are also

categorized by whether they refer to patterns of typical behavior, coupled with the expectation that people behave in that pattern (e.g. descriptive norms), or general rules specifying behaviors that individuals should or should not engage in (i.e. injunctive norms; McDonald & Crandall, 2015).

To date, there is relatively little empirical work on the relationship between social norms for PA and exercise identity. In a preliminary study, explicit exercise identity was significantly positively correlated with both proximal descriptive social norms regarding exercise ( $r = .48, p < .001$ ), and distal descriptive social norms regarding exercise ( $r = .20, p < .001$ ; Yun & Silk, 2011). Yun and Silk (2011) also found a positive relationship between descriptive exercise norms and individuals' intentions to exercise when individuals had weak exercise identities. Conversely, there was no significant effect of descriptive norms on intentions to exercise for individuals with strong exercise identities. These findings suggest that social norms may be important during the process of developing a new identity but less influential once the identity has been established. Moreover, these results provide preliminary evidence of a relationship between descriptive social norms regarding exercise and exercise identity, and it is the aim of the current study to build upon these findings by assessing whether descriptive social norms can predict exercise identity.

Descriptive social norms regarding exercise have been shown to predict exercise intentions and actual PA engagement, whereas no effect of injunctive norms has been found on PA engagement (Kitts & Chiang, 2008, Okun et al., 2003). This is unsurprising given that external motivation alone is not related to sustained behavioral engagement (Teixeira et al., 2012). Therefore, descriptive norms, rather than injunctive norms, related to PA may be particularly important for promoting PA, which may help individuals to develop exercise-related identities given that one must engage in a behavior before an associated identity can be formed (Anderson & Cychosz, 1994, 1995; Rhodes et al., 2016).

Exercise identity is most commonly assessed using explicit (i.e. self-report) measures. However, implicit measures of exercise identity have also been used. It is possible that these measures capture different aspects of identity given that implicit and explicit exercise identity are only weakly correlated ( $r = .22$ ; Banting et al., 2009). An alternative explanation for the weak relationship is that, unlike explicit measures, implicit measures are thought to be less susceptible to social desirability bias (Greenwald & Hamilton Krieger, 2006). Thus, when explicitly asking individuals about their identities in the context of social norms, it is possible that individuals may either knowingly or unknowingly provide biased responses (Conroy et al., 2000; Hausenblas et al., 2004). As such, assessing implicit exercise identity may provide a less biased insight into how individuals view themselves, as implicit measures are designed to assess automated responses. Therefore, while examining the extent to which social norms may influence exercise identity, it is important to assess identity both explicitly and implicitly.

The current study tests the degree to which proximal and distal descriptive social norms regarding exercise are associated with explicit and implicit exercise identities. It is hypothesized that proximal and distal descriptive social norms in favor of exercise will be associated with stronger implicit and explicit exercise

identities. This study further explores whether proximal and distal descriptive social norms more strongly predict implicit or explicit exercise identities. This hypothesis is non-directional. The current study is a registered report with all hypotheses and analyses being pre-registered ([blinded for review osf.io/x9kvh](#)). This preliminary study will provide insight into whether implicit exercise identity is predicted by descriptive social norms regarding PA similarly to explicit exercise identity. If social norms regarding PA appear to have a different relationship with implicit exercise identity than with explicit exercise identity, then it is possible that implicit identity measures are, in fact, measuring a different aspect of exercise identity. In this case, determining which form of identity is the mostly strongly related to exercise maintenance will be an important question to be addressed by future research. In contrast, if social norms regarding exercise predict both explicit and implicit identity, it could be evidence that explicit and implicit identity are not distinct. Therefore, it would matter less which type of identity is targeted by interventions. Alternatively, social norms regarding exercise could predict both explicit and implicit identity even if each exercise identity assesses different components of identity, at which point targeting social norms through group-based PA interventions could have the potential to change multiple facets of exercise identity and behavioral maintenance. Thus, this study will lay a foundation for future basic and applied research regarding psychological factors that may influence identity development and PA engagement.

There were no a priori reasons to expect that the relationships between descriptive social norms and identity (i.e. implicit or explicit) would vary as a function of sex or age. Therefore, no covariates were included in any analyses.

## Method

### Participants and procedure

The present manuscript is a primary registered report using original data obtained from Amazon Mechanical Turk (MTurk) coupled with data obtained from the Attitudes, Identities, and Individual Differences (AIID) study (Hussey et al., 2018). Participants ( $n = 200,000$ ) in the AIID study reported demographic information before completing two online research sessions. Participants created usernames on a website and self-selected to participate in online research studies. In the first session, participants were randomly assigned to one of 95 attitude domains (e.g. Relaxing/Exercising, Television/Books, Summer/Winter, Pepsi/Coke). Participants then completed either an evaluation (i.e. attitude) or self-identity type (i.e. categorizing as being associated with self or others) Implicit Association Test (IAT) and explicit measures related to the assigned attitude domain. In the second session, participants were randomly assigned to a second attitude domain and completed the associated IAT and explicit measures, without replacement. Participants were randomly assigned to IAT type using a 3:1 ratio for evaluation:identity. For the purpose of the present study, only participants who completed the implicit measure of exercise self-identity in either the first or second research session were of interest.

