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The Single Category Implicit Association Test as a Measure of Implicit Social Cognition

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The Single Category Implicit Association Test (SC-IAT) is a modification of the Implicit Association Test that measures the strength of evaluative associations with a single attitude object. Across 3 different attitude domains—soda brand preferences, self-esteem, and racial attitudes—the authors found evidence that the SC-IAT is internally consistent and makes unique contributions in the ability to understand implicit social cognition. In a 4th study, the authors investigated the susceptibility of the SC-IAT to faking or self-presentational concerns. Once participants with high error rates were removed, no significant self-presentation effect was observed. These results provide initial evidence for the reliability and validity of the SC-IAT as an individual difference measure of implicit social cognition.

Keywords: implicit social cognition, associative processes, individual differences

Over the past 20 years, there has been an increasing awareness that much social cognition occurs outside of conscious awareness or conscious control (Bargh & Ferguson, 2000; Greenwald, 1992; Kihlstrom, 1990). Implicit social cognition may be inaccessible to conscious introspection, and thus it is necessary to develop measures that do not rely on introspection and self-report in order to understand and measure these processes (Greenwald & Banaji, 1995). One particularly fruitful approach to measuring implicit social cognition has been the development of individual difference measures of associative strength.

Although a large number of these association-based measures of implicit social cognition have been developed (for a review, see Fazio & Olson, 2003), the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) has become the most commonly used among the implicit measurement techniques because it is reliable, easy to administer, and robust and produces large effect sizes, particularly in comparison to other implicit measures of social cognition (Greenwald et al., 1998; Greenwald & Nosek, 2001). The IAT is unique among the recently developed association-based measures of implicit social cognition because it cannot reveal the evaluative associations with a single target concept.

> Because it uses complementary pairs of concepts and attributes, the IAT is limited to measuring the relative strengths of pairs of associations rather than absolute strengths of single associations. In practice, however, the IAT can nevertheless be effectively used because many socially significant categories form complementary pairs, such as positive–negative (valence), self–other, male–female, Jewish–Christian, young–old, weak–strong, warm–cold, liberal–conservative, aggressive–peaceful, and so forth. (Greenwald & Farnham, 2000, p. 1023)

This property is both a strength and a limitation of the measure. As highlighted by Greenwald and Farnham (2000), many attitude objects have a complementary category, and it makes sense to consider these attitude objects relative to another category.

Yet for some research questions, evaluative associations with a single target concept may be of interest. For example, to measure self-esteem by using the IAT, researchers have measured the positive and negative associations a person has with the self in comparison to an unspecified other (or with *me* in comparison to *not me*). At the same time, an alternative approach to measuring self-esteem would be to measure only evaluative associations with the self with no complementary category (see Karpinski, 2004). This approach is not possible within the standard IAT paradigm. Furthermore, there are also instances in which the choice of a complement is not obvious. Consider a researcher interested in predicting President Bush's job approval rating. This researcher may want to obtain a measure of evaluative associations with President Bush, but relative to whom? In such instances, it may be useful to have an IAT-type task that does not require the use of a complementary category (see also Blanton & Jaccard, 2006; Blanton, Jaccard, Gonzales, & Christie, 2006; De Houwer, 2002).

In addition, greater information may be obtained by measuring the evaluative associations with two concept domains independently rather than examining only comparative associations. Whereas measures of two concept domains can reveal two dimensions of information, the IAT provides only one. For example, on a Black–White IAT, scores are interpreted as a comparison of one's positive White associations and/or negative Black associations with one's negative White associations and/or positive Black associations. A high score could indicate (a) the presence of many positive White associations, (b) the presence of many negative Black associations, (c) the lack of negative White associations, and/or (d) the lack of positive Black associations. From the single IAT score, it is impossible to determine which of these factors, or which combination of these factors, contributes to the overall score

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(Blanton & Jaccard, 2006; Blanton et al., 2006; Nosek, Greenwald, & Banaji, 2005). If a single category IAT-type task were available, then a measure of the evaluative associations with Whites and of the evaluative associations with Blacks could be obtained independently, to eliminate some of the ambiguity in the interpretation of IAT scores.

Several implicit social cognition measures have been developed to assess evaluative associations with a single attitude object. Priming-based measures (see Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997; Fazio, Jackson, Dunton, & Williams, 1995; Wittenbrink, Judd, & Park, 1997), the Go/No-Go Association Task (Nosek & Banaji, 2001), and the Extrinsic Affective Simon Task (De Houwer, 2003) can all be used to assess associations with a single attitude object. Each of these measures may be used to assess the evaluative associations with a single target; however, the reliability of these measures has been very low (see Bosson, Swann, & Pennebaker, 2000; De Houwer, 2003; Nosek & Banaji, 200l; Olson & Fazio, 2003; Teige, Schnable, Banse, & Asendorpf, 2004). Thus, there is still the need for a reliable individual-difference measure of the evaluative associations with a single attitude object.

The Single Category IAT (SC-IAT)

Another possible type of measure to assess the strength of evaluative associations with a single attitude object is a modified version of the IAT that eliminates the need for the second contrast category. We designed the SC-IAT as a two-stage modification of IAT procedure to measure the evaluative associations with a single category or attitude object. Because the SC-IAT is a modification of IAT procedure, it shares many properties with the IAT, including its ease of use and interpretation. In each stage, target words associated with the attitude object and an evaluative dimension are presented in random order. In the first stage, good words and attitude object words are categorized on one response key, and bad words are categorized on a different key. In the second stage, bad words and attitude object words are categorized on one response key, and good words are categorized on a different key (see Table 1 for a comparison of a self–other IAT to a self-SC-IAT).

Independently, other researchers have developed similar modifications of the IAT to assess evaluative associations with a single attitude object. The Single Target IAT (ST-IAT; Wigboldus, Holland, & van Knippenberg, 2005) is conceptually identical to our SC-IAT, differing only in minor procedural details. In an initial test of its utility, a Christian ST-IAT was found to correlate with explicit attitude questions about Christianity, and an Islamic ST-IAT was found to correlate with explicit attitude questions about Islam. Neither of the implicit measures correlated with a comparative Christianity versus Islam explicit attitude measure. Additionally, the difference between the Christian ST-IAT and Islamic ST-IAT correlated weakly and only marginally significantly with a Christian–Islamic IAT (Wigboldus et al., 2005). These findings provide some empirical evidence that a measure of associations with a single category or target may reveal different information than a comparative IAT; however, additional research is needed to determine whether single-category or target IAT measures are reliable, valid across content domains, and relatively impervious to self-presentation.

Overview of Studies

In the four studies that follow, we examined the reliability, validity, and susceptibility to faking of the SC-IAT in four different concept domains. For all four studies, we also examined the IAT and explicit measures of attitudes. In cases where the concept of interest was a comparative domain, a difference between two SC-IATs (such as a White SC-IAT and a Black SC-IAT) was computed to obtain a comparative SC-IAT score. We expected an IAT and a comparative SC-IAT to reveal similar findings in terms of known groups validity, correlations with explicit measures, and predictive validity. Unlike the IAT, a comparative SC-IAT can be decomposed into its components, and thus, the SC-IATs may allow for specific conclusions in these domains, to supplement the overall findings obtained from the IAT and comparative SC-IAT. In cases where measurement of associations with a single category may be preferable to a comparative measure, compared with the IAT, we expected the SC-IAT to provide unique and meaningful information about the category of interest.

We determined a fixed order of measures for each study in order to reduce the large sample size requirements if we were to counterbalance the presentation of all the measures. We presented all implicit measures of attitudes prior to the explicit measures of

Table 1
Comparison of the Implicit Association Test (IAT) and Single Category IAT (SC-IAT)

IAT					SC-IAT				
Block	Trials	Function	Left-key response	Right-key response	Block	Trials	Function	Left-key response	Right-key response
1	30	Practice	Pleasant words	Unpleasant words					
2	30	Practice	Self words	Other words					
3_a	30	Practice	Pleasant words + self words	Unpleasant words + other words	1_c	24	Practice	Good words + self words	Bad words
4_a	30	Test	Pleasant words + self words	Unpleasant words + other words	2_c	72	Test	Good words + self words	Bad words
5	30	Practice	Other words	Self words					
6_b	30	Practice	Pleasant words + other words	Unpleasant words + self words	3_d	24	Practice	Good words	Bad words + self words
7_b	30	Test	Pleasant words + other words	Unpleasant words + self words	4_d	72	Test	Good words	Bad words + self words

Note. Blocks with a common subscript were experienced as one continuous block.

attitudes. Recently, Nosek and colleagues (2005) have argued that the order of presentation of implicit and explicit measures does not alter their psychometric properties or their intercorrelation. Other studies have found evidence that the completion of explicit measures of attitudes affects subsequent responses on implicit measures and artificially increases the observed correlation between implicit and explicit measures of attitudes (Bosson et al., 2000). We know of no studies where completing the implicit measures has significantly affected the responses on subsequent explicit measures. Thus, to be conservative, we always presented the implicit measures prior to the explicit self-report measures.

Study 1

The goal of Study 1 was to examine the SC-IAT in a situation where a comparative measure, such as the IAT, would be useful. We investigated attitudes toward soda brands, with the goal of predicting whether participants preferred Coke products to Pepsi products. Previous studies using the IAT to examine evaluative associations with Coke and Pepsi have measured associations at the product level (such as associations with the beverages Coca-Cola and Pepsi-Cola; see Maison, Greenwald, & Bruin, 2004). In Study 1, we used the IAT and SC-IAT to measure associations at the brand level. The Coke brand included the beverages Coke and Diet Coke; the Pepsi brand included the beverages Pepsi and Pepsi One. As a consequence, the results of this study were expected to be similar, but not identical to, the results of previously conducted studies.

Because this study was the first test of the SC-IAT methodology, we examined whether the SC-IAT revealed known soda attitudes. That is, the SC-IAT should reveal that Coke product drinkers have more favorable associations with Coke products than with Pepsi products and that Pepsi product drinkers have more favorable associations with Pepsi products than with Coke products. When participants choose between a Coke and a Pepsi product, the outcome variable is a dichotomous choice. Because the outcome variable is a comparative, dichotomous choice, a comparative Coke–Pepsi IAT would seem to be an ideal attitude measure. As a consequence, we expected a soda SC-IAT (the difference between a Coke SC-IAT and a Pepsi SC-IAT) to be similar in its effects to a Coke–Pepsi IAT, with regards to known group differences, correlations with explicit attitude measures, and prediction of soda choice.

