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The Relationship of Personalized and Traditional IATs with Explicit Attitude and Behavioral Measures

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THE RELATIONSHIP OF PERSONALIZED AND TRADITIONAL IATS WITH
EXPLICIT ATTITUDE AND BEHAVIORAL MEASURES

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science

By

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September 16, 2011

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Rebecca Rae Riffle ENTITLED The Relationship of Personalized and Traditional IATs with Explicit Attitude and Behavioral Measures BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science

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ABSTRACT

Riffle, Rebecca Rae. M.S., Department of Psychology, Wright State University, 2011. The Relationship of Personalized and Traditional IATs with Explicit Attitude and Behavioral Measures.

Researchers suggest that the Implicit Association Test (IAT) is structurally flawed, allowing contamination of responses that are influenced by stereotypical associations. This research investigated the use of a personalized IAT (PIAT) to reduce extrapersonal associations. The IAT and the PIAT were adapted to measure unconscious gender bias in science, technology, engineering, and mathematics (STEM) fields. Explicit gender bias was measured by self-reports and a new measure, the Instant Uncontrollable Reactions (IUR) questionnaire. Partial support was found for the PIAT-explicit attitudes relationship reflecting less gender bias than the IAT-explicit attitudes relationship. It was expected that the PIAT-IUR relationship would show less gender bias than the IAT-IUR relationship, but this was not supported. However, the relationship between the IUR and explicit attitude and behaviors yielded many significant results. The present study adds support for the PIAT, introduces the use the IUR, and provides implications for reducing gender bias in the STEM workplace.
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I. INTRODUCTION

Researchers have studied the attitude-behavior relationship since the early 1900’s (LaPiere, 1934). In most studies, self-report measures are used to estimate the validity and consistency of attitudes and then examine their relationship to behaviors (Greenwald, Nosek, & Banaji, 2003; Han, Czellar, Olson, & Fazio, 2010; Olson & Fazio, 2004). However, self-reports capture only explicit (i.e., conscious) attitudes (Karpinski & Hilton, 2001). The Implicit Association Test (IAT) is a measure designed to detect implicit (i.e., unconscious) attitudes (Greenwald, McGhee, & Schwartz, 1998) and has been used frequently to measure prejudice, social identity, and levels of self-esteem (Olson & Fazio, 2004). The IAT assesses attitudes based on the categorization of target items and uses the response latency as an index of the strength of the automatic associations (Greenwald et al., 2003; Han et al., 2010). Associations that closely reflect an individual’s implicit attitudes (e.g. flower and pleasant vs. insect and unpleasant) are responded to faster than associations that do not reflect an individual’s attitudes (e.g. flower and unpleasant vs. insect and pleasant).

Researchers debate whether the IAT captures extrapersonal associations, which refers to irrelevant information of a social or cultural nature such as stereotypes, instead of implicit attitudes (Karpinski & Hilton, 2001; Olson & Fazio, 2004). Societal pressures and influences can affect how individuals explicitly evaluate a target object, causing a mismatch between their implicitly held evaluations and their behavior (Han et al., 2010; Olson & Fazio, 2004). Due to these potential problems with the IAT (e.g., capturing
extrapersonal associations), Olson and Fazio (2004) developed a personalized version of the IAT (PIAT) to measure implicit attitudes in a way that is more aligned with assessing personal attitudes. This research examined the relationship between the PIAT and IAT with explicit attitude measures and behaviors in the domain of gender bias toward scientists in the science, technology, engineering, and mathematics (STEM) fields.

**Attitude-Behavior Inconsistency**

LaPiere (1934) conducted an experiment in which he travelled across the western United States along with a Chinese couple. Along the way, they stopped at various hotels and restaurants and found only one out of 200 businesses that overtly discriminated against the Chinese couple. Six months after the journey, LaPiere sent a letter to each of the 200 establishment owners, asking if they would serve Chinese guests. Ninety-two percent of the owners responded that they would not serve Chinese patrons, even though the majority had during the journey with LaPiere (Fazio & Roskos-Ewoldson, 2005; Perry, Gillespie & Parker, 1976). Since detection of this attitude-behavior inconsistency, scientists have examined attitude theory and attempted to explain why the discrepancy exists between attitudes and subsequent behaviors (Ajzen & Fishbein, 1977; Han et al., 2010; Snyder & Kendzierski, 1982). This early study led researchers to investigate the attitude-behavior relationship in various domains such as voting (Fazio & Williams, 1986), choosing to engage in social situations that are consistent with personal beliefs (DeBono & Snyder, 1995; Snyder & Kendzierski, 1982), and racial and gender prejudice (Nosek et al., 2009; Olson & Fazio, 2004).
The Attitude Construct

