Implicit health associations across the adult lifespan

Alexandra J. Werntz

Charlottesville, Virginia

A predissertation research project presented to the

graduate faculty of the University of Virginia

in candidacy for the

Degree of Master of Arts

Department of Psychology

University of Virginia

August, 2016

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Bethany A. Teachman

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Sophie Trawalter

Abstract

Objective: Explicit reports of one's health self-concept (e.g., how would you rate your overall health?) are commonly used in research and clinical practice. These measures predict important health outcomes, but rely on conscious introspection so may not fully capture the different components of health self-concept (e.g., less consciously controlled components) that relate to actual health. The current study examined the health-Implicit Association Test (health-IAT), and how it may add to our prediction of health from self-reports.

Design: 1004 participants (ages 18-85) completed this web-based study with the health-IAT (assessing *self-healthy* implicit associations) and explicit assessments of health.

Main outcome measures: Self-reported measures of physical functioning.

Results: The health-IAT was valid and reliable. On average, individuals exhibited stronger implicit *self-healthy* than *self-sick* associations. Older age (compared to younger age) was associated with stronger *self-healthy* implicit associations. Further, consistent with hypotheses, the health-IAT incrementally predicted self-reported markers of physical functioning, even after controlling for age and explicit health self-concept.

Conclusions: The health-IAT appears to be a valid and reliable new measure that assesses implicit self-concept relating to physical health among adults within a wide age range. Results point to the potential value of assessing implicit health self-concept in both research and practice.

Keywords: Implicit Association Test, physical health, aging, self-concept

Implicit health associations across the adult lifespan

How would you rate your overall health? This single question, usually answered by qualitative descriptors ranging from *excellent* to *poor*, is one of the most widely used measures in health research to assess participants' physical health (for review, see Jylhä, 2009). Despite its brevity, it is a good predictor of current and future health (for reviews, see DeSalvo, Bloser, Reynolds, He, & Muntner, 2006; Jylhä, 2009). However, a number of factors can bias explicit self-report, including social desirability (e.g., to avoid prejudicial attitudes associated with physical disability; Park, Faulkner, & Schaller, 2003) or past illness experiences (Jylhä, 2009). Thus, although this traditional measure provides meaningful data, it draws only on deliberate, consciously controlled reports of physical health, potentially missing other components of health self-concept that may predict physical functioning. Self-report measures predicting physical functioning are essential for research and in clinic settings, as it is not always feasible for clinicians and researchers to directly assess physical health and functioning.

Implicit associations, or those more automatic connections stored between concepts in memory (Lane, Banaji, Nosek, & Greenwald, 2007b; Nosek, Greenwald, & Banaji, 2007), have been a fruitful area of research for understanding how people automatically associate topics in the social and clinical psychology domains. Implicit association measures complement explicit self-report data by capturing associations that are less under conscious control than explicit measures. To add to our understanding of the relationship between self-concepts of physical health and physical functioning, we introduce the health-Implicit Association Test (health-IAT), which is an indirect and implicit measure of the extent to which individuals consider themselves physically healthy versus sick. It is a variant of the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), which has been used extensively in self-concept (see review by Devos & Banaji, 2003) and psychopathology (see Roefs et al., 2011) research. The health-IAT can tap into individuals' less consciously controlled evaluations of their health status, and may provide unique information about how individuals conceptualize their own health. For example, if

an individual feels pressure to present as unhealthy in order to qualify for disability benefits, explicit self-rated health may be low, while implicit self-concept of health may be higher. Given these and related concerns, there is some discussion within the self-rated health literature about the potential for social desirability to threaten the validity of responses to self-rated health questions (e.g., Eriksson, Undén, & Elofsson, 2001; Wu et al., 2013; and see discussion in Streiner, Norman, & Cairney, 2014, pg. 106). Moreover, social desirability is related to over-reporting physical activity (Adams et al., 2005). Thus, while explicit measures provide important clues to understanding health self-concept, also including a measure that is less sensitive to social desirability (like the IAT; see Greenwald et al., 1998) may provide additional insights into how individuals think about their health.

There is relatively little literature examining implicit associations within the health psychology domain. However, initial findings point to the promise of these measures to enhance understanding of health problems and behaviors. For example, there is work concerning implicit obesity associations, which bridges the stigma and health domains (Teachman, Gapinski, Brownell, Rawlins, & Jeyaram, 2003). Recent research also shows that stronger implicit associations between tan faces and positive attributes – as compared to negative attributes - predicts risky sun-related behaviors (Ratliff & Howell, 2015). Also, individuals with somatoform disorder were found to exhibit stronger *self-discomfort* associations compared to healthy control participants on an IAT designed to assess *self-discomfort* (vs. *healthiness*) associations (Riebel, Egloff, & Witthöft, 2013), and the implicit discomfort associations were associated with physical weakness and symptoms. Thus, implicit associations related to physical health have the potential to provide meaningful information regarding physical health.