Method

Participants

Fifty-six students (41 women, 15 men) enrolled in an introductory psychology course at Temple University participated in this experiment. All participants received course credit for their participation.

Procedure

Participants were tested in groups of up to 3 at a time. Each participant was seated at a desk with a Gateway 1.5 Gz Pentium 4 desktop computer using Medialab and Direct RT software. All tasks were presented on the computer, and all participants completed the tasks in the same order: a Coke–Pepsi IAT measure of soda associations, a Coke SC-IAT, a Pepsi SC-IAT, and explicit measures of soda preferences. At the conclusion of the session, the participants were thanked and completely debriefed.

IAT measure of soda brand associations. A Coke–Pepsi IAT procedure followed the standard IAT paradigm (see Greenwald et al., 1998) with minor modifications. Specifically, participants completed seven stages in the same order (see Table 1 for an example). In each stage, participants responded to 30 target presentations, and the target stimuli were selected randomly, without replacement. The evaluative dimension was labeled *pleasant* and *unpleasant,* and the object dimension was labeled *Coke* and *Pepsi*. Five target words were used for each of the evaluative dimensions (pleasant: *brilliant, diamond, joy, truth,* and *sunrise*; unpleasant: *awkward, hate, failure, slum,* and *stink*). All target words were presented in lowercase letters. Five target pictures were also selected to be associated with the Coke brand (pictures of two-liter bottles and six-packs of cans of Coke and Diet Coke) and with the Pepsi brand (pictures of two-liter bottles and six-packs of cans of Pepsi and Pepsi One).

The procedure of the IAT was similar to the SC-IAT with five exceptions. First, participants responded by using the *a* key and the *5* key on the number keypad to categorize target words and pictures. Second, the target word remained on the screen until the participants responded. Third, participants were not given feedback regarding the accuracy of their responses. Fourth, the category reminder labels were appropriately positioned in the center of the screen, immediately to the left or right side of the target word. Fifth, the evaluative dimension was labeled *pleasant* and *unpleasant*.

SC-IAT measure of Coke and Pepsi brand associations. The Coke SC-IAT consisted of two stages, which all participants completed in the same order. Each stage consisted of 24 practice trials immediately followed by 72 test trials (three blocks of 24 trials each). In the first stage (Coke + good), Coke pictures and good words were categorized on the *z* key, and bad words were categorized on the *2* key on the numeric keypad. In an attempt to prevent a response bias from developing, Coke pictures, good words, and bad words were not presented at equal frequency, but were presented in a 7:7:10 ratio so that 58% of correct responses were on the *z* key and 42% of correct responses were on the *2* key. In the second stage (Coke + bad), good words were categorized on the *z* key, and Coke pictures and bad words were categorized on the *2* key on the numeric keypad. Coke pictures, good words, and bad words were presented in a 7:10:7 ratio so that 42% of correct responses were on the *z* key and 58% of correct responses were on the *2* key.

The evaluative dimension was labeled *good* and *bad,* and the object dimension was labeled *Coke*. Twenty-one target words were used for each of the evaluative dimensions (see Appendix), and all target words were presented in lowercase letters. Seven target pictures were selected to be associated with Coke (pictures of six-packs and two-liter bottles of Coke and Diet Coke). Within each category, words and pictures were selected randomly without replacement.

Each stage was preceded by a set of instructions concerning the dimensions of the categorization task and the appropriate key responses. Each target word or picture appeared centered on the screen. Category reminder labels were appropriately positioned on the bottom fourth of the screen. The target word remained on the screen until the participants responded or for 1,500 ms. If participants failed to respond within 1,500 ms, a reminder to "Please respond more quickly!" appeared for 500 ms. This response window is largely window dressing; pilot testing revealed that the response window truncates less than 1% of all critical responses. Nevertheless, the response window creates a sense of urgency and may decrease the likelihood that participants engage in controlled processing during the task. Following each response, participants were given feedback regarding the accuracy of their response. A green *O* in the center of the screen for 150 ms followed correct responses; a red *X* in the center of the screen for 150 ms followed each incorrect response.

For the Pepsi SC-IAT, the procedure was repeated with the target category *Pepsi* and target pictures of Pepsi products (pictures of six-packs and two-liter bottles of Pepsi and Pepsi One). All participants completed the Pepsi + good task followed by the Pepsi + bad task.

Explicit measures of soda preferences. Next, participants completed semantic differential, feeling thermometer, and rating scale measures regarding their attitudes toward the Coke and Pepsi brands. For the semantic differential, participants rated the Coke and Pepsi brands on five bipolar dimensions: *ugly–beautiful, bad–good, unpleasant–pleasant, foolish–wise,* and *awful–nice*. Each dimension was rated on a 7-point scale ranging from −3 (the negative pole) to 3 (the positive pole), and participants were instructed to circle zero if the anchoring adjectives were irrelevant to the concept (Coke, $\alpha = .88$; Pepsi, $\alpha = .92$). A semantic differential measure of soda brand preference was computed by subtracting semantic differential ratings of the Pepsi brand from semantic differential ratings of the Coke brand. For the feeling thermometer, participants were asked to rate how positive or negative they found the Coke and Pepsi brands on a scale from 0 (*extremely negative*) to 100 (*extremely positive*). A feeling thermometer measure of soda brand preference was computed by subtracting feeling thermometer ratings of Pepsi from thermometer ratings of Coke. A rating scale measure of Coke brand enjoyment was obtained by asking participants to indicate their agreement or disagreement on a 6-point scale with the following statements: "I enjoy drinking Coke (and Coke products)" and "Coke products satisfy my thirst." Higher numbers indicated more agreement with the statement (Coke, $\alpha = .49$). These questions were repeated with Pepsi as the target brand (Pepsi, $\alpha = .67$). A rating scale measure of soda preference was computed by subtracting ratings of Pepsi from ratings of Coke. All three explicit brand attitude measures correlated strongly with each other (Coke attitudes, $\alpha = .81$; Pepsi attitudes, $\alpha = .90$; and soda [Coke – Pepsi] attitudes, $\alpha = .92$). As a result, the three explicit measures were standardized and averaged to create standardized explicit brand attitude ratings of Coke, Pepsi, and soda (Coke – Pepsi).

Finally, participants answered a behavioral intention question. Participants indicated whether they would prefer a free Coke or Pepsi product (indifference and refusal were also response options). On the basis of this question, participants were defined as Coke drinkers ($n = 17$), Pepsi drinkers ($n = 30$), or neither ($n = 6$).

Results

IAT and SC-IAT Data Reduction

Compared with the IAT, error rates were significantly higher on both the Coke SC-IAT, $t(55) = 4.19$, $p < .01$, and the Pepsi SC-IAT, $t(55) = 3.61$, $p < .01$. This result is not surprising given that the response window in the SC-IAT procedure was included to facilitate quick responding, and quicker responding is likely to be accompanied by increased error rates. Participants with an error rate greater than 20% on the soda IAT, the Coke SC-IAT, or the Pepsi SC-IAT were excluded from analysis, resulting in the elimination of 3 participants (average error rates: Coke SC-IAT = 6.60%; Pepsi SC-IAT = 6.43%; soda IAT = 3.25%).

IAT scores were computed by using the newer *D*-score algorithm for IAT data (Greenwald, Nosek, & Banaji, 2003). For the resulting IAT scores, higher numbers indicated a bias for Coke compared with Pepsi. For the SC-IAT, a scoring algorithm was modeled on the *D*-score algorithm used for the IAT data. Because the 24 practice trials in each stage were truly practice, data from the practice blocks were discarded (Blocks 1 and 3). Responses less than 350 ms were eliminated, nonresponses were eliminated, and error responses were replaced with the block mean plus an error penalty of 400 ms. The average response times of Block 2 (e.g., Coke + good) were subtracted from the average response times of Block 4 (e.g., Coke + bad). This quantity was divided by the standard deviation of all correct response times within Blocks 2 and 4. Thus, Coke SC-IAT and Pepsi SC-IAT *D* scores indicate more positive than negative associations with Coke and Pepsi. Finally, a soda SC-IAT *D* score was computed by subtracting the Pepsi SC-IAT *D* score from the Coke SC-IAT *D* score.

Reliability of the SC-IAT and IAT

To determine the reliability of the SC-IAT, we divided each SC-IAT into thirds (blocks of 24 test trials) and calculated a SC-IAT score separately for each third of the trials without dividing by the standard deviation of correct response times. A measure of internal consistency was obtained by calculating the average intercorrelation among these scores. Dividing the task into thirds (or halves) underestimates the reliability of the entire measure. Fortunately, the Spearman–Brown correction can be applied to compensate for this underestimate of the true internal consistency for the entire measure (designated adjusted *r*; Nunnally, 1978). All internal consistency correlations reported in this article have been adjusted by using the Spearman–Brown correction. These adjusted reliability coefficients are conceptually equivalent and directly comparable to the Cronbach's alphas computed for the explicit measures.

A reliability analysis on the SC-IAT measures from Study 1 revealed a reasonable level of internal consistency (Coke, adjusted $r = .61$; Pepsi, adjusted $r = .69$). For the IAT, a reliability correlation was computed by correlating the IAT score computed from the practice trials with an IAT score computed from the test trials (following the procedure outlined by Greenwald et al., 2003; adjusted $r = .82$). Overall, the reliability of the SC-IAT is somewhat low compared with the IAT. However, the reliability of the SC-IAT is similar to the reliability typically observed for IAT measures (see Greenwald et al., 2003; Nosek et al., 2005) and higher than the reliability of other implicit measures (see Bosson et al., 2000; Olson & Fazio, 2003).

Implicit and Explicit Measures of Soda Attitudes

First, we divided the sample into Coke drinkers and Pepsi drinkers, on the basis of the behavioral choices. The predicted differences emerged on all the comparative soda measures (see top of Table 2). Coke drinkers displayed a greater bias for Coke compared with Pepsi than did Pepsi drinkers on the IAT, SC-IAT, and explicit attitude measures (ps $< .02$, ds ≥ 0.87).

Single category measures also tended to reveal the expected group differences (see bottom of Table 2). Coke drinkers had more favorable explicit attitudes toward Coke than did Pepsi drinkers ($d = 0.69$), and Pepsi drinkers had more favorable attitudes toward Pepsi than did Coke drinkers ($d = 2.40$). A Coke SC-IAT revealed no significant difference in evaluative Coke associations for Coke and Pepsi drinkers ($d = 0.20$), but a Pepsi SC-IAT revealed that Pepsi drinkers had more positive associations with Pepsi than did Coke drinkers ($d = 0.94$).