There was a substantial amount of missing data in the original AIID study. Only 391 participants completed the identity IAT within the relaxing-exercising category, of which 151 completed the single-item explicit measure of exercise identity. Further, all 151 participants who had complete data for the implicit and explicit identity measures had at least one missing data point for the multi-item scales assessing proximal and distal social norms (i.e.  $n = 0$  with complete data for measures of implicit identity, explicit identity, proximal social norms, and distal social norms;  $n = 61$  with complete data for implicit identity, explicit identity, and one measure of social norms). Employing missing data procedures for multi-item scales (i.e. person-mean imputation for missing data on the multi-item proximal and distal social norms measures), resulted in complete data for all 151 participants.

Given the amount of missing data, there was not sufficient power to conduct the planned analyses using the AIID sample alone. Thus, at least 274 additional cases were needed to achieve sufficient statistical power ( $n = 425$ , power = .90,  $\alpha = .05$ ; see Statistical Analyses section for power analysis details). Participants were recruited online via MTurk and completed a subset of the measures as those in the AIID study. Specifically, only data on the Relaxing/Exercising domain was collected. Participants completed the self-identity IAT, the explicit measure of exercise identity, and measures of proximal and distal descriptive social norms. Demographics were also collected. Participants from MTurk followed a slightly modified protocol, as measures were collected in a single online session with participants also reporting on their actual PA behavior. The PA measure was placed at the end of the survey for the MTurk sample, to avoid impacting responses to any other items. Participants were compensated \$2.00 for their participation.

## Measures

### Demographics

Participants reported their age and sex.

### Implicit exercise identity

An exercise identity IAT was conducted (see Greenwald et al., 2003 for IAT procedure and scoring). Stimuli in the exercise identity IAT from the categories exercising (i.e. Lift Weights, Run, Jump, Workout, Aerobics, and Crosstraining), relaxing (i.e. Sit, Rest, Watch TV, Snooze, Recline, and Lie Down) and from the attributes self (i.e. I, Me, Mine, Myself, and Self), and other (i.e. Other, They, Them, Their, and Theirs) were presented to participants in seven blocks of trials (Greenwald et al., 2003; Hussey et al., 2018). First, participants completed two practice blocks where the stimuli from the categories ‘exercise’ and ‘relaxing’ were presented separately from the stimuli from the attributes ‘self’ and ‘other’. The categories and attributes were then presented together forming a congruent experimental block that was separated into a practice trial and an experimental trial (i.e. ‘exercise’ and ‘self’ categories were paired on one side of the screen with ‘relaxing’ and ‘other’ categories paired on the other side of the screen). Participants categorized the exercise identity IAT stimuli as belonging to either the exercise/self categories or relaxing/other categories.



Next, the fifth block was presented, which was a practice block where the categories were reversed and presented without the attributes. Finally, the reversed categories were paired with the attributes to form the incongruent experimental block composed of a practice and experimental trial (i.e. 'exercise' and 'other' categories were paired as were 'relaxing' and 'self' categories). Participants categorized the exercise identity IAT stimuli as belonging to either the exercise/other categories or relaxing/self categories. Participants were randomly assigned to receive either the congruent or incongruent block first.

### **Explicit exercise identity**

Explicit exercise identity was measured using a single-item from the AIID study: 'How much is exercise part of your self-concept?'. Response options were rated from 1 = 'Not at all' to 6 = 'Very Much'.

### **Proximal and distal descriptive social norms**

Proximal descriptive social norms were measured using three items from the AIID Study: 'Do your friends tend to prefer exercising or relaxing?', 'Do your family members tend to prefer exercising or relaxing?', and 'Do people you know tend to prefer exercising or relaxing?'. Distal descriptive norms were measured using three items from the AIID study (Hussey et al., 2018): 'Does the average person prefer exercising or relaxing?', 'Does the culture you live in prefer exercising or relaxing?', and 'Do most people prefer exercising or relaxing?'. Response options for proximal and distal descriptive norms were rated from 1 = 'Strongly Prefer Relaxing to Exercising' to 7 = 'Strongly Prefer Exercising to Relaxing'.

### **Physical activity**

Moderate and vigorous PA engagement was assessed using four items from the International Physical Activity Questionnaire - Short Form (Craig et al., 2003), which assessed the number of days and minutes per day in the past week of moderate and vigorous activity. A composite measure of total weekly minutes of moderate and vigorous PA engagement was computed. Specifically, hours of moderate and vigorous PA per day were converted into minutes and summed with minutes of moderate and vigorous PA, respectively. Total number of minutes per day of moderate and vigorous PA was multiplied by the number of days per week individuals engaged in moderate and vigorous physical activities, respectively. Total average moderate and vigorous PA per week were then summed to create the final measure of total average minutes of moderate and vigorous PA (MVPA) per week. These additional PA measures were located at the end of the MTurk survey to avoid affecting responses to the measures replicated from the AIID sample.