In addition to assessing the psychometric properties of the novel health-IAT in a large, heterogeneous sample, we also will examine how implicit health associations vary as a function of age in a cross-sectional sample. Although older age is associated with declines in physical health and functioning (Franks, Gold, & Fiscella, 2003; Mora, DiBonaventura, Idler, Leventhal, &

Leventhal, 2008), explicit self-rated health does not always reflect this shift. Some counterintuitive evidence suggests that increased age is associated with *better* self-rated health (Jylhä, Guralnik, Balfour, & Fried, 2001; Ferraro, 1980), whereas other evidence suggests a negative relationship (Delaney, Harmon, Kelleher, & Kenny, 2008) or no reliable association across the adult lifespan (Leinonen, Heikkinen, & Jylha, 1998). Given these mixed findings across studies, it will be important to examine not only the association between age and both implicit and explicit self-rated health in the current sample, but also compare these two age/health self-concept associations. For example, if better explicit, but worse implicit, self-rated health is associated with older age, this may suggest that individual's less vs. more consciously controlled self-concepts rely on different health reference points (e.g., older adults could evaluate their health relative to other older adults or to younger adults, leading to highly discrepant evaluations).

This study will also test whether *self-healthy* implicit associations predict markers of physical functioning beyond explicit self-rated health and age to evaluate the incremental predictive validity of the implicit measure. Although explicit self-rated health correlates with some aspects of physical health and functioning (e.g., Latham & Peek, 2013; Jylhä, 2009), the relationship is rarely straightforward. For example, in older adults, the relationship between physical functioning and explicit self-rated health is weaker with increasing age (Jylhä et al., 2001; Hoeymans, Feskens, Kromhout, & Van den Bos, 1997). Given the complex findings for explicit self-rated health predicting physical functioning and the clear importance of predicting this critical life outcome, there remains a need to determine if there are other unique predictors, especially in settings where it is not possible to collect information regarding actual physical functioning. There may be additional variance accounted for in physical functioning by individuals' implicit self-healthy associations. Prior work in the mental health field has found that implicit self-concepts of being calm versus anxious incrementally predict anxiety symptoms, and implicit self-concepts of being happy versus sad incrementally predict depression symptoms

(Werntz, Steinman, Glenn, Nock, & Teachman, 2016). Moreover, implicit associations have been found to predict health-linked behaviors beyond explicit reports (e.g., drinking behaviors, Jajodia & Earleywine, 2003; Lindgren et al., 2013; Lindgren et al., in press). Interactions between *self-healthy* implicit associations and age and between *self-healthy* implicit associations and explicit self-rated health are also examined as predictors of reports of physical functioning, though these secondary analyses are exploratory. The value of the interactions concerns whether the IAT will be differentially predictive under different circumstances (e.g., interactions with age may tell a doctor whether the health-IAT is a good predictor of physical health problems for her younger patients, but not her older ones).

Overview and Hypotheses. The current study examines implicit physical health associations tied to the self across the adult lifespan using the novel health-IAT. This measure will assess the relative strength of individuals' associations between the *self* and *healthy* vs. the *self* and *sick*. The study will first assess the health-IAT's reliability and validity. *Self-healthy* implicit associations are expected to positively relate to explicit self-rated health and self-reported markers of physical functioning, though correlations between implicit and explicit measures tend to be small (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). Stronger relationships are expected between the health-IAT and the explicit self-rated physical health and physical functioning measures (providing evidence of convergent validity), compared to relationships with other non-physical measures of health, such as social health (providing preliminary evidence of discriminant validity), because the health-IAT was designed to measure implicit physical health by using stimuli expected to activate physical health concepts, such as "fit" and "active." Second, the study will explore how age (and other demographic characteristics) differentially relates to implicit and explicit health self-concept across the adult lifespan. These tests are exploratory, based on past mixed findings for age's relationship to self-rated health in the explicit health self-concept literature. Third, implicit self-concepts of health will be tested as a predictor of established markers of self-rated physical functioning, after

controlling for explicit health self-concept and age. The health-IAT is expected to show incremental predictive validity, given than it is thought to measure less consciously controlled aspects of health not captured by the explicit measure. Finally, the interaction between the health-IAT and age, and the interaction between the health-IAT and explicit health self-concept, will be examined as additional predictors of the variance in markers of physical functioning.

Methods

Participants

The current study was administered on the Project Implicit website (www.implicit.harvard.edu) from June 26, 2012 through November 28, 2012. Of the 1321 individuals randomly assigned to the current study, 1004 participated (ages 18 to 85, mean = 43.6 years, *SD* = 16.8, 70% female). Participation was restricted to United States citizens for this initial evaluation to avoid the potential impact of national differences in attitudes toward aging and health. Race was reported as 76% White, 12% Black or African American, 5% Biracial, 3% Asian, and 4% other. Ethnicity was reported as 82% not Hispanic or Latino, 7% Hispanic or Latino, and 4% other. This was a relatively well-educated sample with 28% reporting having a graduate or other advanced degree, 25% having a Bachelor's degree or some graduate school, 39% having some college or an Associate's degree, and 6% having less than a college education. Although more diverse than a typical collegiate sample, Project Implicit samples are not representative of any one population (Nosek & Smyth, 2011).