Correlational Analyses

Soda IAT scores were significantly correlated with soda SC-IAT scores, $r(51) = .29$, $p = .04$, suggesting that the soda brand associations measured by the SC-IAT were significantly related to the soda brand associations measured by the IAT, as expected. However, soda IAT scores were unrelated to explicit soda ratings,

Table 2
Study 1: Summary Statistics for the IAT and Explicit Attitude Measures by Soda Preference

	Coke drinkers (n = 17)		Pepsi drinkers (n = 30)		Difference		
Attitude measure	*M*	*SD*	*M*	*SD*	*d*	*t*(45)	*p*
Comparative measures							
Soda IAT	0.35	0.21	0.02	0.44	0.87	2.91	<.01
Soda SC-IAT	0.34	0.44	−0.03	0.53	0.74	2.47	.02
Explicit soda attitudes	0.91	0.72	−0.56	0.66	2.11	7.08	<.01
Single category measures							
SC-IAT							
Coke SC-IAT	0.25	0.30	0.18	0.35	0.20	0.68	.50
Pepsi SC-IAT	−0.09	0.33	0.22	0.31	0.94	3.16	<.01
Explicit attitudes							
Explicit Coke attitude	0.42	0.83	−0.15	0.80	0.69	2.32	.03
Explicit Pepsi attitude	−0.79	0.77	0.60	0.42	2.40	8.08	<.01

Note. For comparative soda measures, positive values indicate a bias or preference for Coke over Pepsi. For single category Coke and Pepsi measures, positive values indicate a bias or preference for Coke or Pepsi, respectively. IAT = Implicit Association Test; SC-IAT = Single Category Implicit Association Test.

$r(51) = .18$, $p = .20$. Follow-up analyses revealed that soda IAT scores were also unrelated to explicit Coke or explicit Pepsi attitudes, $r(51) = .21$, $p = .14$, and $r(51) = -.05$, $p = .74$, respectively.

As expected, soda SC-IAT scores were positively correlated with explicit soda attitudes, $r(51) = .29$, $p = .04$. Follow-up analyses revealed that Coke SC-IAT scores were positively correlated with explicit Coke attitudes, $r(51) = .27$, $p = .05$, and uncorrelated with explicit Pepsi attitudes, $r(51) = -.01$, $p = .97$. Similarly, Pepsi SC-IAT scores were positively correlated with explicit Pepsi attitudes, $r(51) = .26$, $p = .06$, and uncorrelated with explicit Coke attitudes, $r(51) = -.07$, $p = .61$. These results suggest that Coke and Pepsi SC-IAT scores reveal specific information pertaining to Coke and Pepsi preferences, respectively, and not general information about soda preferences.

Additionally, attitudes and associations with Coke were unrelated to attitudes and associations with Pepsi on both explicit ratings, $r(51) = -.01$, $p = .93$, and the SC-IAT measures, $r(51) = -.06$, $p = .66$.

Prediction of Soda Choice

Next, we examined the ability of the IAT, SC-IAT, and explicit measures to predict soda choice. For the soda choice outcome variable, participants who chose a Coke product were given a value of 1, participants who indicated no preference were given a value of 0, and participants who chose a Pepsi product were given a value of −1. First, the Coke SC-IAT, Pepsi SC-IAT, and soda IAT were entered in a simultaneous regression predicting soda choice (see top of Table 3). These results indicated that both the IAT and Pepsi SC-IAT significantly predicted soda choice, but the Coke SC-IAT was unrelated to soda choice. Next, the analysis was repeated with explicit soda attitudes added to the model (see bottom of Table 3). Explicit attitudes were strong predictors of soda choice. However, even once explicit preferences were controlled, the IAT, Coke SC-IAT, and Pepsi SC-IAT significantly predicted soda choice.[1]

An alternative method of comparing the predictive validity of the SC-IAT and the IAT is to examine the percentage of variance accounted for by SC-IAT and IAT measures in soda choice. A series of regression analyses revealed that the Coke and Pepsi SC-IATs predicted 17% of the variance in soda choice (7% beyond the variance explained by explicit measures). A soda IAT predicted 12% of the variance in soda choice (4.9% beyond the variance explained by explicit measures). Taken together, these results provide strong evidence for the utility of the SC-IAT above and beyond the IAT and explicit attitude measures.

Information Obtained From the SC-IAT and IAT

One advantage to using two single attitude measures as opposed to one comparative attitude is that a greater amount of information is obtained from the two single attitude measures (see Figure 1). On the top panel of Figure 1, Coke SC-IAT scores are plotted against Pepsi SC-IAT scores. From this panel, information about Coke, Pepsi, and soda (Coke – Pepsi) associations may be obtained. Some participants had favorable associations with both Coke and Pepsi (the upper right quadrant), some had unfavorable associations with both Coke and Pepsi (the lower left quadrant), and some had favorable associations toward one soda and unfa-

[1] If the 6 individuals who did not indicate a preference for a Coke or Pepsi product are eliminated from the analysis, then these relationships can also be examined by using a logistic regression predicting soda choice. For a logistic regression with implicit measures only, the results closely parallel the standard regression analysis. IAT scores ($p = .05$) and Pepsi SC-IAT scores ($p = .06$) predicted the soda choice, whereas Coke SC-IAT scores did not ($p = .63$). However, when explicit soda attitudes were added to the equation, none of the implicit measures or the explicit measure uniquely predicted soda choice (all $ps > .28$).

Table 3
Study 1: Predicting Soda Choice

Predictor	Prediction of soda choice		
	β	t	p
Implicit measures only			
Coke SC-IAT	.06	0.47	.64
Pepsi SC-IAT	−.35	2.74	<.01
IAT	.28	2.10	.04
Implicit and explicit measures			
Coke SC-IAT	.16	1.76	.09
Pepsi SC-IAT	−.22	2.33	.02
IAT	.23	2.43	.02
Explicit soda attitudes	.67	7.37	<.01

Note. $N = 52$. All variables were entered simultaneously. SC-IAT = Single Category Implicit Association Test; IAT = Implicit Association Test.

vorable associations toward the other soda (the remaining two quadrants). Information about participants' relative soda associations can be obtained by observing where the participant falls in reference to the dashed diagonal line. Participants with SC-IAT scores falling above the line had more positive and/or less negative associations with Coke than Pepsi; participants with SC-IAT scores falling below the line had more positive and/or less negative associations with Pepsi than Coke. In the bottom panel of Figure 1, soda IAT scores are plotted. Only information about participants' relative soda associations is available from this panel. Participants with scores on the left side of the graph (scores less than zero) had more positive and/or less negative associations with Pepsi than Coke, whereas participants with scores on the right side of the graph (scores greater than zero) had more positive and/or less negative associations with Coke than Pepsi.

Discussion

These results provide initial support for the SC-IAT as a valid measure of evaluative associations with a single attitude object. The validity of the SC-IAT was established on multiple levels: known groups validity, convergent validity, and predictive validity. First, along with the IAT and explicit soda preferences, the soda SC-IAT discriminated between Coke and Pepsi drinkers. Second, the SC-IAT measure of soda preferences correlated significantly with explicit soda preferences. The Coke and Pepsi SC-IATs were specific in their measurement of associations. The Pepsi SC-IAT revealed that Pepsi drinkers had more positive than negative associations with Pepsi, compared with Coke drinkers. The Pepsi SC-IAT also correlated with explicit Pepsi attitudes, but not with explicit Coke attitudes. Likewise, the Coke SC-IAT correlated with explicit Coke attitudes, but not with explicit Pepsi attitudes. Third, the Pepsi SC-IAT, and to a lesser extent the Coke SC-IAT, reliably predicted intended soda choice, even when controlling for IAT scores and explicit attitude ratings.

This study was ideally suited for a comparative IAT style of measurement, and as expected, the IAT discriminated between Coke and Pepsi drinkers and predicted intended soda choice. Thus, it is somewhat surprising that the soda SC-IAT measure correlated significantly with explicit soda preferences, whereas the IAT failed to correlate with explicit measures of soda attitudes. Overall, these results suggest that the SC-IAT may have some utility above and beyond the IAT even in situations where the outcome variable is comparative.

Although the Coke and Pepsi SC-IATs performed well on a number of aspects, there were a couple of curious aspects of these results. First, the reliability of the SC-IAT measures was lower than the reliability observed for the IAT. One possibility is that not having a comparative category for the attitude object may result in extra error variance in responses. If this were true, then SC-IAT measures would inherently have lower reliabilities than IAT measures. A second possible explanation for the low reliability of the SC-IATs is that the 1,500-ms response window not only resulted in a higher error rate, but also increased unreliability for the SC-IAT. A final possibility is that the order of the tasks adversely affected the reliability of the SC-IAT. For the IAT, all responses to the attitude objects of interest are comparative. After completing an IAT, participants may continue to think about the attitude objects in a comparative manner. If a SC-IAT were to follow an IAT, participants' responses may be influenced by the comparative mind-set induced by the IAT, perhaps resulting in increased error

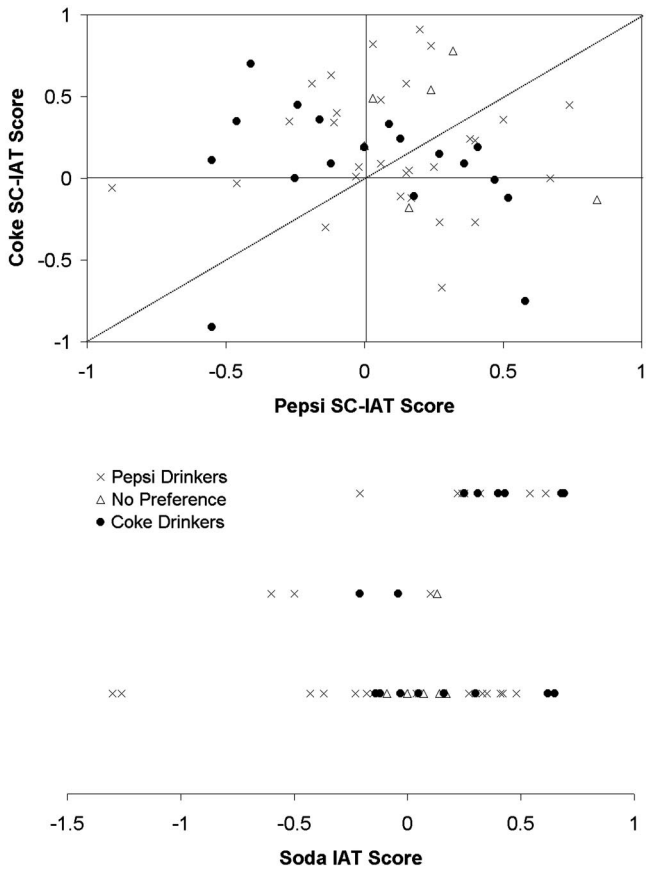

Figure 1. A comparison of information available from independent Coke and Pepsi Single Category Implicit Association Tests (SC-IATs) and a Coke–Pepsi Implicit Association Test (IAT). IAT and SC-IAT scores were calculated by using the *D*-score algorithm ($N = 53$).

variance in the SC-IAT. The issue of the reliability of the SC-IAT is one that will be revisited in subsequent studies.