### **Statistical analyses**

A power analysis was conducted to determine whether the number of participants in the AIID study (i.e.  $n = 0$  with complete data on all measures;  $n = 29$  with complete data on implicit and explicit identity measures, and proximal social norms measure;  $n = 32$  with complete data on implicit and explicit identity measures, and distal social norms measure;  $n = 151$  after using person-mean imputation for missing cases) would be

sufficient to detect an incremental difference in  $R^2$  (power = .90,  $\alpha$  = .05). The relation between descriptive norms and implicit identity has yet to be tested in the literature. Therefore, power was estimated using a small effect size ( $f^2$  = .03) with two tested predictors (i.e. proximal and distal descriptive norms) to be conservative. Results revealed that the AIID sample would not be sufficiently powered as at least 425 participants were needed.

## Results

### Preliminary analyses

It was planned to use sample mean imputation to address missing data within the proximal and distal descriptive norm measures. However, this method of imputation is not recommended for variables that have a substantial amount of missing data (i.e. > 5%; Tabachnick & Fidell, 2007). As such, person-mean imputation was used instead given that many participants had at least partial data on the proximal and descriptive social norm measures. Within the AIID sample, 122 and 119 cases had at least one missing value for the proximal and distal social descriptive norm items, respectively, which were imputed. There were no missing data on the descriptive norm measures in the MTurk sample. Only cases that had complete data for the variables of interest (i.e. after imputation for multi-item scales) were included for analysis. The total sample size was  $n = 430$  (AIID:  $n = 151$ ; MTurk:  $n = 279$ ) with complete data on all four measures of interest (i.e. implicit and explicit exercise identity as well as proximal and distal descriptive social norms).

IAT trials were scored in the AIID dataset according to the Greenwald et al. (2003) improved scoring algorithm. Thus, participants who completed greater than 10% of their individual trials in under 300 ms were removed from all analyses. Additionally, any single trials that took longer than 10,000ms were removed from the calculation of IAT scores. On trials where participants incorrectly classified stimuli, reaction time was specified as the individual's block mean + 600 ms. Participant's implicit exercise identity score was calculated by subtracting the mean of Block 6 from the mean of Block 3 and by subtracting the mean of Block 7 from the mean of Block 4. Resulting values were divided by the pooled standard deviation from the respective blocks. The average of the two resulting values was taken with higher scores being indicative of a stronger implicit exercise identity. The MTurk sample IAT trials were scored using the same criteria via Iatgen software (Carpenter et al., 2019).

Two ordinary least squares regression analyses with proximal and distal descriptive social norms regarding exercise predicting (1) implicit exercise identity and (2) explicit exercise identity were conducted. Before such analyses, the data was assessed for multivariate outliers for each analysis (i.e. cases with Mahalanobis distances greater than the critical value of  $X^2(2) = 13.28$  at  $p < .001$ ). Tests of multivariate outliers were conducted within the sample as a whole and within the individual AIID and supplemental MTurk samples individually. Two multivariate outliers were identified within the sample as a whole and one multivariate outlier was identified within the MTurk sample. Multivariate outliers were removed one at a time, and no

other multivariate outliers were identified after re-running the analyses once these outliers were removed. No multivariate outliers were found within the AIID subsample. Primary tests of the hypotheses were conducted with and without the inclusion of multivariate outliers and results did not differ in direction or significance (Steege et al., 2016). Therefore, results are reported with the multivariate outliers included.

Harman's Single Factor Test was used to assess the potential impact of common method variance on the relationship between explicit exercise identity and explicitly measured societal norms (Tehseen et al., 2017). A principal component analysis was used with an unrotated factor solution. The first factor accounted for 50.79% of covariance between explicit identity and societal norms (eigenvalue = 3.56), and factor loadings ranged between .30 and .79. The second factor accounted for 16.54% of covariance between explicit identity and societal norms (eigenvalue = 1.16), and factor loadings ranged between  $-.43$  and  $.44$ . The primary factor accounted for the majority of covariance (i.e.  $> 50\%$ ) between explicit identity, proximal descriptive social norms, and distal descriptive social norms. Therefore, common method variance is a limitation of the present study.

