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Self-Reported and Automatic Cognitions are Associated with Exercise Behavior in Cancer Survivors

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Abstract

Objective—Physical activity is beneficial for cancer survivors but exercise participation is low in this population. It is therefore important to understand the psychological factors underlying exercise uptake so that more effective interventions can be developed. Social cognitive theory constructs such as outcome expectancies predict exercise behavior but self-report measures have several limitations. We examined the associations between implicit (automatic) cognitions and exercise behavior and self-efficacy in endometrial cancer survivors.

Methods—This was a longitudinal study to examine predictors of exercise behavior in female endometrial cancer survivors who all received an exercise intervention. Participants (N=100, mean age=57.0) completed questionnaires to assess “self-report” exercise-related measures (outcome expectancy, attitudes and identification with exercise) as well as reaction time tasks to assess “implicit” exercise cognitions (expectancy accessibility, implicit attitudes and implicit self-identification with exercise) at baseline and at 2, 4 and 6 months follow-up. Exercise behavior was measured using accelerometers and self-report. Data were analyzed using linear mixed models.

Results—Expectancy accessibility was associated with exercise duration independent of the corresponding self-report measure. Exercise implicit attitudes and self-identification were

prospectively associated with exercise self-efficacy only after adjustment for the corresponding self-report measures and baseline self-efficacy. Self-report measures were also associated with study outcomes.

Conclusions—Both self-reported cognitions and implicit cognitions may be useful to identify individuals at risk of failing to exercise. Individuals so identified might be provided with a different or more intensive intervention. The data also suggest cognitive targets for intervention.

Regular physical activity (PA) is associated with physical and mental health benefits in many populations including cancer survivors (Je, Jeon, Giovannucci, & Meyerhardt, 2013). Evidence indicates that poor PA uptake is a risk factor for endometrial cancer incidence (Gierach et al., 2009). Moreover, in endometrial cancer survivors, PA is generally low and may further decline after diagnosis (Blanchard, Courneya, & Stein, 2008) possibly worsening health-related functioning. Theory-based research aimed at understanding and increasing PA in this population is needed.

Social cognitive theory (SCT; Bandura, 1986) constructs self-efficacy and outcome expectancies are predictors of PA uptake in survivors of endometrial and breast cancer (Basen-Engquist et al., 2013; Pinto, Rabin, & Dunsiger, 2009). Expectancies are usually measured by self-report measures that tap explicit, conscious awareness and reflective thought processes. However, it has been argued that automatic or implicit cognitive processes must also be examined to understand health behaviors (Marteau, Hollands, & Fletcher, 2012; Neal, Wood, & Quinn, 2006). Few studies have examined associations between implicit exercise cognitions and PA behavior (Banting, Dimmock, & Grove, 2011; Bluemke, Brand, Schweizer, & Kahlert, 2010; Calitri, Lowe, Eves, & Bennett, 2009) and only one has used a population of cancer survivors. In a pilot study of endometrial cancer survivors, implicit positive outcomes expectancies were associated with objective PA levels during the following week (Perkins, Waters, Baum, & Basen-Engquist, 2009). Examining whether implicit or automatic cognitions predict PA uptake and maintenance is clinically relevant because these cognitions may be amenable to change through appropriate interventions.

This study examined associations between implicit exercise cognitions measured using reaction time tests and a) exercise self-efficacy (ESE) and b) daily minutes of exercise (MoE) in endometrial cancer survivors. ESE was used as an outcome because it has been treated as such in previous studies (e.g., Rogers, McAuley, Courneya, & Verhulst, 2008), because of its strong association with exercise behavior (e.g., Pinto et al., 2009; Basen-Engquist et al., 2013), because ESE can mediate the effect of outcome expectancies on PA (Basen-Engquist et al., 2013), and because ESE is often considered a mediator of the effect of interventions on exercise behavior (e.g., Lewis, Marcus, Pate, & Dunn, 2002). Self-reported cognitions were also assessed to provide comparative data, and to permit a test of whether implicit exercise cognitions predicted outcomes when controlling for the corresponding self-report measure.