A second curious finding in Study 1 is that all Pepsi measures (SC-IAT and explicit measures) discriminated between Coke and Pepsi drinkers better and predicted soda choice better than did Coke measures. We are puzzled by this finding, but it may be the result of the Temple University environment. Temple University has an exclusive agreement with Pepsi to provide soft drinks on campus. All vending machines and restaurants on campus serve only Pepsi products. Thus, Temple University students may receive more information regarding Pepsi products than Coke products, and this environmental bias may lead to greater predictive validity and known-groups validity for the Pepsi SC-IAT than for the Coke SC-IAT. Regardless, evidence for the validity of the Coke SC-IAT was obtained; the Coke SC-IAT correlated with explicit Coke attitudes and not explicit Pepsi attitudes.

Study 2

A comparative attitude or associative measure is not ideally suited for all contexts. For example, when investigators wish to predict smoking behavior, there is no clear complementary behavior to smoking; it depends on the nature of the research question. Similarly, self-esteem researchers may be interested in assessing evaluative associations with the self and not comparative self–other associations (see Karpinski, 2004). In these situations, a SC-IAT measure of associations may provide a more specific measure of the evaluative associations in question than an IAT. Because self-report measures of self-esteem are not explicitly comparative, we expected to find that a self-SC-IAT would correlate more strongly with explicit measures of self-esteem than would a self–other IAT.

Study 2 was designed to investigate the use of a SC-IAT as a measure of self-associations. The procedure of Study 2 closely followed the procedure of Study 1, with one key exception. To examine the possibility that taking a (comparative) IAT prior to a SC-IAT adversely affected the reliability of the SC-IAT, we switched the order of the SC-IAT and the IAT. Thus, participants completed a self-SC-IAT, a self–other IAT, and then explicit measures of self-esteem.

Method

Participants

Sixty-six students (16 men, 41 women, 9 unknown) enrolled in an introductory psychology course at Temple University participated in this experiment. All participants received course credit for their participation.

Procedure

All tasks were presented on the computer, and all participants completed the tasks in the same order: a SC-IAT measure of self-associations, an IAT measure of self–other associations, and explicit measures of self-esteem. At the conclusion of the session, the participants were thanked and completely debriefed.

SC-IAT measure of self-associations. The self-SC-IAT was identical to the Coke and Pepsi SC-IATs used in Study 1, with the exception of the target words and category labels. The evaluative dimension remained labeled *good* and *bad*, and the object dimension was labeled *self*. Five target words were selected to be associated with the category self (*participant's first name*, *participant's last name*, *me*, *I*, and *myself*). The good and bad target words were identical to the words used in Study 1. All target and category words were presented in lowercase letters. Participants first completed the self + positive blocks, followed by the self + negative blocks.

IAT measure of self–other associations. The IAT procedure was identical to the procedure used in Study 1, with the exception of the target words and category labels. The category labels *self* and *other* replaced the labels of *Coke* and *Pepsi*, respectively. Five target words were also selected to be associated with each of the attitude objects (self: *participant's first name*, *participant's last name*, *me*, *I*, and *myself*; other: *he*, *her*, *his*, *hers*, and *person*).

Explicit measures of self-esteem. Participants next completed three explicit measures of self-esteem: a self semantic differential, a self feeling thermometer, and the Rosenberg Self-Esteem Scale (Rosenberg, 1965). For the semantic differential, participants rated *self* on five bipolar dimensions: *ugly–beautiful*, *bad–good*, *unpleasant–pleasant*, *foolish–wise*, and *awful–nice*. Each dimension was rated on a 7-point scale ranging from −3 (negative pole) to 3 (positive pole). The five items were summed to form a semantic differential measure of self-esteem ($\alpha = .55$). The self feeling thermometer consisted of a single item, with participants rating themselves on a thermometer ranging from 0 (*cold or unfavorable*) to 100 (*warm or favorable*). For presentation purposes, feeling thermometer scores have been rescaled to range from −50 to 50 so that zero indicates neutral self-attitudes. For the Rosenberg scale, participants responded to each item on a 7-point scale ranging from 1 (*disagree strongly*) to 7 (*agree strongly*). The 10 items were averaged to compute a measure of self-esteem ($\alpha = .86$). These three explicit measures of self-esteem were strongly interrelated ($\alpha = .80$), and thus, the three measures were standardized and averaged to compute a single explicit measure of self-esteem.

Results

IAT and SC-IAT Data Reduction and Reliability Analysis

Because of a computer error, the explicit attitude data were lost for 9 participants. Replicating the results of Study 1, error rates were significantly higher for the self-SC-IAT than for the self–other IAT, $t(65) = 3.15$, $p < .01$. Participants with an IAT error rate greater than 20% were excluded from analysis, resulting in the elimination of 5 participants. Participants with a SC-IAT error rate greater than 20% were also excluded, resulting in elimination of 9 additional participants. The resulting error rates were consistent with those observed in Study 1 (self-SC-IAT = 6.60%, self–other IAT = 4.53%).

IAT and SC-IAT scores were computed by using the scoring algorithms described for Study 1. Self–other IAT scores were computed so that higher numbers indicate more positive associations with the self (and/or negative associations with an other) than negative associations with the self (and/or positive associations with an other), and the self-SC-IAT scores were such that higher scores indicate greater positive than negative associations with the self.

To determine the reliability of the SC-IAT, we divided each SC-IAT into thirds and calculated a SC-IAT score separately for each block of 24 test trials. In this study, the SC-IAT displayed a level of reliability that is similar to the level of reliability typically found for the IAT (adjusted $r = .73$). For the IAT, a reliability correlation was computed by correlating the IAT score computed from the practice trials with the IAT score computed from the test trials. The observed reliability coefficient was on the lower end of what is typically observed in IAT data (adjusted $r = .58$).

Average Levels of Self-Esteem

Overall, all measures showed a pattern consistent with an interpretation of high self-esteem (see Table 4). All three explicit measures of self-esteem revealed the presence of positive self-evaluations (all ds $\geq$ 1.35). Implicit measures revealed a similar pattern. The IAT revealed that participants had more positive self-associations and/or negative other associations than negative self-associations and/or positive other associations (d = 1.84). The SC-IAT revealed that participants had more positive self-associations than negative self-associations (d = 1.13). No significant gender differences were observed on any of the measures of self-esteem (all ps $\geq$ .13).

Relationship Between Implicit and Explicit Measures of Self-Esteem

It is interesting to note that the self-SC-IAT and self–other IAT scores were only marginally correlated, $r(50) = .25$, $p = .07$. In other words, the self-associations measured by the SC-IAT were only weakly related to the self–other associations measured by the self–other IAT. The self–other IAT failed to correlate with the standardized explicit measure of self-esteem, $r(42) = .01$, $p = .93$. Conversely, a significant positive correlation was observed between the self-SC-IAT and the explicit measure of self-esteem, $r(42) = .38$, $p = .01$.

A regression analysis was conducted to investigate whether the self-SC-IAT predicted unique variance in explicit reports of self-esteem. Consistent with the correlation findings, the regression analysis revealed that self-SC-IAT scores were uniquely predictive of explicit self-esteem ($\beta = .40$, $p = .01$), whereas IAT scores were not uniquely predictive of explicit self-esteem ($\beta = -.09$, $p = .54$).

Discussion

Study 2 provided additional evidence for the reliability and validity of the SC-IAT as a measure of implicit social cognition. Like the self–other IAT and explicit measures of self-esteem, the self-SC-IAT revealed more positive than negative self-associations, suggesting positive self-esteem in the sample. Unlike the self–other IAT, the self-SC-IAT correlated significantly with explicit measures of self-esteem. These correlations are larger than correlations typically observed between implicit and explicit measures of self-esteem (see Bosson et al., 2000; Greenwald & Farnham, 2000) but are similar in size to correlations found between an affective priming measure of self-esteem and explicit measures of self-esteem (Wentura, Kulfanek, & Greve, 2005).

In addition, a small and nonsignificant relationship was observed between self-SC-IAT scores and self–other IAT scores. Karpinski (2004) hypothesized that the evaluative self–other associations measured by the IAT may be qualitatively different from evaluative self-associations, and these results provide support for this claim. The self–other IAT has proven to be a useful measure of self-esteem in many contexts, yet the current findings suggest that a self-SC-IAT may provide additional information about implicit self-esteem that is not captured by the self–other IAT. However, the correlation we observed between explicit measures of self-esteem and the self–other IAT is lower than what is typically reported (e.g., see Bosson et al., 2000). The reasons for this discrepancy are unclear, but the end result is that this study may underestimate the IAT–explicit self-esteem relationship and the SC-IAT/IAT relationship.

The results of Study 2 provided stronger evidence for the reliability of the SC-IAT than did Study 1. In this study, the SC-IAT displayed a level of internal consistency similar to the reliabilities that are typically found by using the IAT. One difference between this study and Study 1 is that in the current study, the SC-IAT measure was obtained prior to the IAT measure. This result provides indirect support to the hypothesis that the completion of a (comparative) IAT may interfere with ensuing SC-IAT measures. Thus, for subsequent studies, we will present the SC-IAT measures prior to the IAT measures.

Table 4
Study 2: Descriptive Statistics

			Difference from midpoint		
Measure	*M*	*SD*	*t*	*p*	*d*
Implicit measures					
Self–other IAT	0.58	0.32	$t(51) = 13.24$	$<.01$	1.84
Self-SC-IAT	0.45	0.40	$t(51) = 8.13$	$<.01$	1.13
Explicit measures					
Rosenberg SE Scale	5.39	1.03	$t(43) = 8.94$	$<.01$	1.35
Self semantic differential	8.74	2.93	$t(43) = 19.75$	$<.01$	2.98
Self feeling thermometer	27.70	18.54	$t(43) = 9.91$	$<.01$	1.49

Note. Midpoint is the middle point of the scale or the point of the scale at which a person has neutral self-associations. IAT = Implicit Association Test; SC-IAT = Single Category Implicit Association Test; SE = Self-Esteem.