The statistical assumptions of multiple regression in the full sample were tested, as well as in the AIID and supplemental sample individually. No differences were identified between samples on any assumptions. First, the assumption of linearity between the predictor and outcome variables was met based on scatterplots. Second, multicollinearity was examined using variance inflation factor (VIF) and tolerance scores. All VIF scores were  $< 10$ , and all tolerance scores were  $> .2$ , which was indicative of no multicollinearity in the data. Third, the independence of the residuals was tested using a Durbin-Watson test. This assumption was not met as several values were not close to 2 (i.e. below 1). This was indicative of the residuals not being independent in the full sample when predicting explicit exercise identity, in the AIID sample when predicting both implicit and explicit exercise identity, and in the MTurk sample when predicting explicit exercise identity. Results should be interpreted with caution. Fourth, whether the variance of the residuals was constant was tested (i.e. homoscedasticity) using a standardized residual versus standardized predicted values plot. The assumption was met as there were no signs of funneling. Fifth, whether the values of the residuals were normally distributed was assessed using a P-P plot by examining deviations from the diagonal line. No deviations from normality were detected. Finally, whether any cases were influential biasing the model was examined using Cook's Distance values. There were no Cook's Distance values  $> 1$ . Thus, it is unlikely that any case biased the model outcomes.

Descriptive statistics (means and standard deviations) and zero-order correlations are reported for the assessed variables (see [Table 1](#)).

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**Table 1. Descriptive statistics across subsamples and full sample zero-order correlations.** 

	Full Sample	AIID Sample	MTurk Sample	1	2	3	4
1. Implicit Identity							
<i>M</i>	−.09	−.02	−.14				
<i>SD</i>	.46	.48	.44				
<i>N</i>	430	151	279				
2. Explicit Identity				.04			
<i>M</i>	4.33	3.99	4.52				
<i>SD</i>	1.37	1.32	1.37				
<i>N</i>	430	151	279				
3. Proximal Norms				.04	.27**	.82	
<i>M</i>	3.53	3.69	3.45				
<i>SD</i>	1.53	1.40	1.59				
<i>N</i>	430	151	279				
4. Distal Norms				−.04	.30**	.60**	.87
<i>M</i>	3.31	3.39	3.27				
<i>SD</i>	1.48	1.45	1.49				
<i>N</i>	430	151	279				
5. MVPA				.03	.14*	.05	.09
<i>M</i>	184.88	—	184.88				
<i>SD</i>	183.85	—	183.85				
<i>N</i>	273	—	273				

Note. The multivariate outliers remain included. Cronbach's alpha in diagonal for multi-item measures. 

\* $p < .05$ . \*\* $p < .001$ .

### Participant demographics

The sample consisted of 430 participants with a mean age of 35.68 years ( $SD = 12.58$ ) that was 42.6% female. There were 151 cases within the AIID sample with a mean age of 32.22 ( $SD = 13.25$ ) and 53.60% that were female. Within the MTurk sample, there were 279 cases with a mean age of 37.41 ( $SD = 11.89$ ) and 36.6% that were female.

### Primary tests of hypotheses

**Full sample**

Social norms did not significantly account for variance in implicit exercise identity,  $R^2 = .01$ ,  $F(2, 427) = 1.69$ ,  $p = .19$ . Proximal social norms regarding exercise did not significantly predict implicit exercise identity,  $\beta = .10$ ,  $t(428) = 1.73$ ,  $p = .08$ , 95% CI [-.004, .06]. Distal social norms regarding exercise did not significantly predict implicit exercise,  $\beta = -.08$ ,  $t(428) = -1.40$ ,  $p = .16$ , 95% CI [-.06, .01]. Effect sizes of proximal and distal descriptive social norms predicting implicit exercise identity differed in direction but were similar in magnitude (i.e. small) within the sample. Social norms significantly accounted for 4.8% of variance in explicit exercise identity,  $R^2 = .05$ ,  $F(2, 427) = 10.81$ ,  $p < .001$ . Specifically, stronger proximal social norms regarding exercise predicted stronger explicit exercise identity,  $\beta = .15$ ,  $t(428) = 2.76$ ,  $p = .01$ , 95% CI [.04, .23]. In contrast, distal social norms regarding exercise did not predict explicit exercise identity,  $\beta = .10$ ,  $t(428) = 1.85$ ,  $p = .07$ , 95% CI [-.01, .19]. Effect sizes of proximal and distal descriptive social norms predicting explicit exercise identity were similar in magnitude (i.e. small) and direction within the sample (see [Table 2](#) for regression results).