Measures[1]

*Implicit Measurement of Health Self-concept***.**

Implicit Association Test (IAT; Greenwald et al., 1998). The IAT is a computerized, reaction time test designed to measure the relative strength of an individual's association between target and attribute categories. In the current study, the target category labels were *self*

[1] Additional measures were collected as part of a larger study on aging, health, and cognitive biases. Information about these measures is available from the corresponding author.

vs. *others*, and the attribute category labels were *healthy* vs. *sick*. Participants sorted category exemplars into superordinate categories, with the primary measure of interest being the difference in average sorting time when the category-attribute pairings were *self-healthy* (and *others-sick*) vs. *self-sick* (and *others-healthy*). The IAT follows a seven-block design (see Lane, Banaji, Nosek, & Greenwald, 2007a) with four critical blocks (blocks 3, 4, 6, and 7) and three single dimension practice blocks (blocks 1, 2, and 5). Blocks 1, 2, 3, 5, and 6 contained 20 trials, while blocks 4 and 7 contained 40 trials. During the critical blocks, each target category label was paired with an attribute label (e.g., *self* + *healthy* and *others* + *sick*), and these label pairings were displayed at the top of a computer screen (one pair on either side). Words belonging to any one of the four categories were then presented individually in the center of the screen, and participants were instructed to sort them correctly using the corresponding key (e.g., "ill" would be sorted with *others* + *sick* because "ill" fits in the category *sick*). During a second critical block, pairings were switched (e.g., *self* + *sick* and *others* + *healthy*). Order of the critical blocks was counterbalanced among participants. The difference in reaction time to classify stimuli across the two category pairing conditions divided by the pooled standard deviation was used to calculate the IAT *D* score (Greenwald, Nosek, & Banaji, 2003). *D* scores range from -2 to 2, with a score of 0 indicating no difference in implicit association strength between self-healthy and self-sick associations. Positive *D* scores indicate stronger *self-healthy* implicit associations, while negative scores indicate stronger *self-sick* associations. Although we refer to the association with the self as healthy or sick in the paper for ease of discussion and because information about the self tends to be preferentially processed (see Baumeister, 1998), it is important to note that the IAT is a relative measure, so a positive *D* score would indicate a stronger *self-healthy (vs. sick)* association relative to *others-healthy (vs. sick)* association. Thus, more positive *D* scores also refer to stronger *others-sick* implicit associations; however, for simplicity and convenience we refer to higher *D* scores as stronger self-healthy implicit associations.

IAT stimuli selection. Target and attribute category exemplars were: *self* (me, self, I, my), *others* (not me, other, them, they), *healthy* (healthy, fit, strong, active), and *sick* (sick, ill, ailing, pained). The words were chosen based on pilot testing during which 15 individuals (who were not part of the current sample) rated 27 health- and sickness-related words based on their ease of classification into the categories *physically healthy* and *physically sick.* Pilot data were also collected on the valence of each of the words and on their ease of classification. On a 7-point Likert-type scale (1 = *very negative*, 7 = *very positive*), the average rating for the chosen healthy exemplars was 6.41, with all selected items scoring above 6.00. The average rating for the chosen *sick* exemplars was 2.00, with all selected items scoring below 2.20. Using a similar scale ranging from 1 (*very hard to classify*) to 7 (*very easy to classify*), the average rating for ease of classification for all selected *healthy* and *sick* exemplars was 6.08, with all selected items scoring above 5.40. (The *self* and *others'* stimuli have been used extensively in prior studies, so were not re-rated here.)

Data reduction. IAT data were screened for possible exclusion using the scoring algorithm described in Greenwald et al. (2003). Trials with reaction times greater than 10,000 ms were removed. IAT data were discarded if participants responded to 10% or more of the trials faster than 300 ms. Additionally, scores for participants with errors on 30% or more of all trials, or 40% or more of trials in a critical block, were omitted. This led to the exclusion of 69 individuals' IAT scores (9.1% of IAT data). Thus, 757 participants completed the IAT, but 69 participants' data were cut based on current scoring procedures (e.g., too many slow trials, too many errors), leaving 688 valid health-IAT scores.

Explicit Measures of Health Self-concept.

Comparative subjective health. Participants rated their overall health "compared to others of about the same age" on a 4-point Likert-type scale from 1 (*excellent*) to 4 (*poor*; similar to Thomas, Kelman, Kennedy, Ahn, & Yang, 1992). (Note, more traditional versions of health self-concept do not add the comparison to same aged-peers component, but we elected to

include this comparison to anchor the rating and because of our interest in associations between health self-concept and age.)

Duke Health Profile-Perceived health subscale (DUKE; Parkerson, Broadhead, & Tse, 1990). The perceived health subscale consists of an explicit item that asks respondents to indicate their agreement with the statement "I am basically a healthy person." Scores range from 0 to 100, with 100 representing optimal health.