Study 3

One of the more interesting applications of the IAT is its use as a measure of implicit racial associations. Studies using a Black–White IAT have typically found that White participants display a large racial bias in favor of Whites and/or against Blacks (Dasgupta, McGhee, Greenwald, & Banaji, 2000; Greenwald et al., 1998; Monteith, Voils, & Ashburn-Nardo, 2001; Nosek, Banaji, & Greenwald, 2002). One possible interpretation of this effect is that "virtually all White Americans may have automatic negative associations to African American names" (Greenwald et al., 1998, p. 1475). Yet, because of the comparative nature of the IAT, there are multiple interpretations of this IAT race bias. For example, a person who has no evaluative associations with Blacks, and mostly positive associations with Whites, would display the typical IAT race bias. Likewise, an IAT racial bias may emerge for participants who have mostly positive associations with Blacks but also have more positive associations with Whites (Blanton & Jaccard, 2006; Blanton et al., 2006; Gehring, Karpinski, & Hilton, 2003). In these alternative interpretations of the IAT race bias, participants would not have automatic negative associations with Blacks.

We hypothesized that the SC-IAT could be used to help interpret meaning of the IAT race bias. For Study 3, separate Black and White SC-IATs were used to assess the strength of evaluative

associations with Blacks and Whites independently. We expected a race bias SC-IAT (White SC-IAT–Black SC-IAT) to reveal a similar race bias as the IAT; White SC-IAT scores were hypothesized to be higher than Black SC-IAT scores. If this effect is due to out-group prejudice, then participants would also have negative Black SC-IAT scores. However, if the SC-IAT and IAT race biases are a result of in-group favoritism, then we would expect to observe positive evaluative associations on a White SC-IAT and less positive (but not negative) evaluative associations on a Black SC-IAT. Furthermore, we explored differences in automatic race biases between White and Black participants. Previous studies have found that Black participants tend to show either no IAT race bias or a small IAT race bias in favor of Whites and/or against Blacks (Nosek et al., 2002).

In Study 3, participants completed a White SC-IAT, a Black SC-IAT, a Black–White IAT, and explicit measures of racial attitudes. Several modifications were made to both the procedures of the IAT and SC-IAT. First, participants taking the IAT received response feedback, seeing a green *O* following a correct response and a red *X* following an incorrect response. This modification is in line with standard versions of the IAT that typically include response feedback. Second, we reduced the number of critical trials in each SC-IAT from 72 to 48 in order to reduce the time required for each SC-IAT. Third, we increased the response window for the SC-IAT from 1,500 ms to 2,000 ms. If the 1,500-ms response window was contributing to high error rates on the SC-IAT, then increasing the response window may alleviate this problem.

Method

Participants

Eighty-one White students (24 men, 57 women) and 37 Black students (9 men, 28 women) enrolled in an introductory psychology course at Temple University participated in this experiment. All participants received course credit for their participation.

Procedure

The procedure mirrored the procedure of Study 1, with *Black American* and *White American* as the categories of interest. All tasks were presented on the computer, and all participants completed the tasks in the same order: a White-SC-IAT, a Black-SC-IAT, a Black–White IAT, and explicit measures of racial attitudes. At the conclusion of the session, the participants were thanked and completely debriefed.

SC-IAT measure of Black and White associations. The Black SC-IAT and White SC-IAT were similar to the soda SC-IATs used in Study 1, with three exceptions. First, the target words and category labels were changed to be relevant for the categories Black and White. The evaluative dimension remained labeled *good* and *bad*; the category dimension was labeled *White American* for the White SC-IAT and *Black American* for the Black SC-IAT. Six Black faces and six White faces were selected to be associated with the categories Black and White, respectively. These face stimuli were identical to those used by Nosek et al. (2002). Second, the response window was lengthened from 1,500 ms to 2,000 ms. If participants did not respond within 2,000 ms of the presentation of the target word or face, they were reminded to respond more quickly. Third, the number of critical trials was reduced from 72 trials to 48 trials.

IAT measure of Black–White associations. The IAT procedure was identical to the procedure used in Study 1, with two exceptions. First, the target words and pictures and category labels were modified to be appropriate for a Black–White IAT. The category labels *White American* and *Black American* replaced the labels of *Coke* and *Pepsi*, respectively. Six target faces were also selected to be associated with each of the attitude objects (three male and three female for each race, identical to the stimuli used for the SC-IATs). In addition, several of the unpleasant target words were changed to avoid overlap with the Black stereotype (see Appendix). Finally, unlike Studies 1 and 2, participants received response feedback for correct and incorrect responses. Participants viewed a green *O* for 150 ms following a correct response and a red *X* for 150 ms following an incorrect response.

Explicit measures of race attitudes. Participants next completed two explicit measures of White and Black attitudes: a semantic differential (White, $\alpha = .84$; Black, $\alpha = .89$) and a feeling thermometer. These measures were identical to those used in the previous studies, but the target category labels *White American* and *Black American* were used to assess attitudes toward Whites and Blacks, respectively. These two explicit attitudes measures were strongly related (White, $\alpha = .64$; Black, $\alpha = .81$), and thus they were standardized and averaged to form composite explicit attitude measures of Whites and Blacks. Explicit measures of comparative racial attitudes were obtained by subtracting the explicit measures of Blacks from the explicit measures of Whites, such that higher numbers indicated more favorable attitudes of Whites compared with Blacks.

Results

IAT and SC-IAT Data Reduction and Reliability Analysis

Compared with the IAT, error rates were significantly higher on the White SC-IAT, $t(117) = 7.93$, $p < .01$, and the Black SC-IAT, $t(117) = 7.40$, $p < .01$. Participants with an error rate greater than 20% on the Black SC-IAT, the White SC-IAT, or race IAT were excluded from analysis, resulting in the elimination of 5 participants. The resulting average error rates were consistent with error rates observed in previous studies (White SC-IAT = 6.15%; Black SC-IAT = 5.97%; race IAT = 3.08%). These findings suggest that increasing the response window did not result in a reduction of the SC-IAT error rate.

As in the previous studies, IAT and SC-IAT scores were computed by using the *D* algorithm. A comparative race SC-IAT score was obtained by subtracting Black SC-IAT scores from White SC-IAT scores. For both the race SC-IAT and IAT, positive scores indicate more positive associations with Whites (and/or negative associations with Blacks) than negative associations with Whites (and/or positive associations with Blacks).

To determine the reliability of the SC-IAT, we calculated a SC-IAT score for each of the two test blocks of 24 test trials. A reliability analysis on these scores revealed greater internal consistency for the White SC-IAT (adjusted $r = .70$) than for the Black SC-IAT (adjusted $r = .55$). For the IAT, a reliability correlation was computed by correlating IAT scores computed from the practice trials with IAT scores computed from the test trials (adjusted $r = .75$). Similar to Study 1, the SC-IAT displayed lower levels of internal consistency than did the IAT.

Implicit and Explicit Measures of Racial Attitudes

Explicit measures. For the comparative explicit race bias measures, White and Black participants reported an in-group bias (see top of Table 5). On both the feeling thermometer and semantic differential, White participants rated Whites more positively than Blacks ($ps \leq .01$, $ds \geq 1.39$), and Black participants rated Blacks

Table 5
Study 3: Descriptive Statistics

Attitude measure	Whites (n = 79)			Blacks (n = 34)			Difference between White and Black participants		
	M	*SD*	*d*	*M*	*SD*	*d*	*t*(111)	*p*	*d*
Explicit measures									
Race feeling thermometer	9.19	16.22	0.57	−15.21	16.26	−0.94	7.33	<.01	1.39
White feeling thermometer	24.35	14.19	1.72	18.91	17.36	1.09	1.75	.08	0.33
Black feeling thermometer	15.16	16.65	0.91	24.12	15.82	2.15	5.63	<.01	1.07
Race semantic differential	0.40	1.02	0.39	−0.47	0.75	−0.62	4.45	<.01	0.85
White semantic differential	0.85	0.84	1.01	0.61	0.82	0.75	1.38	.17	0.26
Black semantic differential	0.45	0.80	0.56	1.08	0.98	1.10	3.60	<.01	0.68
Implicit measures									
Race IAT	0.63	0.30	2.07	0.09	0.42	0.22	7.68	<.01	1.46
Race SC-IAT	0.16	0.52	0.30	−0.07	0.63	−0.10	2.03	.04	0.39
White SC-IAT	0.17	0.37	0.46	0.16	0.44	0.36	0.18	.86	0.03
Black SC-IAT	0.01	0.33	0.04	0.22	0.43	0.52	2.80	<.01	0.49

Note. For comparative race measures, higher numbers indicate more positive (or fewer negative) attitudes or associations with Whites than with Blacks. For single category measures, higher numbers indicate more positive attitudes. IAT = Implicit Association Test; SC-IAT = Single Category Implicit Association Test.

more positively than Whites ($ps \leq .01$, $ds \geq .62$). Examination of the separate ratings of Whites and Blacks revealed that these in-group biases were due to in-group favoritism and not out-group prejudice. On both the semantic differential and feeling thermometer measures, White and Black participants reported favorable attitudes toward both Whites and Blacks (all $ps \leq .01$, $ds \geq 0.56$).

Implicit measures. As expected, for White participants, the implicit comparative measures of racial attitudes revealed significant race biases (see bottom of Table 5). The IAT revealed a large race bias ($d = 2.07$, $p < .01$), whereas the SC-IAT revealed a small- to medium-sized race bias ($d = 0.30$, $p < .01$). Echoing the findings on the explicit measures, these findings indicate that White participants showed an in-group bias at the implicit level, favoring Whites over Blacks. For Black participants, both implicit measures of race bias revealed no significant racial biases (IAT, $d = 0.22$, $p = .22$; SC-IAT, $d = -0.10$, $p = .57$). A test for the difference between these effects revealed that White participants displayed a significantly stronger in-group bias than did Black participants on both the IAT ($d = 1.46$, $p < .01$) and the SC-IAT ($d = 0.39$, $p = .04$). Because the IAT cannot be decomposed into component attitudes of Whites and attitudes of Blacks, no further conclusions can be made about the nature of the race bias observed with the IAT.