Methods

Participants

Women (N=100) previously diagnosed with endometrial cancer (stage I, II or IIIa) were recruited from the Oncology Center and satellite clinics of the University of Texas M. D. Anderson Cancer Center and from a private gynecologic oncology clinic in Houston, TX. Inclusion criteria were: being at least six months post-treatment and disease free, and not meeting the recommended level of PA (PA of moderate/greater intensity on at least 5d/w for 30 min, or vigorous intensity PA for 20 min on at least 3 d/w, and having maintained such level for 6 months) (Chodzko-Zajko et al., 2009). The study was approved by the Institutional Research Board of UT M. D. Anderson Cancer Center.

Design

The parent study was a six-month longitudinal study examining SCT predictors of PA uptake in endometrial cancer survivors receiving a PA intervention (Basen-Engquist et al., 2013). Participants attended laboratory sessions at baseline, two, four and six-months, and also completed five days of ecological momentary assessment (EMA) before each laboratory visit and five days of EMA after each laboratory visit using a Hewlett-Packard iPAQ RX1950. The intervention was a home-based exercise program based on recommendations adapted from the American College of Sports Medicine guidelines (see supplement).

Measures

Outcome Variables—Exercise Self-Efficacy (ESE) was assessed using a 18-item questionnaire (McAuley et al., 1999) measuring participant's confidence in carrying out PAs of graded intensity using the stem item "How confident I am that I can (e.g., walk briskly for a hour without stopping?). Ratings range from 1 to 5; higher scores reflect greater confidence in one's ability to complete an exercise task.

Minutes of exercise (MoE) was assessed using a composite measure derived from three data sources as described in Basen-Engquist et al., 2013: I) an accelerometer device, II) self-report exercise minutes recorded after each exercise activity during EMA, III) exercise minutes recorded at the end of each day (see supplement).

Self-report Predictor Variables—Outcome expectancies (OE) were assessed using an adapted scale that measures decisional balance (positive and negative expectancies) in exercise behavior (Basen-Engquist et al., 2006). Participants were asked how likely it would be that each statement in the scale would happen if they exercised regularly with responses anchored at 1 (not likely) and 5 (extremely likely); higher scores represent greater positive, or negative, exercise outcome expectations. Thus, this OE measure was not a measure of importance/value but of expectancy/likelihood (see supplement).

Attitude to exercise (AE) was assessed using a set of five semantic differential items. Each 7-point item (−3 to +3 scale) consisted of polar-opposite adjective pairs (e.g., good-bad, pleasant-unpleasant). Participants gave ratings for the concept of exercise; composite scores were calculated by averaging the ratings. The AE measure assessed affective attitudes as

described by Ajzen (1991) because items deal with emotional judgments (e.g., good vs. bad) rather than costs and benefits (e.g., healthy vs. unhealthy).

Self-Identification with exercise (IE) was assessed using the single item: “Please rate below how much you see yourself as a person who exercises”. Responses ranged from 1 to 7 with a higher score reflecting greater self-identification as an exerciser.

Implicit Predictor Variables (see on-line supplement)—*Expectancy Accessibility (EA)* was measured using an expectancy accessibility task administered on a desktop computer as described in detail elsewhere (Waters et al., 2012).

Implicit Attitude to Exercise (IAT-v) was assessed using the Implicit Association Test (Fazio & Olson, 2003). The IAT effect was scored as a D score, and a more positive D score reflects a more positive implicit attitude.

Implicit Self-Identification with Exercise (IAT-si) was assessed in a similar way to the IAT-v except that the concepts (words) used in the IAT-v were changed. For the IAT-si, a more positive D score reflects a stronger implicit self-identification with exercise.

Procedure

Eligible participants completed paper and pencil questionnaires at the orientation visit. They were subsequently equipped with the Actigraph and asked to wear it for seven days prior to their baseline laboratory visit. At all laboratory visits, the cognition tasks and exercise questionnaires were administered before and after a cycle ergometer fitness test implemented on a stationary bike (Monark 839e) to index cardiorespiratory fitness. Consistent with procedures in a previous analysis (Basen-Engquist et al., 2013), a mean score (i.e., mean of pre- and post- scores at each timepoint) was used. Order of completion of implicit and self-report assessments was counterbalanced across participants.