*Self-reported Markers of Physical Functioning***.**

Because data collection for the current study occurred online, allowing for a large and relatively more diverse sample than is typical in the laboratory, we were unable to examine the health-IAT in relation to truly objective markers of physical health. However, prior research has found a strong relationship between self-reported physical functioning and actual physical ability (e.g., walking on a treadmill; Wittink, Rogers, Sukiennik, & Carr, 2003), and self-reported measures of physical functioning relate moderately to actual physical activity (as measured by sensors on the body; Harada, Chiu, King, & Stewart, 2001). Thus, in the present study, we use two well-validated, albeit self-reported, markers of physical functioning as the variables to be predicted by the more subjective implicit and explicit evaluations of health self-concept:

Duke Health Profile-Physical health subscale (DUKE; Parkerson et al., 1990). The 5-item physical health subscale includes questions assessing perceived difficulties with physical exertion (e.g., walking up a flight of stairs), as well as degree of struggle with sleeping, pain, and quick fatigue. This subscale ranges from 0 to 100, with higher scores reflecting better health. This subscale correlates with the physical score of the Sickness Impact Profile (SIP; Bergner, Bobbitt, Carter, & Gilson, 1981; Gilson et al., 1975), a widely-used, behaviorally-based 136-item measure of health status (r = -.63 in Parkerson et al.).

Number of Prescription Medications (Mulsant, Ganguli, & Seaberg, 1997)**.** Participants indicated the number of prescription medications that they were currently taking for physical difficulties using an 11-point scale from 0 (*none*) to 10 (*10 or more*). Among older adults,

number of prescription medications is related to number of recent physician visits and hospitalizations (Lassila et al., 1996) and to number of comorbid conditions (Espino et al., 1998).

*Measures of non-physical health***.**

Duke Health Profile-Anxiety and Depression subscales (DUKE; Parkerson et al., 1990). The anxiety and depression symptom subscales correlate strongly with established clinical measures of anxiety and depression (Parkerson, Broadhead, & Tse, 1996). For ease of interpretation, the anxiety and depression scales were reverse scored, so that higher scores represent better health (with scores again ranging from 0 to 100).

Duke Health Profile-Social health subscale (DUKE; Parkerson et al., 1990). The social health scale asks for ratings on five items relating to relationships, such as "I am happy with my family relationships," and how often he/she took part in social events over the previous week. The scores can range from 0 to 100, with 100 being the best self-reported social health.

Procedure

The institutional review board at the University of Virginia approved this study. Volunteers were told that they were going to be asked about their physical health and feelings. Project Implicit volunteers were randomly assigned to the current study and could only be assigned to the study once. To ensure generally comparable representation of age groups in the sample, once the number of individuals completing the full study was approximately 100 for a particular age range (18-24, 25-34, 35-44, 45-54, 55-64, 65 and older), that age range was closed to recruitment. Because some participants discontinued before reaching the end of the study, as often occurs in online research, there is a greater number of participants in the dataset than 600. We kept all consenting individuals' data, regardless of whether the participant completed all study measures, to retain as much data as possible. Following informed consent, participants completed the health-IAT and the block of health questionnaires in random order (order of questionnaires was also randomized within the block). The study lasted approximately

15 minutes, and upon study completion, participants were fully debriefed and given the opportunity to receive their health-IAT feedback, as is standard for Project Implicit studies (e.g., *Your data suggest a strong implicit association between Me [versus Not me] and Sick [versus Healthy]*).

Results

Descriptive statistics and correlations between the key health and demographic variables (e.g., age) are reported in Table 1. Correlations among implicit and explicit health variables are reported in Table 2. Owing to the large sample size and number of analyses, alpha was set to .01.

Implicit Self-Concept of Health

A one-sample *t*-test demonstrated that the mean *D* score for the health-IAT was positive, indicating that, on average, participants had relatively stronger *self-healthy* than *self-sick* associations ($t[687] = 40.39$, $p < .001$, $d = 1.54$).

*Internal consistency***.** Internal consistency for the health-IAT was calculated using split-half reliability formed from alternating couplets of trials (following Menatti, Smyth, Nosek, & Teachman, 2013). The two halves were highly correlated ($r = .77$, $p < .001$), indicating good internal consistency.

*Convergent and discriminant validity***.** Consistent with expectations, the health-IAT showed a pattern of small, significant correlations with the explicit self-rated health measures and markers of physical functioning[2]. As expected, relatively stronger *self-healthy* implicit associations correlated with better explicit reports of self-rated health (on the DUKE perceived

[2] Exploratory analyses (suggested by a reviewer) testing task order effects indicated Health-IAT means did not differ as a function of task order in the study. However, correlations between the health-IAT and explicit measures were slightly stronger when the explicit questions were presented first for some of the relationships (i.e., between the health-IAT and the DUKE perceived health score and the comparative subjective health score). Moreover, when the IAT came first in the study, the correlation between the health-IAT and the DUKE physical health score weakened ($r = .05$, $p = .320$) as well weakened with the number of prescription medications taken ($r = .01$, $p = .848$).

health subscale and the comparative subjective health item), as well as reports of physical functioning (i.e., DUKE physical health subscale and number of prescription medications). *Self-healthy* associations were also slightly positively correlated with measures of social health. Magnitude of the relationships did not vary markedly (see Table 2), though the results suggest that the health-IAT was more strongly related to the explicit, overall subjective health evaluations than to the mental health measures or to the number of medications report.