However, the race SC-IAT is composed of a difference between a White SC-IAT and a Black SC-IAT, and each of these components can be analyzed separately. An analysis of the White SC-IAT component revealed that both White and Black participants had more positive than negative associations with Whites ($ds \geq 0.34$, $ps \leq .04$), and there was no significant difference in the valence of White associations held by Whites and Blacks, $t(111) = 0.18$, $p = .86$, $d = 0.03$. But for the Black SC-IAT component, Black participants had significantly more positive associations with Blacks than did White participants, $t(111) = 2.80$, $p < .01$, $d = 0.49$. Follow-up analyses revealed that Black participants had positive associations with Blacks ($d = 0.52$, $p < .01$), and White participants had equally positive and negative associations with Blacks ($d = 0.04$, $p = .72$). These results suggest that, on average, the SC-IAT racial bias emerged for Whites because of implicit in-group favoritism (favorable associations with Whites) and not because of implicit out-group prejudice (negative associations with Blacks).

SC-IAT scores can also be used to help interpret the contribution of evaluative White and Black associations to IAT scores. To investigate whether IAT scores reflect meaningful variations in both evaluative White and evaluative Black associations, a regression analysis was conducted to predict IAT scores from Black SC-IAT and White SC-IAT scores. This analysis revealed that race IAT scores were positively associated with White SC-IAT scores ($\beta = .24$, $p < .01$) and negatively associated with Black SC-IAT scores ($\beta = -.30$, $p < .01$). Thus, as expected, a Black–White IAT measured evaluative associations with both Blacks and Whites.

Correlations between measures. As expected, race SC-IAT scores were significantly correlated with IAT scores, $r(111) = .40$, $p < .01$. This relationship remained significant when examining only White participants, $r(77) = .36$, $p < .01$, and also when examining only Black participants, $r(32) = .40$, $p = .02$. Furthermore, White SC-IAT scores were uncorrelated with Black SC-IAT scores, $r(111) = -.11$, $p = .23$, suggesting that evaluative associations with Whites were independent from evaluative associations with Blacks.

All of the implicit measures tended to not be correlated with explicit measures of racial bias (see Table 6). For White participants in this sample, both the IAT and a race SC-IAT failed to correlate with explicit measures of racial attitudes (all $ps > .22$), whereas for Black participants, both the IAT and a race SC-IAT

Table 6
Study 3: Correlations Between Implicit and Explicit Measures

Explicit attitude measure	Race IAT	SC-IAT measures: Race SC-IAT	White SC-IAT	Black SC-IAT
White participants ($n = 79$)				
Explicit race attitudes	−.05	.14	.17	−.08
Explicit attitudes toward Whites	.08	.17	.16	−.08
Explicit attitudes toward Blacks	.14	.01	.17	−.02
Black participants ($n = 34$)				
Explicit race attitudes	.29†	.29†	.48*	.10
Explicit attitudes toward Whites	.07	.01	.25	.23
Explicit attitudes toward Blacks	−.23	−.23	−.15	.16

Note. SC-IAT = Single Category Implicit Association Test; IAT = Implicit Association Test.
† $p < .10$. * $p < .01$.

correlated marginally with explicit measures of racial attitudes (all ps $\leq .10$). Additionally, little evidence was found for correlations between the White and Black SC-IATs and their respective explicit attitude measures, either for White or Black participants (all ps $> .15$).

Discussion

Study 3 provided evidence for the validity of the SC-IAT on multiple levels. First, similar mean-level effects were observed on the IAT and the race SC-IAT. On both these measures, White participants displayed a pro-White bias, and Black participants displayed no significant evaluative race bias. For White participants, the race bias observed by using the IAT was substantially larger than the race bias observed by using the SC-IAT. However, because no objective measure of implicit race bias exists, it is unclear whether this difference in effect sizes between the measures is meaningful.

Second, the White SC-IAT and Black SC-IAT facilitated the interpretation of IAT and race SC-IAT scores. For White participants, the SC-IAT race bias emerged because of positive evaluative White associations and neutral evaluative Black associations; for Black participants, the lack of a SC-IAT race bias emerged because of positive evaluative Black associations and equally positive evaluative White associations. This pattern of results suggests that the SC-IAT and IAT race biases observed in White participants were, on average, a result of in-group favoritism and not out-group prejudice. At the very least, the current results show that IAT and SC-IAT race biases can be due to in-group favoritism and may occur in the absence of out-group negativity.

Third, the race SC-IAT correlated significantly with the race IAT. Thus, there is some evidence that the race SC-IAT and the race IAT are measuring similar aspects of Black–White evaluative associations. These results suggest that a Black–White IAT, a White SC-IAT, and a Black SC-IAT may all provide useful information regarding evaluative associations regarding Blacks and Whites. However, neither the IAT nor the SC-IATs consistently correlated with the explicit attitudes measures.

One area of concern regarding the SC-IAT is the low reliability coefficients of the SC-IAT measures, particularly the Black SC-IAT. Consistent with the findings of Study 1, the SC-IATs displayed lower levels of internal consistency than did the IAT. Although the White SC-IAT displayed adequate levels of reliability, the reliability of the Black SC-IAT was poor. In this study, the number of critical trials in the SC-IAT procedure was reduced from 72 to 48. It is possible, and indeed likely, that this modification adversely affected the reliability of the SC-IAT measure. A second modification to the SC-IAT procedure was an increase in the length of the response window from 1,500 ms to 2,000 ms. This change was intended to reduce the error rate, but this change was ineffective. The reliability and validity of the SC-IAT appear to be greater when the SC-IAT procedure includes at least 72 critical trials and a 1,500-ms response window, as was used in Study 2.

A more troubling possibility is that the low reliability of the SC-IAT was due to participants attempting to respond to the task in a socially desirable manner. This concern arises from the finding that the Black SC-IAT had poor reliability and from the reduced effect size on the race SC-IAT in White participants, compared with the IAT. The SC-IAT was designed to be relatively impervious to controlled processing in general and especially to social desirability concerns. The moderate-sized correlation between the IAT and a race SC-IAT suggests that social desirability pressures might not have affected SC-IAT responses in a sizable way. Nevertheless, the possibility that the SC-IAT may not be as implicit as previously thought is a disturbing finding, and Study 4 was designed to investigate this issue more thoroughly.

Study 4

One of the advantages of implicit measures of social cognition is that they are impervious to self-presentational motivations and social desirability concerns. Thus, for the SC-IAT to be useful as an implicit measure of social cognition, it must be shown that participants cannot control or fake their responses on the task.

There are reasons to suspect that it may be easier for participants to control or fake their responses on the SC-IAT than on the IAT. Undoubtedly, it is easier for participants to reconceptualize the instructions in order to disrupt measurement of the associations of interest on the SC-IAT than on the IAT. For example, participants may recode the SC-IAT instructions as follows: "If it is a 'bad' target word, press the right key; for all other target words, press the left key." Similarly, if the target category is represented by pictures and the evaluative dimension is represented by words (as in Studies 1 and 3), participants may use an "all pictures to the left" rule and avoid encoding the content of the target pictures. Although participants could use these strategies to control or fake their responses on the SC-IAT, it is not clear that they do use these strategies spontaneously.

Study 4 was conducted to investigate participants' ability to control or fake their responses on a SC-IAT measuring evaluative associations with women. Participants were randomly assigned to display positive or negative attitudes toward women and then completed a SC-IAT measuring evaluative associations with

women. Because the modifications of the SC-IAT procedure used in Study 3 (reducing the number of critical trials in each stage to 48 and increasing the response window to 2,000 ms) were ineffective, we used a SC-IAT with 72 critical trials in each stage and with a 1,500-ms response window (as was used in Study 2). For comparison purposes, participants also completed a male–female IAT and explicit attitude measures toward women.

We expected that participants would easily be able to present the desired response on the explicit attitude measures. A number of researchers have investigated the susceptibility of the IAT to faking. Steffens (2004) reviewed the literature and concluded that small, nonsignificant effects of faking on the IAT were typically observed. Thus, we anticipated a small effect of instruction on the male–female IAT scores. The primary question of interest was the effect of instruction on the female SC-IAT scores and how this effect compared with the effect observed for the IAT and explicit attitude measures.

Method

Participants

Eighty-four students (20 men, 64 women) enrolled in an introductory psychology course at Temple University participated in this study. All participants received course credit for their participation.

Procedure

Participants were randomly assigned to respond to all questions and tasks as if they had very positive attitudes or very negative attitudes toward women. Participants then completed a SC-IAT measure of evaluative associations with women, a male–female IAT, and self-report measures of attitudes toward women.

SC-IAT measure of female associations. The female SC-IAT was identical to the self-SC-IAT procedure used in Study 2, with appropriate modifications to measure associations with women. The evaluative dimension was labeled *good* and *bad*, and the concept dimension was labeled *female*. Five target words were used for the category female (*her, woman, girl, she,* and *lady*).

IAT measure of male–female associations. The IAT procedure was identical to the procedure used in Study 3 (i.e., unlike Studies 1 and 2, the procedure included response feedback), with appropriate modifications to measure associations with men and women. The evaluative dimension was labeled *pleasant* and *unpleasant,* and the attitude object dimension was labeled *female* and *male*. Five target words were used for each of the attitude object dimensions (male: *him, man, boy, he*, and *guy*; female: *her, woman, girl, she,* and *lady*). In Blocks 3 and 4, participants paired female + pleasant and male + unpleasant. This pairing was reversed in Blocks 6 and 7: male + pleasant and female + unpleasant.

Explicit measures of attitudes toward females. Participants next completed three explicit measures of attitudes toward women: a female semantic differential ($\alpha = .98$), a female feeling thermometer, and the Modern Sexism Scale (Swim, Aikin, Hall, & Hunter, 1995). The semantic differential and feeling thermometer measures were identical to those used in the previous studies, but the target category was changed to be *females*. Participants responded to the items of the Modern Sexism Scale on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*; $\alpha = .88$). Modern sexism scores were recoded so that higher numbers indicated less sexism. The three attitude measures were highly interrelated ($\alpha = .92$) and thus were averaged to compute a composite measure of self-reported attitudes toward women.

Results

IAT and SC-IAT Data Reduction and Reliability Analysis

As in the previous studies, IAT scores were computed by using the *D* algorithm, such that higher numbers indicate a profemale (and/or antimale) bias. For the IAT, a reliability coefficient was computed by correlating an IAT score computed from the practice trials with an IAT score computed from the test trials (adjusted $r = .78$). SC-IAT scores were computed by using the modified *D* algorithm, such that higher numbers indicate more positive than negative associations with women. To determine the reliability of the SC-IAT, a SC-IAT score was calculated for each of the three test blocks of 24 test trials (adjusted $r = .85$). Similar to Study 2, the SC-IAT displayed slightly higher levels of internal consistency than the IAT.