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**Table 2. Full sample, AIID, and MTurk subsamples regression results. +**

	Implicit Exercise Identity	Explicit Exercise Identity
Full Sample	$R^2 = .01$ , $F(2, 427) = 1.69$ , $p = .19$	$R^2 = .05$ , $F(2, 427) = 10.81$ , $p < .001$
Proximal Norms	$\beta = .10$ , $t(428) = 1.73$ , $p = .08$	$\beta = .15$ , $t(428) = 2.76$ , $p = .01$
Distal Norms	$\beta = -.08$ , $t(428) = -1.40$ , $p = .16$	$\beta = .10$ , $t(428) = 1.85$ , $p = .07$
AIID Sample	$R^2 = .01$ , $F(2, 148) = .57$ , $p = .57$	$R^2 = .02$ , $F(2, 148) = 1.70$ , $p = .19$
Proximal Norms	$\beta = .11$ , $t(149) = .93$ , $p = .32$	$\beta = .16$ , $t(149) = 1.78$ , $p = .08$
Distal Norms	$\beta = -.07$ , $t(149) = -.75$ , $p = .46$	$\beta = -.10$ , $t(149) = -1.15$ , $p = .25$
MTurk Sample	$R^2 = .01$ , $F(2, 276) = .91$ , $p = .40$	$R^2 = .10$ , $F(2, 276) = 15.96$ , $p < .001$
Proximal Norms	$\beta = .09$ , $t(277) = 1.22$ , $p = .23$	$\beta = .15$ , $t(277) = 2.15$ , $p = .03$
Distal Norms	$\beta = -.08$ , $t(277) = -1.16$ , $p = .25$	$\beta = .22$ , $t(277) = 3.18$ , $p = .002$

No table footnotes are available

Whether regression coefficients significantly differed for social norms predicting implicit versus explicit exercise identity was also explored. The slopes for implicit and explicit identity did not differ when predicted by proximal social norms,  $Z = -1.04$ ,  $p = .30$ . When predicted by distal norms, the slope for explicit (vs. implicit) identity was greater,  $Z = -3.33$ ,  $p = .001$ . These results suggest that the slopes for implicit and explicit exercise identity in relation to distal descriptive social norms are significantly different from each other. However, each of these slopes were not significantly different from zero. Thus, these results should be interpreted with caution.

### **AHD sample**

Social norms did not predict implicit exercise identity,  $R^2 = .01$ ,  $F(2, 148) = .57$ ,  $p = .57$ . Similarly, proximal social norms regarding exercise did not predict implicit exercise identity,  $\beta = .11$ ,  $t(149) = .93$ ,  $p = .32$ , 95% CI [-.03, .90]. Additionally, distal social norms regarding exercise did not predict implicit exercise,  $\beta = -.07$ ,  $t(149) = -.75$ ,  $p = .46$ , 95% CI [-.08, .04]. Effect sizes of proximal and distal descriptive social norms predicting implicit exercise identity differed in direction but were similar in magnitude (i.e. small) within this subsample. Social norms did not predict explicit exercise identity,  $R^2 = .02$ ,  $F(2, 148) = 1.70$ ,  $p = .19$ . Proximal social norms regarding exercise did not predict explicit exercise identity,  $\beta = .16$ ,  $t(149) = 1.78$ ,  $p = .08$ , 95% CI [-.02, .31]. Similarly, distal social norms regarding exercise did not predict implicit exercise,  $\beta = -.10$ ,  $t(149) = -1.15$ ,  $p = .25$ , 95% CI [-.25, .07]. Effect sizes of proximal and distal descriptive social norms predicting explicit exercise identity differed in direction but were similar in magnitude (i.e. small).

Differences between slopes for social norms predicting implicit versus explicit exercise identity were assessed. No differences were found between implicit and explicit identity when predicting proximal social norms,  $Z = -.57$ ,  $p = .57$ . Similarly, the slopes for implicit and explicit identity did not differ significantly when predicted by distal social norms,  $Z = .35$ ,  $p = .73$ .

### **Supplemental MTurk sample**

Social norms did not predict implicit exercise identity,  $R^2 = .01$ ,  $F(2, 276) = .91$ ,  $p = .40$ , nor did proximal social norms regarding exercise predict implicit exercise identity,  $\beta = .09$ ,  $t(277) = 1.22$ ,  $p = .23$ , 95% CI [-.02, .06]. Distal social norms regarding exercise also did not predict implicit exercise,  $\beta = -.08$ ,  $t(277) = -1.16$ ,  $p = .25$ , 95% CI [-.07, .02]. Effect sizes of proximal and distal descriptive social norms predicting

implicit exercise identity differed in direction but were similar in magnitude (i.e. small) within this subsample. In contrast, social norms regarding exercise significantly accounted for 10.4% of variance in explicit exercise identity,  $R^2 = .10$ ,  $F(2, 276) = 15.96$ ,  $p < .001$ . Stronger proximal social norms regarding exercise significantly predicted stronger explicit exercise identity,  $\beta = .15$ ,  $t(277) = 2.15$ ,  $p = .03$ , 95% CI [.01, .24]. Similarly, stronger distal social norms regarding exercise significantly predicted stronger explicit exercise identity,  $\beta = .22$ ,  $t(277) = 3.18$ ,  $p = .002$ , 95% CI [.08, .32]. Effect sizes of proximal and distal descriptive social norms predicting implicit exercise identity were similar in magnitude (i.e. small) and direction within this sample.