Relationships Between Implicit and Explicit Measures of Health Self-Concept and Age and Other Demographic Variables

There was a small, positive significant correlation between age and the health-IAT score, such that being older was associated with relatively stronger *self-healthy* associations. Further, older age was significantly associated with better perceived physical health (on the DUKE perceived health subscale and the comparative subjective health single item) and mental health (on the DUKE anxiety and depression subscales), but age was associated with worse reports of physical functioning (as measured by the DUKE physical health subscale and taking more prescription medications). Note that the correlation strength between the health-IAT and age was similar to the correlation strength between the comparative subjective health measure and age. See Table 2.

A series of additional tests were then conducted to evaluate associations between health and other demographic variables. Independent samples *t*-tests to check for group differences between men and women on the implicit and explicit health variables showed no relation between gender and the health-IAT, but men indicated better physical health on the DUKE than women, and women exhibited lower scores on the DUKE depression subscale than men, indicating greater depressive symptoms among women. The analogous *t*-tests comparing non-Hispanic/Latino and Hispanic/Latino individuals showed no group differences on the health-IAT or the other health variables. Next, univariate analyses of variance (ANOVAs) to examine race differences (comparing Caucasians, Asians, African Americans, Individuals reporting more than

one race, and a Combined group of other minorities that all had smaller sample sizes) on the health variables found a significant effect of race on the health-IAT, with follow-up LSD comparisons indicating that Caucasians exhibited stronger *self-healthy* implicit associations than the combined group (i.e., American Indian/Alaska Native, Native Hawaiian or other Pacific Islander, other, or unknown). However, this effect size was small and not predicted, so we do not want to over-interpret this finding. Finally, Spearman correlations revealed that greater education was associated with stronger *self-healthy* implicit associations and better explicit self-rated health. See Table 1.

Implicit Self-Concept of Health as an Incremental Predictor of Markers of Physical Functioning

Step-wise regression models were run to test whether the health-IAT and its two-way interactions with age and comparative subjective health predicted unique variance in markers of physical functioning, beyond the effects of age and comparative subjective health. Comparative subjective health was selected as the explicit measure of self-rated health for the models because it is similar to the widely used explicit self-rated health questions in the literature, and provides a rigorous test of incremental predictive validity given its established prior predictive ability. Separate models were run to predict (1) the DUKE physical health subscale, and (2) number of prescription medications taken for physical difficulties. The models were fit using a general linear model, and all variables were mean-centered for ease of interpretation.

In the model predicting the DUKE physical health subscale, age and comparative subjective health were entered in step 1 of the analysis. Health-IAT score was entered in step 2, and step 3 included the health-IAT x age and the health-IAT x comparative subjective health interactions. The overall (3-step) model was significant, $F(5, 665) = 63.94$, $p < .001$, $R^2 = .33$. As evident in Table 3a, younger age and better comparative subjective health predicted better physical health. Notably, stronger *self-healthy* implicit associations predicted better physical health (though the effect was small), indicating that the health-IAT exhibited incremental

predictive validity beyond age and explicit self-rated health when predicting markers of physical functioning. The interaction terms were not significant predictors.

In the model predicting number of prescription medications, age and comparative subjective health were again entered in step 1 of the analysis, step 2 included the health-IAT score, and step 3 included the health-IAT x age and the health-IAT x comparative subjective health interaction variables. The overall (3-step) model was significant, $F(5, 668) = 61.63$, $p < .001$, $R^2 = .32$. As evident in Table 3b, younger age and better comparative subjective health predicted taking a smaller number of prescription medications for physical health difficulties. Stronger *self-healthy* implicit associations also predicted taking fewer medications, again showing incremental predictive validity, although the effect was again small in magnitude. The interaction terms were again not significant.[3]

As a supplementary test to further examine the IAT's incremental predictive validity above known predictors of health self-concept, the health-IAT was examined as a predictor over and above negative affect and age.[4] As evident in Tables 4a and 4b, the health-IAT significantly predicted both the DUKE physical health subscale and the number of prescription medications, over and above age and negative affect, as measured by the DUKE depression and anxiety subscales. The overall (3-step) model was significant for predicting the DUKE physical health subscale, $F(5, 666) = 108.74$, $p < .001$, $R^2 = .45$. The overall model predicting the number of prescription medications for physical health difficulties was also significant, $F(5, 663) = 49.56$, $p < .001$, $R^2 = .27$.