Effect of the Self-Presentation Instructions

As expected, participants instructed to present positive attitudes toward women displayed significantly more positive explicit attitudes toward women than did participants instructed to present negative attitudes toward women (present positive, $M = 0.71$; present negative, $M = -0.78$), $t(82) = 11.84$, $p < .01$, $d = 2.61$.

For the IAT, we first examined whether the error rate differed across conditions. A *t* test of the IAT error rate revealed no significant difference in the IAT error rate as a function of presentation instructions, $t(82) = 0.40$, $p = .69$, $d = 0.09$. Following the procedure from the previous studies, 1 participant with an error rate larger than 20% was excluded from the remaining IAT analyses, and the resulting error rate was 5.30%. Somewhat surprisingly, a medium instruction effect was observed for the IAT. Participants instructed to present positive attitudes toward women displayed significantly higher IAT scores than did participants instructed to present negative attitudes toward women (present positive, $M = 0.60$; present negative, $M = 0.37$), $t(81) = 2.03$, $p = .05$, $d = 0.45$.[2]

For the SC-IAT, we also examined whether the error rate differed across conditions. A *t* test of the SC-IAT error rate revealed a significant medium-sized difference in the SC-IAT error rate as a function of presentation instructions, $t(82) = 2.15$, $p = .04$, $d = 0.48$. Participants who attempted to present negative attitudes toward women had a significantly higher error rate on the task ($M = 18.04\%$) than did participants who attempted to present positive attitudes toward women ($M = 12.94\%$). An analysis of the SC-IAT scores of all participants revealed a large instruction effect (present positive, $M = 0.68$; present negative, $M = 0.28$), $t(82) = 3.31$, $p < .01$, $d = 0.73$. However, the standard practice with IAT and SC-IAT data is to exclude participants with high error rates from the analyses. Once the 25 participants with a SC-IAT error rate larger than 20% were removed from the data (10 from the positive condition and 15 from the negative condition), the overall SC-IAT error rate no longer differed by condition ($M = 9.42\%$),

[2] This presentation effect on IAT scores was observed only when the *D*-score algorithm was used to compute IAT scores; when the original log-based IAT scoring algorithm was used, no presentation effect emerged, $t(81) = 0.10$, $p = .92$, $d = 0.02$.

$t(57) = 0.47$, $p = .64$, $d = 0.12$. Furthermore, a t test revealed that SC-IAT scores did not differ significantly as a function of condition, although a small presentation effect in the anticipated direction was observed (present positive, $M = 0.60$; present negative, $M = 0.50$), $t(57) = 0.92$, $p = .36$, $d = 0.24$. These analyses suggest that participants can fake a SC-IAT score, but to do so they also increase their error rate.

An alternative interpretation of these results is that the fakers (those who had large SC-IAT error rates) are different from nonfakers, confounding the interpretation of the results. Although we cannot entirely rule out this possibility, we think it is unlikely. First, the fakers were not significantly different from the nonfakers on any demographic variable we had collected (gender, ethnicity, and native language; all ps $> .25$). Second, it is possible that the nonfakers were insensitive to the presentation manipulation and/or that the fakers tried harder than the nonfakers. However, the nonfakers did show the predicted self-presentation effect on the explicit attitude measures, $t(57) = 7.73$, $p < .01$, $d = 2.05$, and the size of this self-presentation effect did not differ between fakers and nonfakers, $t(80) = 1.45$, $p = .15$, $d = 0.32$. Furthermore, if the nonfakers did not take the SC-IAT task seriously, then we would expect their responses to be mostly error variance. On the contrary, these participants displayed a strong bias in favor of women, $t(58) = 12.60$, $p < .01$, $d = 1.64$, a result that is consistent with other female SC-IAT findings (Karpinski & Lytle, 2005). Finally, the fact that the nonfakers had low error rates also suggests that they approached the task with sincerity.

A Closer Analysis of SC-IAT Error Rates

The high error rates observed in this study appear to be specifically associated with the instruction manipulation. The SC-IAT error rate was higher in Study 4 than in Studies 1–3, and other studies have found normal error rates on the female SC-IAT when no presentation instructions were provided (see Karpinski & Lytle, 2005).

We conducted several follow-up analyses of the SC-IAT error rates to better understand why the instruction manipulation resulted in such high error rates on the SC-IAT. First, we investigated whether the increased error rate was due to an increase in true errors (pressing the wrong response key) or due to an increase in the failure to respond within the 1,500-ms response window. An inspection of the error rates revealed that the overall error rate (15.37%) was due to a high rate of incorrect responses (13.69%) and a low rate of failure to respond within the response window (1.68%).

Next, we computed overall error rates separately for each class of target word (female vs. good vs. bad) within each block of the SC-IAT (Block 1: female + good vs. Block 2: female + bad). A Target Word × Block × Instruction Condition mixed ANOVA on these error rates revealed main effects for each of the factors, but these main effects were qualified by two significant higher order effects: a Block × Condition interaction, $F(1, 164) = 12.00$, $p < .01$, and a Target Word × Block interaction, $F(2, 164) = 6.70$, $p < .01$ (see Figure 2).

The Block × Condition interaction indicates that participants who were instructed to present positive attitudes toward women had higher error rates when pairing female + bad than when pairing female + good ($d = 0.92$), whereas participants who were instructed to present negative attitudes did not significantly differ in their error rates across the blocks ($d = 0.05$). On average, participants in both instruction conditions showed evidence of more positive than negative associations with women, suggesting that in the absence of faking, most participants have more positive than negative associations with women (see also Karpinski & Lytle, 2005). Thus, participants instructed to present positive attitudes may not have had to adjust their responses for the female + good pairings as a result of the instructions—only when they reached Block 2 (pairing female + bad) did they have to start monitoring their responses, resulting in higher error rates. Conversely, participants instructed to present negative attitudes had to adjust their responses for the female + good pairings in response to the instructions. As a consequence, they may have adjusted their responses from the start of the task, resulting in high error rates in both blocks. Therefore, this Block × Condition interaction is consistent with the claim that participants make more errors when they are attempting to fake a SC-IAT score. Consistent with this interpretation, when participants with high error rates were excluded from the analysis, the Block × Condition interaction dropped to nonsignificance, $F(1, 114) = 1.52$, $p = .22$.

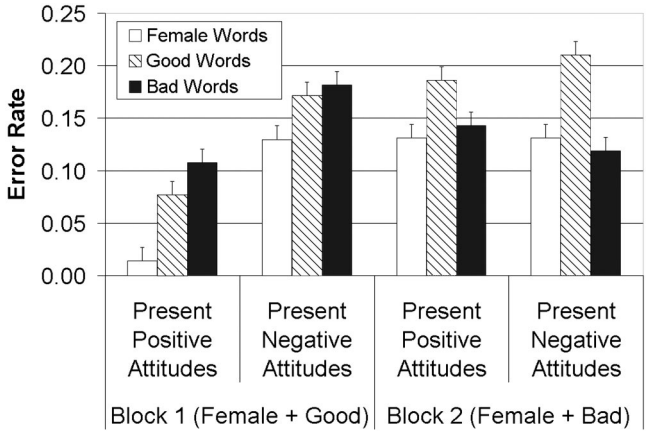

Figure 2. Single Category Implicit Association Test error rates by target, stage, and instruction condition ($N = 84$).

The Target Word × Block interaction indicates that participants' error rates for the types of target words differed across blocks. For Block 1 (female + good), participants had a lower error rate for female target words than for good target words ($d = 0.44$) or for bad target words ($d = 0.61$; and error rates for good and bad target words did not significantly differ, $d = .17$). For Block 2 (female + bad), participants had higher error rates for good target words than for female or bad target words (ds ≥ 0.43), and error rates for female and bad words did not significantly differ ($d = 0.01$). The interpretation of this interaction is unclear, but it does not appear to be a result of the presentation instructions. Supporting this conclusion, the Target Word × Block interaction remained significant once individuals with high error rates were excluded from the analysis, $F(2, 114) = 7.87$, $p < .01$.

Finally, we examined whether the D-score algorithm might exaggerate the effect of a high error rate on SC-IAT scores. The

D-score algorithm replaces errors with the block mean plus a 400-ms penalty. To determine whether this error penalty affected the results, we computed an alternative SC-IAT score by using the *D*-score algorithm, but we eliminated all error responses from the computation. An analysis on these adjusted SC-IAT scores paralleled the previous analysis. When all participants were analyzed, an instruction effect was observed, $t(82) = 2.53$, $p = .01$, $d = 0.55$, and this effect disappeared when participants with high error rates were excluded, $t(57) = 0.54$, $p = .59$, $d = 0.14$. Thus, the observed effects are not dependent on the inclusion or exclusion of incorrect response times in the scoring algorithm.

Discussion

The results of Study 4 suggest that participants can fake a SC-IAT score, but to do so they also significantly increase their error rate. Once participants with high error rates were excluded from the analysis, only a small, nonsignificant presentation effect remained. The bad news about these findings is that when participants wish to fake a SC-IAT score, a significant number of them spontaneously develop strategies that enable them to present the desired attitude. Participants in this study were not provided with strategies to fake the SC-IAT; they discovered strategies on their own. The good news about this finding is that when participants attempt to fake a SC-IAT score or to present a certain attitude on a SC-IAT, they are likely to make many errors, and they can be identified and excluded from subsequent analyses.

Somewhat surprisingly, participants were also able to fake IAT scores in this study. Participants who were able to present a particular attitude on the IAT did so without significantly increasing their error rate, making it impossible to identify them and remove them from the sample. We are somewhat skeptical of this result, as no faking effect was found when IAT scores were computed by using the older log-based scoring algorithm. Nevertheless, the concerns about the faking of SC-IAT scores appear to be no worse than concerns about faking of IAT scores.

The results of Study 4 suggest that several cautions regarding the use of the SC-IAT are in order. First, the ability of participants to fake a SC-IAT score may decrease power (due to the discarding of those with high error rates). Second, it may be the case that participants who are able to fake a SC-IAT score are different from those who were unable to fake a SC-IAT, resulting in a biased sample, although there is no evidence for this claim in the current study. Third, as previously highlighted, it may be easier for participants to fake a SC-IAT score if category targets are pictures and evaluative targets are words. For potentially sensitive domains, it may be prudent to present category targets and evaluative targets by using the same form of presentation (but there was no evidence of high error rates or faking of SC-IAT scores in Study 3 when Black and White faces were used as the target stimuli).