Whether slopes significantly differed for social norms predicting implicit versus explicit exercise identity was also explored. The slopes did not differ when predicted by proximal social norms,  $Z = -.95$ ,  $p = .34$ . Similarly, the slopes for implicit and explicit identity did not significantly differ when predicted by distal social norms,  $Z = -1.08$ ,  $p = .28$ .

### **Exploratory analyses**

A limitation of the AIID sample is that there were no measures of actual PA engagement, which meant that the relationships between descriptive social norms, exercise identity, and PA engagement could not be assessed. Therefore, measures of PA engagement were collected in the supplemental sample as pilot data. Whether PA was related to proximal and distal descriptive social norms regarding exercise, and to implicit and explicit exercise identity was assessed. Six cases were removed from the analysis due to participant reporting error (e.g. reporting impossible values for PA engagement, such as engaging in PA more than seven days per week or 24 h per day). One multivariate outlier was found in the regression model predicting weekly MVPA from four predictor variables: proximal and distal descriptive social norms regarding exercise, implicit and explicit exercise identity (critical value  $X^2(4) = 18.47$ ). No other multivariate outliers were identified after this outlier was removed. Ordinary least squares regression was used to assess whether measures of interest predicted moderate and vigorous PA.

### **Multivariate outliers excluded**

A model predicting moderate and vigorous PA was significant,  $R^2 = .02$ ,  $F(2,267) = 6.27$ ,  $p < .001$ . Stronger explicit exercise identity predicted higher levels of MVPA engagement,  $\beta = .22$ ,  $t(268) = 3.50$ ,  $p = .01$ , 95% CI [11.61, 41.12], as did stronger proximal descriptive social norms,  $\beta = .18$ ,  $t(268) = 2.44$ ,  $p = .02$ , 95% CI [3.54, 33.33]. However, implicit exercise identity,  $\beta = .08$ ,  $t(268) = 1.37$ ,  $p = .17$ , 95% CI [-13.26, 74.31], and distal descriptive social norms,  $\beta = -.10$ ,  $t(268) = -1.40$ ,  $p = .16$ , 95% CI [-27.15, 4.63], were not significant predictors of MVPA engagement.

### **Multivariate outliers included**

A model predicting MVPA was significant,  $R^2 = .07$ ,  $F(4, 268) = 4.99$ ,  $p = .001$ . Stronger explicit exercise identity predicted higher levels of MVPA engagement,  $\beta = .22$ ,  $t(269) = 3.54$ ,  $p < .001$ , 95% CI [12.91, 45.80]. However, implicit exercise identity,  $\beta = .08$ ,  $t(269) = 1.27$ ,  $p = .20$ , 95% CI [-17.17, 80.13], proximal descriptive social norms,  $\beta = .05$ ,  $t(269) = .65$ ,  $p = .52$ , 95% CI [-10.85, 21.47], and distal descriptive social norms,  $\beta = .03$ ,  $t(269) = .39$ ,  $p = .70$ , 95% CI [-13.77, 20.62], did not predict MVPA.

Taken together, explicit exercise identity was a significant predictor of weekly MVPA in 100% of multiverse analyses, and proximal descriptive social norms was a significant predictor of MVPA in 50% of multiverse analyses. Implicit exercise identity and distal descriptive social norms were significant predictors of MVPA in 0% of multiverse analyses.

## Discussion

This study assessed whether proximal and distal descriptive social norms were associated with explicit and implicit exercise identities, using the sample as a whole as well as subsamples (i.e. AIID and MTurk). Results varied across each of these samples. It is important to note that only the full sample was large enough to meet *a priori* power calculations. Thus, conclusions drawn from subsample analyses should be interpreted with caution.

Across all samples, implicit exercise identity was not associated with proximal or distal descriptive social norms. Only proximal descriptive social norms were associated with explicit exercise identity in the full sample. Both proximal and distal descriptive social norms were positively associated with explicit exercise identity in the MTurk sample, and neither proximal nor distal descriptive social norms were associated with explicit exercise identity in the AIID subsample. These results suggest that proximal social-descriptive norms regarding exercise are positively related to explicit, but not implicit exercise identities. It is important to note that all effect sizes were small within each of the analyses, regardless of significance level.

The second hypothesis was non-directional and explored whether proximal or distal descriptive social norms would be more strongly associated with implicit and explicit exercise identities. In the sample as a whole, the slopes for explicit exercise identity and implicit exercise identity significantly differed when associated with distal descriptive social norms. These slopes were similar in magnitude but appeared to differ in direction (i.e. explicit identity = .10, implicit identity = -.08). However, neither the slopes for implicit nor explicit identity significantly differed from zero. Thus, the difference between these slopes must be interpreted with caution. Explicit (vs. implicit) exercise identity was slightly more strongly associated with distal descriptive norms. However, it is important to note that both of these relationships were relatively weak. This was the only significant finding across all samples for this hypothesis. These results suggest that implicit identity may be similarly related to proximal and distal descriptive social norms, but distal norms had a slightly stronger association with explicit (vs. implicit) exercise identity. It may be beneficial to include distal descriptive norms in future intervention development. For example, by including an education section about behavioral



engagement in people who are of similar age to the participant or of the same gender-identity (i.e. distal) or by having participants brainstorm how the target identity fits within their broader pre-existing identities affiliated with their peer networks (e.g. friend, student, daughter or son), to reduce potential conflict (i.e. proximal). It should be noted that distal social norms were not associated with either explicit or implicit exercise identity in the first hypothesis—this finding only suggests that distal norms may have been differently associated with explicit exercise identity as compared to implicit identity.