Discussion

[3] In a secondary analysis, education was also entered in step 1 in both models. Education was not a significant predictor of the DUKE physical health subscale or number of prescription medications, and the health-IAT continued to be a significant predictor. Implicit-explicit task order was also added in to the first regression models to examine whether the order affected the results. When entered in to step one in both models, task order was not a significant predictor and did not affect the predictive validity of the health-IAT.

[4] We would like to thank an anonymous reviewer for suggesting these additional analyses.

The present study introduced the new health-IAT and examined its psychometric properties and relationships with age and other demographic variables, as well as its incremental predictive validity of reported markers of physical functioning. On average, participants more strongly associated the *self* with *healthy* on the health-IAT. In line with hypotheses, the health-IAT exhibited convergent validity by correlating with multiple explicit reports of health and physical functioning. Relative to its correlations with subjective physical health measures, the health-IAT had slightly smaller correlations with the measure of social health, consistent with our hypothesis for discriminant validity, but all of the correlations between the IAT and health indicators were small, so further tests are needed to establish discriminant validity. The task also showed good split-half reliability. With increasing age, participants exhibited stronger *self-healthy* implicit associations (and explicitly reported better comparative subjective health). Further, when controlling for age and comparative subjective health (and age and negative affect), the health-IAT predicted established markers of self-rated physical functioning, though these effects were small. Taken together, these results point to the potential role of implicit *self-healthy* associations as a unique and valid predictor of important health variables.

Validity of the Novel Implicit Health Self-concept Measure

The health-IAT demonstrated convergent validity with explicit self-rated health items, although correlation strengths were low, as is typical of many implicit-explicit relationships, and not surprising given their lack of shared method variance (see Greenwald, Poehlman, Uhlmann, & Banaji, 2009). Importantly, this pattern was observed across multiple indicators, including self-rated perceived health and comparative subjective health. Regarding discriminant validity, there was a small relationship between the health-IAT and the social health measure. This suggests that the health-IAT is related to one's social health (e.g., how often one socialized in the past week). That a small relationship exists between one's social health and implicit physical health associations is not surprising, given the extensive literature on the relationship between social

support and physical and mental health (see Thoits, 2011, for hypothesized mechanisms), and suggests that future work should examine additional indicators of discriminant validity for the health-IAT.

The finding that, on average, individuals associated the *self* with *healthy* is in line with previous research suggesting the prevalence of *self-positive* attribute associations (both explicitly: Brown, 1986; and implicitly: Yamaguchi et al., 2007). In fact, recent work in persons with somatoform disorders also shows stronger implicit healthiness than discomfort self-concept (Riebel et al., 2013), consistent with our results that the tendency to associate the self with positive attributes may extend to physical health self-concept. The health-IAT may also be picking up on components of self-esteem, given the task requires the individual to pair the *self* with *healthy* versus *sick* words. Not surprisingly, our *sick* exemplars were rated more negatively than our *healthy* exemplars, which could mean *self-healthy* implicit associations overlap with more general, implicit self+positive associations. However, prior research has shown specificity in what the IAT is able to predict (i.e., fear-based affective terms in an IAT were still predictive of specific animal phobia even when good-bad implicit judgments were accounted for; Teachman, Gregg, & Woody, 2001).

Evidence for the health-IAT's incremental prediction of self-reported markers of physical functioning followed from multiple tests showing the health-IAT was predictive even when controlling for age and comparative subjective health, and age and negative affect (i.e., symptoms of depression and anxiety). This latter prediction reflects a particularly rigorous test, because greater anxiety and depression are related to worse physical health (e.g., greater anxiety and depression are related to declines in physical functioning in patients with heart failure; Shen et al., 2011) and negative affect is related to worse explicit health self-concept among older adults (Segerstrom, 2014). The current results highlight the importance of assessing individuals' implicit *self-healthy* associations, given they predict a small amount of additional variance in markers of physical functioning, over and above well-established

predictors. Despite the small amount of additional variance accounted for by the health-IAT, it is impressive that it was able to actually account for markers of physical functioning over a known predictor, given the complexity of what accounts for one's health status. Moreover, while the health-IAT predicts a small amount of additional variance on average among this heterogeneous sample, future research could investigate whether it predicts greater variance in specific populations (e.g., among individuals who may have concerns about reporting changes in health status). The health-IAT may be picking up on less consciously controlled aspects of health identity that are not captured by explicit health self-concept or mood. A critical next step will be determining the clinical utility of the health-IAT (e.g., in medical settings), and using a longitudinal design to assess whether the health-IAT incrementally predicts future health outcomes.