Data Reduction and Analytic Plan

Linear mixed models (LMM) were used for the primary analyses using SAS PROC MIXED ($\alpha=.05$, 2-tailed tests). Laboratory assessments were the units of analysis and were defined as: T0 (baseline), T1 (+2 months), T2 (+4 months), and T3 (+6 months). For all models a random (subject-specific) intercept and an autoregressive model of order 1 for the residuals within subjects was employed. Assessment timepoint was entered as a categorical variable in all models. Parameter estimates from LMMs are reported as $B \pm 1$ SE. The “self-report” independent variables (IVs) were: OE, AE, and IE. The “implicit” IVs were: EA, IAT-v, and IAT-si. The dependent variables (DVs) were ESE and MoE. First, LMMs examined associations between predictor variables measured at baseline with study outcomes assessed at subsequent timepoints (i.e., not including baseline). Second, assessment-level LMMs were conducted that examined associations between predictor variables and DVs using all available datapoints. In assessment-level analyses, a “Mean IV” score was computed by aggregating over all assessments for each subject (between-subjects effect), and a “Deviation IV” score was computed as the difference between the IV score at each assessment and the subject’s own “Mean IV” score (within-subjects effect) (see supplement) (Hedeker, Mermelstein, Berbaum, & Campbell, 2009). Analyses are presented unadjusted and adjusted

for type of measure (self-report or implicit). For baseline analyses, the baseline value of the DV was also included in the model. Effect sizes are reported as r values (Kashdan & Steger, 2006).

Results

Sociodemographic and clinical descriptive characteristic of the study sample are presented in Basen-Engquist et al., 2013 as well as Table 1. Summary statistics for the study IVs and DVs are presented in Table 2.

Expectancies

Baseline EA was not associated with subsequent ESE, but was significantly associated with subsequent MoE in unadjusted analyses and in analyses that adjusted for the corresponding self-report OE measure (Table 3). Adjusting for baseline MoE rendered the association marginally significant ($p=.07$). Baseline OE was associated with ESE in unadjusted and EA-adjusted analyses. However, controlling for baseline ESE rendered the association non-significant ($p=.26$). No association emerged between OE and MoE.

Mean EA was associated with ESE only in unadjusted analysis, but was associated with MoE in unadjusted and adjusted analyses. No significant associations between Deviation EA and study outcomes emerged. Mean OE was associated with ESE in both unadjusted and adjusted analyses. Mean OE was also associated with MoE but this association did not survive adjustment for EA ($p=.29$). Deviation OE was also associated with ESE in unadjusted and adjusted analyses but was not associated with MoE.

Attitudes

Baseline IAT-v was associated with subsequent ESE only in the fully adjusted model ($p=.05$), whereas no associations emerged between baseline IAT-v and MoE (Table 4A). Baseline AE was associated with subsequent ESE in the unadjusted model and when controlling for the corresponding IAT-v but this association did not survive adjustment for baseline ESE. No association was observed between Baseline AE and MoE.

Mean IAT-v and Deviation IAT-v were not associated with study outcomes. However, Mean AE was associated with ESE and MoE in both unadjusted and adjusted models. Deviation AE was associated with ESE in unadjusted analysis only, and there was no significant association between Deviation AE and MoE.

Self-Identification

Baseline IAT-si was associated with subsequent ESE in the fully adjusted model ($p=.05$), but there was no significant association with MoE (Table 4B). Likewise, no association emerged between baseline IE and subsequent MoE.

There was no significant association between Mean IAT-si or Deviation IAT-si and study outcomes. However, Mean IE and Deviation IE were associated with both ESE and MoE in unadjusted and adjusted analyses.

Overall, the associations reported above ranged from small to small-to-moderate magnitude for implicit measures but extended to moderate-to-large magnitude for self-report measures (Tables 3, 4a, 4b).

Discussion

Overall, this study found that both self-report and implicit measures were associated with ESE and MoE. However, the pattern of associations was somewhat complex and differed between the two measures types.

Baseline EA was prospectively associated with MoE independent of the self-report measure (OE) indicating that the more readily the positive outcomes of exercise come to mind, the greater the exercise duration two- to six- months later. The prospective association between EA and MoE was reduced to marginal significance when baseline MoE was added to the model. In assessment level analyses, EA was also associated with MoE indicating that individuals whose positive exercise cognitions were generally more readily accessible exercised for longer compared to individuals whose cognitions were less readily accessible. This was only partially true for ESE as adjustment for self-report OE rendered the association non-significant. However, OE was associated with ESE after controlling for the EA but not with MoE.

Taken together, the self-reported outcome expectancy measure appears to be more strongly associated with exercise self-efficacy than expectancy accessibility, but expectancy accessibility appears to be more strongly associated with actual exercise behavior than self-reported expectancy. This interesting finding may suggest that this implicit measure may perform better at predicting exercise behavior rather than exercise self-efficacy.