It is possible that measures of implicit exercise identity may tap into different aspects than explicit measures. Distal descriptive social norms may only predict the unique aspects of exercise identity that are assessed when identity is measured explicitly. It is also possible that socially desirable responding on the self-report measures inflated the relationship between proximal descriptive social norms and explicit exercise identity. If the true relationship between proximal descriptive social norms and exercise identity is weak, this may be accurately reflected through the implicit measure given that implicit measures rely on reaction time responses and are consequently are thought to be less susceptible to socially desirable responding (Nosek et al., 2007; Nosek & Smyth, 2007).

Only proximal descriptive social norms were associated with explicit identity in the full sample. Therefore, proximal (vs. distal) descriptive social norms may be more important predictors of identity. Individuals tend to have more accurate representations of proximal social referent groups (e.g. peers, friends, family) than distal referent groups (e.g. a typical person, people in your culture; Halim et al., 2012). As such, individuals may be more accurate at estimating proximal social referents because they may have more direct exposure to behaviors that validate those social norms. Individuals may feel more social pressure toward identifying with a behavior such as exercise if there are stronger proximal (vs. distal) descriptive social norms. In contrast, if an individual believed that exercise engagement was common among people in general (i.e. distal descriptive norm) but not among their peer group (i.e. proximal social norm), they may be less likely to identify as an exerciser given the higher ambiguity of the distal descriptive social norm. The extent to which proximal and distal descriptive social norms influence levels of exercise identity may depend on how much individuals identify with the proximal or distal social group.

Proximal descriptive social norms may yield more opportunities for social support that could indirectly promote exercise identity through higher exercise engagement. For instance, peer groups with stronger social norms toward exercise may discuss exercise tips or share resources that can facilitate exercise engagement (Ball et al., 2010; Okun et al., 2003). Members of these peer groups could have an advantage over others whose peer groups do not have strong descriptive norms regarding exercise because they might not have access to the same level of social support toward exercise. In contrast, while individuals who report strong proximal descriptive social norms regarding exercise may share interactions with their peers that could be facilitative of developing a stronger exercise identity, individuals may not have direct interactions with individuals in distal groups (e.g. perceive a distal descriptive social norm of people in general valuing exercise, but may never encounter someone who embodies that norm). Therefore, there may be fewer

opportunities to reinforce the exercise identity at the distal social norm level, and distal descriptive social norms may be less influential over exercise identity.

Although the effect of exercise-related proximal and distal descriptive social norms on exercise identity was analyzed, the social group context of the norm was not specified. It is possible that the extent to which descriptive social norms influence exercise identity vary by the context of the group to which the social norm pertains. Individuals are constantly navigating various social norms that are context-dependent, and descriptive social norms regarding exercise may be more or less likely to affect one's exercise identity or one's self-identity depending on which social context contains these social norms (Phelan et al., 1991). An aggregate measure of proximal descriptive social norms regarding exercise for peers, family, and people individuals know was used in the present analyses, and it would be valuable in future studies to assess whether descriptive social norms regarding exercise within specific social groups vary in their ability to predict exercise identity. Norms associated with other social categories such as roommates, teammates, significant others, or coworkers, as well as potential cultural differences, should also be assessed to identify the most effective pathway through which to foster exercise identity development.

### **Exploratory analyses**

A limitation of the original AIID sample was that it did not include a measure of actual PA engagement. Thus, preliminary data regarding PA engagement was collected from the MTurk sample to inform whether descriptive social norms and exercise identity are related to actual PA engagement. However, these analyses are exploratory in nature and underpowered. Therefore, they should be interpreted with caution. When multivariate outliers were excluded, a positive relationship between explicit exercise identity and MVPA was found, as well as a relationship between proximal norms and MVPA. No significant relationships were found between implicit exercise identity or distal descriptive social norms and MVPA. When multivariate outliers were included, only explicit exercise identity had a relationship with MVPA. The preliminary relationship between explicit exercise identity and MVPA that persists regardless of outliers is consistent with existing literature, which suggests that individuals who report having stronger exercise identities tend to also report higher MVPA engagement (Anderson & Cychosz, 1994; Cardinal & Cardinal, 1997; West et al., 2011). Proximal descriptive social norms were only significantly related to MVPA when outliers were excluded. However, distal social descriptive norms were not significantly related to MVPA at all. This pattern of results is similar to the previous analyses where exercise identity was only related to proximal descriptive social norms regarding exercise. It is possible that descriptive social norms may have an indirect effect on MVPA engagement through exercise identity. Future studies should evaluate whether exercise identity mediates the relationship between descriptive social norms and MVPA engagement. These findings would be valuable for the development of future interventions that target physical increases in activity engagement.