Health Self-Concept and Associations with Age and Other Demographic Variables

Previous research has yielded mixed findings regarding the relationship between explicit health self-concept and age. Despite decreases in physical functioning that often accompany age (that were also observed in the present study), older age was associated with *better* self-reported health on multiple measures of subjective health, including self-reported health compared to same-aged peers. Importantly, this relationship was also observed for the implicit measure of health self-concept. Although speculative, and the cross-sectional nature of these data prevent us from drawing conclusions tied to change over time, perhaps the positive age/health self-concept relationship may emerge partly as a result of the stereotype of the frail elderly individual, to which older individuals may compare themselves when making self-rated health evaluations. Suls, Marco, and Tobin (1991) note that there are a limited number of individuals who actually fit this stereotype despite its prevalence, which would explain the more positive health self-concept evaluations in older age, on average. Future research could more directly investigate the question of comparison groups or scale anchors by priming or manipulating alternative comparison categories (e.g., active vs. ailing seniors, the self at

different ages vs. self relative to others, etc.). Notably, implicit and explicit health self-concepts related similarly in direction and magnitude to age in the current sample, possibly suggesting people use a similar comparison group when making both implicit and explicit evaluations.

The current study also examined whether the health-IAT and explicit measures of self-rated health varied as a function of other demographic characteristics. Caucasian individuals exhibited slightly stronger *self-healthy* implicit associations than a combined group of minorities, despite there being no significant race differences on explicit reports of health self-concept. We are hesitant to draw strong conclusions from this finding, however, given the combined category consisted of a number of racial groups that each had only small representation in the sample, and better represented racial groups in the current study (e.g., Asian, African American) were not significantly different from the Caucasian group on the health-IAT. Education was also significantly associated with the majority of the health dependent variables, including the health-IAT, such that more education was associated with stronger *self-healthy* implicit associations and better explicit health self-concept (across all three measures). If education is related to greater socioeconomic status (which seems likely, though socioeconomic status was not assessed in the current study), then it may be that education is associated with access to better healthcare, which also influences health self-concept.

Limitations and Conclusion

Though necessary for a large online study, the self-report nature of the physical functioning measures limits our findings. Also, online data collection may have resulted in more distracted participants, as compared to lab-based studies, and the anonymity of online data collection may have allowed the volunteers to report less accurate information. However, recent research indicates that web-based data can be reliable, and participants indicate that they are often *more* comfortable disclosing clinical information online than in person (Shapiro, Chandler, & Mueller, 2013). Given the positive correlation between implicit health self-concept and age, it is also possible that this sample of older adults using the Internet is a healthier sample than the

overall older adult population. This study was also cross-sectional, which prevents developmental, aging-related generalizations from these results. Additionally, given the relative nature of the IAT, findings can be interpreted to suggest the health-IAT is positively related to both stronger *self-healthy* implicit associations and stronger *others-sick* implicit associations. Moreover, the *other* category may change over the adult lifespan, which we were unable to test. The words used in the task were pre-rated by an independent sample based on how easily they could be categorized into "physically healthy" and "physically sick" categories, but during the actual IAT, participants were simply asked to sort the exemplars into "healthy" and "sick" categories. Thus, the categories may have also elicited concepts of mental health, although none of the exemplars specifically represented mental health. Future iterations of the task might test alternate exemplars or category labels to more strongly emphasize the physical aspect of health and sickness during the task. Finally, the explicit comparative subjective health question used in the current study may have introduced a confound that could be controlled in a future study; participants were asked to explicitly rate themselves compared to same-aged peers, while the health-IAT did not specify who the "others" were in the comparison category.

Despite these limitations, this research adds a novel component to the health self-concept research field. The health-IAT was shown to be reliable and valid, and it predicts reports of physical functioning even after controlling for age, a widely used explicit health self-concept measure, education, and negative affect, suggesting that it may be a useful tool for health researchers. The health-IAT may allow researchers and clinicians to examine automatic associations between the *self* and *healthy* among individuals who are reluctant or unable to explicitly report their health, and may also eventually reveal how individuals conceptualize their own physical health in the face of acute or chronic health conditions.

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Acknowledgements

Many, many thanks to Bethany Teachman for her continued mentorship, guidance, and kindness throughout the predissertation process. Thank you also to Jennifer Green for her assistance with study and manuscript preparation. I am also thankful for the feedback provided by members of the Teachman Program for Anxiety, Cognition and Treatment lab. B. Teachman has a significant financial interest in Project Implicit, Inc., which provided services in support of this project under contract with the University of Virginia.

This research was supported in part by NIH R01AG033033 and R34MH106770 grants to B. Teachman, and the National Institute on Aging under Grant T32AG020500 (J. Green was a trainee).