Explicit attitudes are conscious, based on recent experiences, and accessible in memory (McConnell & Leibold, 2001). They reflect how positive or negative a person feels about a target object (Jaccard, Radecki, Wilson, & Dittus, 1995). These attitudes are intentional thoughts or feelings. However, they are subject to normative pressures such as demand effects and social desirability concerns, especially when the attitude object is controversial (e.g., same-sex marriage, abortion, politics; McConnell & Leibold, 2001; Rudman, 2004). In many situations, people care about what others think of them and will endorse attitudes similar to those they care about. Whereas explicit attitudes reflect the intentional, deliberate component of how one feels about a target object, implicit attitudes reflect automatic, unconscious associations about a target object.

Implicit attitudes are involuntary evaluations of an attitude object that are made evident by behaviors or judgments (Greenwald & Banaji, 1995; Greenwald et al., 1998; Rudman, 2004). These attitudes happen automatically before a person has had time to consciously think about a target object and are the foundation for later appraisals and behaviors (Rudman, 2004). For example, women who were raised to endorse the content of fairy tales may, on an implicit level, expect their mate to possess chivalric and otherwise heroic qualities. Another example is the long-standing prominence of negative attitudes toward minorities. These attitudes are likely to remain even when society views minority and majority groups as equal (Rudman, Feinberg, & Fairchild, 2002). People may attempt to consciously alter their explicit beliefs to be contrary to these automatic associations, but may still internalize more negative connotations generally held toward
minorities. Individuals may not even be aware of, or are not willing to admit, that they possess a particular prejudice.

This distinction between implicit and explicit attitudes was explored in research with minority groups (Livingston, 2002; Rudman et al., 2002). Livingston (2002) studied perceived negativity toward minority groups and found that Black participants’ social standing had an influence on their in-group bias. This perceived negativity had a positive correlation with explicit attitudes, but a negative correlation with implicit attitudes. Compared to Blacks who believed that Whites liked their group, Blacks who believed that Whites did not like their group reported a strong pro-Black bias on explicit measures, but had a pro-White bias on implicit measures. In another study, Rudman et al. (2002) found that those with a lower cultural status (i.e. poor, overweight) showed a significant preference toward the higher status group (i.e., rich, thin). For example, when Christians were perceived as higher in status than Jews, Jews associated Christians with positive attributes and Jews with negative attributes. These findings suggest that minorities with the lowest social status are inclined to undervalue their group and unconsciously legitimize the supremacy of the dominant group.

**Attitude Measurement**

There are many ways to measure attitudes, with self-reports being the most popular way to measure explicit attitudes. Fazio and Williams (1986) gave voting age residents questionnaires to assess their attitudes regarding the 1984 presidential election. Voter attitudes about the candidates were explicit and therefore easy to measure with a questionnaire. Attitudes were a significant predictor of voting behavior for both Reagan and Mondale, yet participants’ attitudes about Reagan were much more predictive of their
voting behavior due to the prevalence of President Reagan in the media. Explicit attitude measures were designed to measure easily accessible attitudes. However, while self-reports are dependable in temperate domains, they may not be as reliable with controversial topics (Fazio, 2005).

The directness of explicit attitude measures for controversial topics can cause construct validity concerns due to social desirability and experimenter demand effects (Wilson, Linsey, & Schooler, 2000). Those concerned with social desirability attempt to maximize their socially favorable traits and minimize their socially unfavorable traits (DeMaio, 1984). Self-reports allow people time to think about their answers and present themselves in whatever way they desire. Given a controversial topic, those high in social desirability might be less likely to report their true attitudes and instead endorse attitudes that they think society or the experimenter holds.