Finally, although we did not find presentation effects on the SC-IAT once participants with high error rates were removed, it does not mean that participants cannot devise other strategies to fake a SC-IAT. Although participants did not spontaneously devise effective strategies to fake a SC-IAT score without increasing their error rate, if we had provided participants with a strategy, it is likely that they could have carried out the strategy and we would have found a presentation effect on the SC-IAT. Participants may be more likely to spontaneously discover these alternative strategies if they complete multiple SC-IATs (although in another study, participants had to complete as many as four SC-IATs in a study session and showed no evidence of faking or presentation effects; see Karpinski & Lytle, 2005).

General Discussion

We developed the SC-IAT as a single-category measure of social cognition to complement the IAT. Whereas the IAT measures comparative associations between two attitude objects, the SC-IAT can assess the evaluative associations with a single attitude object. Across three different attitude domains—soda brand preferences, self-esteem, and racial attitudes—we found evidence that the SC-IAT makes unique contributions in the ability to measure and understand implicit social cognition. In the soda brand domain, a Coke SC-IAT and a Pepsi SC-IAT predicted behavioral intentions above and beyond what was predicted by the IAT and explicit measures of soda brand attitudes. As a measure of self-esteem, the SC-IAT demonstrated a significant medium- to large-sized correlation with explicit measures of self-esteem. In addition, the self-SC-IAT and the self–other IAT score were only marginally correlated, supporting the claim that the SC-IAT's measure of self-associations is theoretically distinct from the IAT's measure of self–other associations. As a measure of racial attitudes, similar mean-level effects were observed on the race IAT and the race SC-IAT. However, the use of a White SC-IAT and a Black SC-IAT allowed for a more detailed interpretation of the implicit race bias.

We also extensively examined the reliability of the SC-IAT. In general, the reliability of implicit measures of social cognition has been relatively poor, with the exception of the IAT (Bosson et al., 2000; Olson & Fazio, 2003). Across the four studies and six different SC-IAT measures, the internal consistency of the SC-IAT was reasonable (average $r = .69$; ranging from $r = .55$ to $r = .85$). These reliability coefficients are similar to the internal consistency observed for the IATs used in these studies (average $r = .73$; ranging from $r = .58$ to $r = .82$) and similar to the internal consistency observed for the IAT in previous research (Greenwald et al., 2003; Nosek et al., 2005). Thus, the SC-IAT appears to have a sufficient level of reliability to be of use as an individual difference measure of implicit social cognition.

For the SC-IAT to be useful as a measure of implicit social cognition, the SC-IAT must be relatively unsusceptible to faking or self-presentational concerns. We found that when participants attempted to self-present an attitude on the SC-IAT, many of them had high error rates. Once participants with large error rates were removed from the sample, there was only a small, nonsignificant effect of self-presentation ($d = .24$). This result is consistent with previous research on the IAT, suggesting that there may be a small effect of faking or self-presentation on the IAT (Steffens, 2004). Together, these findings provide strong evidence for the reliability and validity of the SC-IAT as a measure of implicit social cognition.

Interpreting the SC-IAT as a Measure of Evaluative Associations

There has been some controversy surrounding the interpretation of IAT scores (for overviews, see Arkes & Tetlock, 2004; Fazio & Olson, 2003). Because the methodology of the SC-IAT is a modification of the IAT, it is possible that the various proposed limitations and interpretations of the IAT also apply to the SC-IAT. A common theme of these alternative interpretations is that IAT effects may be due, at least in part, to factors other than affective valence. For example, IAT effects may be observed because of the cost of task switching (Mierke & Klauer, 2001), a criterion shift across the different blocks of the task (Brendl, Markman, & Messner, 2001), and the salience of the attitude objects (Rothermund & Wentura, 2004). Additionally, the IAT has been described as a measure of environmental associations, or extrapersonal associations, rather than as a measure of one's personal attitudes (Arkes & Tetlock, 2004; Karpinski & Hilton, 2001; Olson & Fazio, 2004). Some of these alternative interpretations are likely to apply to the SC-IAT as well. For example, the SC-IAT may reveal more about one's environmental associations than one's personal evaluative beliefs.

Additionally, we have been careful to describe the SC-IAT as a measure of associations with a single attitude object and not as an absolute measure of attitudes toward an attitude object. It is likely that no attitude can be measured in absolute terms and that all attitudes require some type of comparative judgment (Festinger, 1950). For example, to determine that one likes Pepsi, a person must know how much he or she likes other beverages or how much other people like Pepsi. Although a contrast category is not specified in the SC-IAT and the SC-IAT is less comparative than the IAT (which explicitly requires a comparison category), the SC-IAT also may not be an absolute measure of associations, in the purest sense. Furthermore, although the SC-IAT avoids using a contrast category for the target category of interest, it still measures the evaluation dimension comparatively (see Blanton et al., 2006).

The presence of these possible alternative explanations for SC-IAT effects and methodological issues regarding the SC-IAT do not suggest that the SC-IAT should not be used as a measure of associations, only that SC-IAT scores should be interpreted cautiously and with these potential limitations in mind.

Recommendations for Using the SC-IAT

On the basis of the results of the studies reported here and other studies conducted in our lab, we have several recommendations for researchers interested in using the SC-IAT as a measure of implicit social cognition. First, as previously mentioned, the SC-IAT is conceptually identical to the ST-IAT and has only minor procedural differences from the ST-IAT (Wigboldus et al., 2005). Compared with the SC-IAT, the ST-IAT includes an initial practice stage with only good and bad target words, has fewer target words in each stage, and does not use a response window. Furthermore, the internal consistency of the SC-IAT tends to be higher than the internal consistency for the ST-IAT (Christian ST-IAT, adjusted $r = .39$; Islamic ST-IAT, adjusted $r = .68$). Until studies are conducted to investigate the effects of these procedural differences on the reliability of single category or target measures, we recommend following the SC-IAT procedure to keep the reliability of the measure high.

Second, we recommend that the SC-IAT be used with at least 24 practice trials and 72 critical trials in each critical block. Unlike the IAT, the SC-IAT does not have separate practice stages; within each block, it is necessary to include practice trials and to exclude those trials from the final calculation of SC-IAT scores. SC-IATs with only 48 trials have been found to have lower internal consistencies than SC-IATs with 72 trials. Likewise, the internal consistency of the ST-IAT, with only 20 trials per block, has also been found to be lower than the internal consistency of the SC-IAT (Wigboldus et al., 2005). Thus, we suggest that 72 trials be the lower bound for the number of trials that should be used for each stage in a SC-IAT.

Third, we recommend that a 1,500-ms response window be included in the SC-IAT procedure. The response window may decrease the likelihood that participants engage in controlled processing during the task. Longer response windows do not appear to increase the reliability or to decrease the error rate, but it may be possible to decrease the response window without adversely affecting the error rate or the reliability of the measure.

Fourth, we recommend using the *D*-score algorithm to compute SC-IAT scores. For the IAT, the *D*-score algorithm has been shown to increase reliability, increase the correlations between the IAT and explicit measures, reduce the correlation between the IAT measure and speed of responding, and reduce the effect of procedural variables (Greenwald et al., 2003). Although not presented here, we also examined SC-IAT scores by using a log-based scoring algorithm, modeled on the original IAT scoring algorithm (Greenwald et al., 1998). We observed a very small trend for larger effect sizes and larger SC-IAT-explicit correlations when the *D*-score algorithm is used compared with the log-based algorithm. We did not have the large samples required to detect small differences between the scoring algorithms by using tests of statistical significance, but because of the similar methodology shared by the SC-IAT and IAT, it is likely that many of the advantages of the *D*-score algorithm will carry over to the SC-IAT.

Fifth, when the SC-IAT and the IAT are used in the same experimental session, we recommend that the SC-IAT measures precede any IAT measure. The IAT encourages a complementary, dichotomous mind-set toward the categories of interest. When an IAT is completed prior to a SC-IAT, the complementary mind-set may carry over to the SC-IAT, possibly resulting in a task that is not a measure of the associations with a single target category and in lower reliability for the task. However, it is also possible that completing the SC-IAT may adversely affect the IAT, and future studies are needed to examine the interplay between these two measures.

Finally, we have presented the SC-IAT as a measure of the evaluative associations with a single target category. However, like the IAT, the SC-IAT is a flexible measure that can be modified to assess other aspects of implicit social cognition. For example, the IAT has been used as a measure of gender identity by assessing the strength of associations between the self and the male–female dimension, relative to the strength of associations between others and the male–female dimension (Aidman & Carroll, 2003; Greenwald & Farnham, 2000; Rudman & Goodwin, 2004). The SC-IAT can be easily modified to assess the strength of associations

between the self and the male–female dimension, without also assessing other associations. In this case, the gender dimension (male–female) would still be assessed as a comparative dimension. The SC-IAT can be used to eliminate one comparative dimension but not both of the comparative dimensions. Likewise, the SC-IAT can be modified to provide measures of implicit stereotypes and other aspects of implicit social cognition (see Karpinski & Lytle, 2005). Additionally, for investigators who wish to reduce the contaminating effects of environmental, or extrapersonal, associations (see Olson & Fazio, 2004), a personalized SC-IAT can be constructed by replacing the category labels *good* and *bad* with *I like* and *I don't like*.

Conclusion

The IAT has been a breakthrough in the ability to measure and understand implicit processes. The SC-IAT is a measure that can be used alone or in combination with the IAT to further illuminate these implicit processes. By continually developing and refining individual difference measures of implicit social cognition, social psychologists can improve their understanding of implicit and explicit social cognition.

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Appendix

Target Words Used in the SC-IAT and IAT

IAT target words		SC-IAT target words	
Pleasant	Unpleasant	Good	Bad
brilliant	awkward	beautiful	angry
diamond	death[a]	celebrating	brutal
joy	hate[b]	cheerful	destroy
truth	failure[b]	excellent	dirty
sunrise	filth[a]	excitement	disaster
	slum[b]	fabulous	disgusting
	stink	friendly	dislike
	ugly[a]	glad	evil
		glee	gross
		happy	horrible
		laughing	humiliate
		likable	nasty
		loving	noxious
		marvelous	painful
		pleasure	revolting
		smiling	sickening
		splendid	terrible
		superb	tragic
		paradise	ugly
		triumph	unpleasant
		wonderful	yucky

Note. SC-IAT = Single Category Implicit Association Test; IAT = Implicit Association Test.
[a] Unpleasant words used in IAT for Study 3 only. [b] Unpleasant words used in IAT for Studies 1, 2, and 4 only.

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