Table 1

Descriptive Statistics and Correlations between Implicit and Explicit Health and Demographic Variables

	Relationship with Demographic Variables					Descriptive Statistics		
	Age	Gender	Ethnicity	Race	Education	*M*	*SD*	Range
Health-IAT	r=.22**	t(684)=1.87	t(612)=.53	F(4, 662)=3.62*, η_p^2=.02	r_s=.16**	.66	.43	-1.14 - 1.54
Explicit Self-rated Health								
DUKE Perceived Health	r=.10*	t(759)=1.21	t(679)=.15	F(4, 737)=.41, η_p^2=.00	r_s=.16**	74.12	30.44	0 - 100
Comparative Subjective Health	r=-.23**	t(770)=-.58	t(687)=-.02	F(4, 747)=.14, η_p^2=.00	r_s=-.22**	2.01	.80	1 - 4
Self-Reported Markers of Physical Functioning								
DUKE Physical Health	r=-.18**	t(759)=4.68**; men > women, d=.38	t(679)=-2.25	F(4, 737)=1.12, η_p^2=.01	r_s=.05	66.03	22.20	0 - 100
Number of Medications	r=.42**	t(768)=-1.20	t(686)=1.92	F(4, 745)=1.73, η_p^2=.01	r_s=.15**	2.55	1.55	0 - 10
Non-physical Health								
DUKE Anxiety	r=.22**	t(759)=2.10	t(679)=-.50	F(4, 737)=2.76, η_p^2=.02	r_s=.11*	70.22	19.73	8.34 - 100
DUKE Depression	r=.22*	t(759)=2.68*; men > women, d=.21	t(679)=-.28	F(4, 737)=1.94, η_p^2=.01	r_s=.12*	69.34	20.67	0 - 100
DUKE Social Health	r=.05	t(759)=-.71	t(679)=-.35	F(4, 737)=.62, η_p^2=.00	r_s =.02	67.85	22.27	0-100

Note. IAT = Implicit Association Test. The follow-up test for the significant differences observed across racial groups for the health-IAT is reported in the text. Five racial categories were used: Asian, African American, Caucasian, More than one race, and Other. Five education categories were used: Less than a high school degree, High school degree, Some college, Bachelor's degree/some graduate school, and Graduate degree.

Table 2

Intercorrelations among Implicit and Explicit Health Measures

	1	2	3	4	5	6	7	8
1) Health-IAT	1							
Explicit Self-rated Health								
2) DUKE Perceived Health	.22**	1						
3) Comparative Subjective Health	-.23**	-.70**	1					
Self-Reported Markers of Physical Functioning								
4) DUKE Physical Health	.16**	.49**	-.48**	1				
5) Number of Medications	-.11*	-.30**	.24**	-.50**	1			
Non-physical Health								
6) DUKE Anxiety	.18**	.38**	-.42**	.56**	-.11*	1		
7) DUKE Depression	.14**	.39**	-.41**	.58**	-.14**	.85**	1	
8) DUKE Social Health	.10*	.28**	-.32**	.25**	-.08	.63**	.42**	1

*$p < .01$ **$p < .001$

Table 3a

Regression model predicting DUKE physical health subscale

	B	*SE B*	*t*	*p*	f^2
Step 1			R^2 = .30		.44
Age	-.40	.04	-9.07	.000	
Comparative Subjective Health	-14.78	.91	-16.17	.000	
Step 2			**Δ** R^2 = .01		.46
Health-IAT	6.06	1.74	3.49	.001	
Step 3			**Δ** R^2 = .01		.48
Health-IAT x Age	.21	.11	1.95	.051	
Health-IAT x Comparative Subjective Health	4.83	2.06	2.34	.020	

Note. IAT = Implicit Association Test.

Table 3b

Regression model predicting number of prescription medications

	B	*SE B*	*t*	*p*	f^2
Step 1			R^2 = .29		.41
Age	.07	.00	15.16	.000	
Comparative Subjective Health	.92	.34	10.21	.000	
Step 2			**Δ** R^2 = .02		.46
Health-IAT	-.80	.17	-4.69	.000	
Step 3			**Δ** R^2 = .00		.46
Health-IAT x Age	-.01	.01	-.72	. 474	
Health-IAT x Comparative Subjective Health	-.12	.20	-.57	.570	

Note. IAT = Implicit Association Test.

Table 4a

Regression model predicting DUKE physical health subscale

	B	*SE B*	*t*	*p*	f^2
Step 1			R^2 = .43		.75
Age	-.41	-.31	-10.38	.000	
Depression	.46	.42	7.72	.000	
Anxiety	.29	.25	4.53	.000	
Step 2			**Δ** R^2 = .02		.80
Health-IAT	7.05	.14	4.55	.000	
Step 3			**Δ** R^2 = .00		.80
Health-IAT x Age	.10	.03	1.02	.308	

Note. IAT = Implicit Association Test. Depression and anxiety symptoms were assessed by the Duke Health Profile- Depression and Anxiety subscales.

Table 4b

Regression model predicting number of prescription medications

	B	*SE B*	*t*	*p*	f^2
Step 1			R^2 = .24		.31
Age	.06	.47	13.72	.000	
Depression	-.02	-.21	-3.25	.001	
Anxiety	-.00	-.04	-.60	.548	
Step 2			**Δ** R^2 = .03		.36
Health-IAT	-.97	-.19	-5.55	.000	
Step 3			**Δ** R^2 = .00		.36
Health-IAT x Age	-.01	-.02	-.45	.652	

Note. IAT = Implicit Association Test. Depression and anxiety symptoms were assessed by the Duke Health Profile- Depression and Anxiety subscales.