### **Limitations and future directions**

This study is not without limitations. First, mainly self-reported measures were used. Such measures are subject to errors in reporting and socially desirable responding, which could result in inaccurate data. However, constructs such as exercise identity and descriptive social norms have been reliably assessed through various self-report measures (Anderson & Cychosz, 1994; Yun & Silk, 2011). Further, explicit exercise identity was assessed using a single-item measure. Future studies should consider using a reliable multi-item measure of exercise identity (e.g. Anderson & Cychosz, 1994).

Second, well-known issues exist regarding the use of the IAT, which was used to assess implicit exercise identity. Specifically, individual-level factors such as past experience using IATs and age have been shown to affect IAT results such that individuals who are performing the IAT for the first time or who are older tend to have larger effect sizes concerning IATs, which is independent of actual associations (Nosek et al., 2007). Another cited concern regarding the IAT is the use of difference scores, which are more susceptible to Type I Error (Cafri et al., 2010). Additionally, exercise identity may be an especially difficult construct to measure implicitly as exercise does not have an explicit opposite like other health behaviors (e.g. drinking or drug use and abstinence). That is, the category of ‘relaxing’ is not naturally at odds with exercise engagement outside of a single point in time. Moreover, relaxing or engaging in rest is likely an especially important behavior for exercisers in terms of muscle growth and repair. Other researchers have used the category ‘sedentary’ in lieu of ‘relaxing’ (e.g. Banting et al., 2009). However, this category may not be completely at odds with exercising as an individual could exercise several times per week and be very sedentary outside of this active time. Taken together, these issues are important to consider when interpreting the results regarding implicit exercise identity. Such results may reflect how participants engage with each measure rather than their true levels of exercise identity or perceptions of descriptive social norms. However, these are standard limitations of any participant-reported measure that cannot be avoided unless another type of measure is used (e.g. objective).

Third, this study was cross-sectional and observational. Therefore, no causal relationships can be ascertained. Although it was predicted that social norms may foster exercise identity, it is also possible that holding an exercise identity can shape social norms. It may also be the case that these two constructs co-occur but do not causally influence one another in either direction. Thus, an experimental study would be required to identify whether causal relationships exist between descriptive social norms and exercise identity. Further, it is possible that the nature of the relationship between descriptive social norms and exercise identity changes over time. Specifically, as exercise identities change (i.e. strengthen or weaken), the social groups with which individuals spend the most time may also shift in an effort toward establishing greater congruence between the self and one’s social contexts. As such, the linear analyses included may not have captured other potential versions of the relationship between exercise identity and descriptive social norms, especially as these dynamic system may evolve over time.

Fourth, the MTurk sample was collected during the COVID-19 pandemic, whereas data collection for the AIID sample was complete prior to the pandemic. As such, cohort effects spurred by the pandemic may

have resulted in systematic changes to exercise identity and descriptive social norms regarding exercise, which may be one reason why the subsample differed significantly on measures of explicit exercise identity and proximal descriptive social norms. Future research should consider how the COVID-19 pandemic and associated disease mitigation efforts may have affected descriptive social norms regarding exercise, exercise identity, and PA engagement among individuals. Future studies should also incorporate objective measures of PA engagement to obtain more accurate data regarding PA.

Fifth, the use of they/them pronouns are becoming increasingly common as singular, rather than plural, pronouns. As such, individuals may view they/them pronouns as pronouns that represent one's own self rather than referring to someone else. Consequently, the use of they/them in IATs as a measure of associating the target with 'others' rather than 'self' could be problematic. Gender identity was not assessed, which is a limitation. Future studies using a self-other IAT should assess gender identity and be mindful of the potential issues with using they/them to indicate association with 'other' rather than 'self'.

## **Conclusion**

The present study investigated the relationship between implicit and explicit exercise identity, proximal and distal descriptive social norms, and PA engagement. Results suggest a relationship may exist between explicit exercise identity, proximal descriptive social norms, and PA engagement. These findings could be useful to further our understanding in how social contexts can facilitate (or potentially inhibit) engagement in target behaviors such as PA, and inform future development of interventions that potentially target exercise identity and social norms to facilitate PA initiation and maintenance.

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No potential conflict of interest was reported by the author(s).

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## Data availability statement


The original data that support the findings of this study (i.e. MTurk sample, but not the AIID sample) are available from the corresponding author, upon reasonable request.


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**Note:** this Edit/html view does not display references as per your journal style. There is no need to correct this. The content is correct and it will be converted to your journal style in the published version.


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