In contrast to the between-subject associations noted above, the study did not reveal a within-subject association between EA and study outcomes indicating that when an individual exhibited greater EA (compared to his/her mean) at any time point, his or her actual ESE or MoE was not greater at that timepoint. The accessibility task may be less sensitive to within-subject changes over time. In addition, the lag between assessment of EA (in the lab) and exercise (5 days before and after lab) may have made it more difficult to find associations.

Implicit exercise attitudes and self-identification were generally not strongly associated with study outcomes. These implicit measures assessed at baseline were associated with subsequent ESE in the fully adjusted model only. Self-report exercise attitudes performed better as shown by significant between- and within-subject associations with both ESE and MoE. Given that most individuals had positive scores on the IAT, it is possible that the participants who enrolled in the study had generally positive IAT effects with limited variability in these scores making it more difficult to detect associations with outcomes.

Strengths of the study include the longitudinal design and the use of objective and self-report measures of exercise duration and cognitive assessments. Limitations include the small sample size, the modest changes in exercise behavior, and the relatively constrained variability in some predictors. A limitation of the EA measure is that it is a function of

implicit cognition about the control activity as well as exercise. Future research should examine the causal relationships between expectancies and exercise self-efficacy and identify whether the latter reflects primarily motivation to exercise or perceived capability (Williams & Rhodes, 2014).

In sum, self-report and implicit measures can help to identify individuals who may be less likely to exercise. These cognitions could provide a specific target for intervention to reduce barriers to physical activity and improve health outcomes in at-risk populations.

Interventions that target automatic processes may lead to individuals behaving in healthier ways, but no study has examined the effect of targeting implicit attitudes or expectancies on exercise. Nonetheless, relevant experimental work has been carried out using similar constructs. For example, an intervention targeting implicit-age-stereotype attitudes and self-perception of aging led to improvement in physical function (Levy, Pilver, Chung, & Slade, 2014). In the health behaviors field, a cognitive bias modification intervention targeting patients' automatic approach bias reduced relapse rate (vs. untrained group) a year later (Wiers, Eberl, Rinck, Becker, Lindenmeyer, 2011).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics of Study Sample (N=100)

Variable	M (SD) or N
Age (years)	57.0 (11.01)
BMI (kg/m ²)	34.2 (9.4)
Time since diagnosis (months)	26 (14.3)
Education (%)	
Less than high school	2
High school diploma/GED	13
Technical/vocational	8
Some college/2-year degree	35
4-year degree	24
Advanced degree	17
Race (%)	
Black/non-Hispanic	7
White/non-Hispanic	74
Asian/non-Hispanic	5
White/Hispanic	12
American Indian/non-Hispanic	1
Disease stage (%)	
I	79
II	16
IIIa	4
Treatment (%)	
Surgery only	57
Surgery + radiotherapy	41

Note: BMI= body mass index. One participant dropped out immediately after the baseline laboratory assessment. and was dropped from all analyses. Ns do not add up to 100 due to missing data.

Table 2

Summary Statistics of Study Measures

Measure	Variable Type	Measure Type	T-0 Baseline n=99	T-1 2 mo n=80	T-2 4 mo n=75	T-3 6 mo n=79
EA effect (ms)	IV	Implicit	0.15 (0.21)	0.09 (0.19)	0.11 (0.15)	0.06 (0.17)
Positive OE (27 to 75)	IV	Self-Report	57.4 (10.3)	59.4 (9.5)	60.4 (10.9)	61.5 (10.0)
Valence IAT (IAT-v) (D score)	IV	Implicit	1.02 (0.35)	0.98 (0.32)	0.96 (0.29)	0.89 (0.33)
Attitude-AE (-3 to +3)	IV	Self-Report	2.13 (0.90)	2.40 (0.70)	2.54 (0.54)	2.47 (0.68)
Self-identification IAT (IAT-si) (D score)	IV	Implicit	0.74 (0.36)	0.75 (0.37)	0.75 (0.42)	0.76 (0.32)
Identification-IE (1 to 7)	IV	Self-Report	3.44 (1.53)	4.27 (1.35)	4.37 (1.44)	4.54 (1.44)
ESE (1 to 5)	DV	Self-Report	3.20 (0.94)	3.72 (0.90)	3.71 (1.03)	3.80 (1.03)
Exercise (minutes/day)	DV	Composite	16.6 (12.1)	19.2 (13.1)	18.5 (12.9)	17.5 (12.5)

Data show Mean (SD) for study measures at each research assessment visit. Due to missing data, ns vary across measures. EA effect = expectancy accessibility effect is difference of RTs to endorse positive outcomes on exercise and control blocks; more positive scores reflect faster endorsements of positive exercise outcomes (vs. control outcomes); AE= Attitudes about exercise; IE= Identification with exercise; ESE= Exercise self-efficacy; IAT= Implicit Association Test (D scores); more positive scores indicate more positive implicit attitude to exercise (Valence IAT) or more positive implicit self-identification with exercise (Self-identification IAT); OE= outcome expectancy; Composite = composite measure derived from accelerometer, self-report after exercise, and self-report at end of day (see text). Data are mean minutes per day aggregated over the assessment period before the laboratory session and the one-week assessment after the laboratory session.

Table 3

Association between Expectancies and Study Outcomes

Analysis	IVs	Covariates	DVs	
			Exercise Self-Efficacy	Minutes of Exercise
Baseline	Expectancy accessibility (EA)	Unadjusted	0.27 (0.18)	4.07 (1.72) * , r=0.13
		Adjusted OE	0.19 (0.17)	4.17 (1.75) * , r=0.13
		Adjusted OE + Baseline	-0.003 (0.01)	2.67 (1.71)
	Outcome expectancy (OE)	Unadjusted	0.035 (0.01) ** , r=0.29	-0.043 (0.11)
		Adjusted EA	0.030 (0.01) * , r=0.23	-0.05 (0.11)
		Adjusted EA + Baseline	0.009 (0.008)	-0.052 (0.10)
Assessment-Level	Mean Expectancy accessibility (M-EA)	Unadjusted	0.46 (0.19) ** , r=0.17	8.24 (2.17) ** , r=0.18
		Adjusted M-OE	0.30 (0.17)	7.73 (2.25) ** , r=0.16
	Mean Outcome expectancy (M-OE)	Unadjusted	0.043 (0.01) ** , r=0.32	0.20 (0.09) * , r=0.10
		Adjusted M-EA	0.038 (0.01) ** , r=0.31	0.09 (0.10)
	Deviation Expectancy accessibility (D-EA)	Unadjusted	0.18 (0.14)	2.72 (2.66)
		Adjusted D-OE	0.10 (0.13)	2.03 (2.69)
	Deviation Outcome expectancy (D-OE)	Unadjusted	0.047 (0.006) ** , r=0.45	0.06 (0.10)
		Adjusted D-EA	0.040 (0.007) ** , r=0.40	0.19 (0.14)

Note: EA= Expectancy accessibility; OE= Outcome expectancy. Data are parameter estimates B (1 SE) from linear mixed models; r values are effect sizes computed by converting t values to r values (Kashdan and Steger, 2006). Mean and Deviation scores are entered concurrently in models (see text). Baseline = baseline ESE/Minutes of Exercise. (Parameter estimates for covariates not shown). Inclusion of endorsement rate for EA outcomes as covariates did not change any outcomes

*
p < .05,

**
p < .01

Table 4A

Associations between Attitudes and Study Outcomes

Analysis	IVs	Covariates	DVs	
			Exercise Self-Efficacy	Minutes of Exercise
Baseline	IAT-valence (IAT-v)	Unadjusted	−0.01 (0.29)	−4.49 (2.86)
		Adjusted AE	0.00 (0.28)	−4.45 (2.88)
		Adjusted AE + Baseline	0.40 (0.20) * , r=0.17	−3.20 (2.71)
	Attitude exercise (AE)	Unadjusted	0.32 (0.11) ** , r=0.22	1.07 (1.16)
		Adjusted IAT-v	0.29 (0.12) * , r=0.21	0.57 (1.23)
		Adjusted IAT-v + Baseline	−0.003 (0.09)	0.06 (1.13)
Assessment-Level	Mean IAT-valence (M-IAT-v)	Unadjusted	0.10 (0.30)	−1.19 (3.09)
		Adjusted M-AE	−0.15 (0.27)	−2.32 (3.13)
	Mean Attitude exercise (M-AE)	Unadjusted	0.58 (0.12) ** , r=0.33	2.87 (1.34) * , r=0.09
		Adjusted M-IAT-v	0.63 (0.14) ** , r=0.31	3.03 (1.57)
	Deviation IAT-valence (D-IAT-v)	Unadjusted	−0.14 (0.16)	1.02 (2.96)
		Adjusted D-AE	−0.13 (0.16)	1.60 (3.03)
	Deviation Attitude exercise (D-AE)	Unadjusted	0.21 (0.07) ** , r=0.20	1.43 (1.13)
		Adjusted D-IAT-v	0.03 (0.07)	1.25 (1.30)

Note: IAT-v= Valence IAT effect; AE= Self-reported attitude. Data are parameter estimates B (1 SE) from linear mixed models; r values are effect sizes computed by converting t values to r values (Kashdan and Steger, 2006). Mean and Deviation scores are entered concurrently in the models (see text). Baseline = baseline ESE/Minutes of Exercise. (Parameter estimates for covariates not shown).

*
p < .05,

**
p < .01.

Table 4B

Associations between Self-identification and Study Outcomes

Analysis	IVs	Covariates	DVs	
			Exercise Self-Efficacy	Minutes of Exercise
Baseline	IAT-self-identification (IAT-si)	Unadjusted	0.50 (0.28)	4.57 (2.81)
		Adjusted IE	0.39 (0.29)	3.80 (2.84)
		Adjusted IE +Baseline	0.45 (0.20) **, r=0.19	2.53 (2.67)
	Identification w/exercise (IE)	Unadjusted	0.15 (0.07) *, r=0.19	0.97 (0.64)
		Adjusted IAT-si	0.12 (0.07)	0.95 (0.68)
		Adjusted IAT-si + Baseline	-0.04 (0.05)	0.18 (0.76)
Assessment-Level	Mean IAT-self-identification w/exercise (M-IAT-si)	Unadjusted	0.42 (0.27)	4.23 (2.75)
		Adjusted M-IE	0.23 (0.27)	2.51 (2.72)
	Mean identification w/exercise (M-IE)	Unadjusted	0.31 (0.06) **, r=0.31	2.54 (0.66) **, r=0.16
		Adjusted M-IAT-si	0.28 (0.07) **, r=0.29	2.29 (0.73) **, r=0.15
	Deviation IAT-self-identification w/exercise (D-IAT-si)	Unadjusted	-0.05 (0.13)	3.69 (2.51)
		Adjusted D-IE	-0.09 (0.13)	2.88 (2.52)
	Deviation identification w/exercise (D-IE)	Unadjusted	0.19 (0.04) **, r=0.33	1.99 (0.61) **, r=0.16
		Adjusted D-IAT-si	0.11 (0.04) **, r=0.19	1.76 (0.72) *, r=0.11

Note: IAT-si= Self-identification IAT effect; IE = Self-reported identification with exercise. Data are parameter estimates B (1 SE) from linear mixed models; r values are effect sizes computed by converting t values to r values (Kashdan and Steger, 2006). Mean and Deviation scores are entered concurrently in the models (see text). Baseline = baseline ESE/Minutes of Exercise (Parameter estimates for covariates not shown).

*
p < .05,

**
p < .01.

Table 5

Correlations between Pre- and Post- Measures at Each Assessment

Measure	Measure Type	T-0	T-1	T-2	T-3
		Baseline	2 mo	4 mo	6 mo
EA effect	Implicit	.62	.57	.51	.83
Positive OE	Self-Report	.93	.90	.94	.94
Valence IAT (IAT-v)	Implicit	.58	.71	.65	.71
Attitude-AE	Self-Report	.83	.50	.68	.79
Self-identification IAT (IAT-si)	Implicit	.50	.62	.72	.60
Identification-IE	Self-Report	.79	.84	.85	.89

Note: Data show Pearson's r for correlations between cognitive measures assessed pre-exercise and post-exercise. All correlations are significant, $p < .01$. The mean r for implicit measures is $r = .64$, and the mean r for self-report measures is $r = .82$. The estimated internal reliability at T-0, T-1, T-2, and T-3 respectively - computed across pre- and post- data using split-half correlations and the Spearman-Brown correction - was: .75, .58, .60, and .83 for the EA effect; .81, .74, .66, and .72 for the IAT-v; and .73, .70, .83, and .70 for the IAT-si.