The present study examined a new explicit attitude measure that might reduce the effects of social desirability. The Instant Uncontrollable Reactions (IUR) questionnaire was designed by Zanna and colleagues to assess automatic reactions by assuring participants that involuntary negative reactions to situations are normal (R. Fazio, personal communication, December 8, 2009). Stereotypes, which are activated automatically and almost instantaneously, exist in all cultures and the purpose of the IUR was to capture these split-second reactions. The IUR attempted to remove the effect of social desirability by asking for the initial response to an item, whether the response was positive or negative. To help counter the social influences on explicit measures, researchers also use indirect implicit measures and look for a relationship between the explicit and implicit measures.
Research suggests that implicit and explicit attitudes are independent of each other and are assessing different attitudes, yet still have a relationship with one another (Greenwald et al., 1998; Karpinski & Hilton, 2001; Nosek, 2005). The strength of the implicit-explicit relationship varies across domains, explaining the range in correlations (i.e., no correlation to moderate correlation) between implicit and explicit attitude measures (Nosek, 2005). Attitudes that are at odds with a person’s explicit beliefs can be prompted automatically, suggesting that multiple processes are being used to assess a target object. Consequently, measures assessing implicit and explicit attitudes are typically correlated with each other to assess their level of convergence. However, because implicit attitudes are unconscious, they cannot be measured with self-reports due to the directness of these types of tests (Karpinski & Hilton, 2001). Indirect measures, typically based on projective or reaction time tasks, are needed to tap into these unconscious beliefs. Explicit measures assess an appraisal after intentional control processes have been given the chance to modify a response, whereas implicit measures assess the appraisal before intentional control processes commence (Nosek, 2005). One of the most widely used implicit attitude measures today is the IAT.

The Implicit Association Test

Greenwald et al. (1998) designed the IAT to measure implicit attitudes by capturing the automatic associations an individual has toward target objects. The IAT measures the strength of an implicit attitude by using reaction time to assess how quickly and accurately an individual can associate an object (e.g., an insect or a flower) with an evaluative attribute (e.g., pleasant or unpleasant words; Karpinski & Hilton, 2001). The IAT works best with concepts that are highly associated. For example, the sorting tasks
are easier when the concepts require a compatible response, such as categorizing items related to flower and pleasant or insect and unpleasant, than when concepts require an incompatible response, such as categorizing items related to flower and unpleasant or insect and pleasant (Olson & Fazio, 2004). Research has shown that the IAT is not biased by the test-taker’s familiarity with the target words used in the test (Dasgupta, McGhee, Greenwald, & Banaji, 2000) and is adaptable to many categories that are capable of triggering attitudes (e.g., weapons vs. harmless objects, young vs. old, disabled vs. abled; Greenwald et al., 1998; Karpinski & Hilton, 2001).

The IAT is popular with both the scientific community and the general public because it is easy to administer and has had a large amount of press coverage (Karpinski & Hilton, 2001). It is adaptable for many research functions (Nosek & Hansen, 2008) and even has its own website. Project Implicit, the international IAT Website (https://implicit.harvard.edu/implicit), is a virtual laboratory where visitors can take over 90 types of IATs measuring various political issues, prejudice, and sex biases so people can discover their own implicit biases. There have been over 4.5 million online tests taken since 1998 when Project Implicit began and there are 44 researchers listed on the Project Implicit Team.

**IAT Procedure.** The IAT is a categorization task designed so that there is only one correct category for each item (Greenwald et al., 1998). For example, in the racial IAT participants are presented with typically Black and White names (e.g., *Tyrone, Hank*) and pleasant and unpleasant words (e.g., *love, stink*). The participants are tested when the categories are combined. The compatible task involves associating White names with pleasant words and Black names with unpleasant words. The incompatible
task involves associating White names with unpleasant words and Black names with pleasant words. Participants are given error feedback if they categorize incorrectly (e.g., a red “X” appears on the screen to prompt the participant to choose the other option). For example, if a participant is given the compatible task and pairs Tyrone with White or love with unpleasant, they receive an error. IAT scores are based on the comparison of response times obtained when comparing compatible versus incompatible pairings. When the task is done, participants who responded more quickly to Black and pleasant than White and pleasant would be said to have more positive associations with Blacks than Whites. Alternatively, participants who responded quicker to White and pleasant than to Black and pleasant are said to have more positive associations with Whites than Blacks.

Potential Problems with the IAT. Since the inception of the IAT there have been debates concerning the ability of the IAT to measure implicit attitudes (Blanton et al., 2009; DeHouwer, 2001; Karpinski & Hilton, 2001). According to DeHouwer (2001), IAT participants seek out the specific information in the target words that is needed to correctly categorize the item. For example, if the IAT categories are “man scientist” and “woman scientist,” a participant seeing the stimulus item “Mary, the physicist” would search for the gender term only (i.e., Mary) instead of considering the entire item. To test this, DeHouwer conducted a British-foreigner IAT, using both positive and negative “British” (e.g., the Queen Mother, Margaret Thatcher) and “foreigner” (e.g., Einstein, Hitler) items. The results showed that the British category was more associated with pleasant items whereas the foreigner category was more associated with unpleasant items because the categories forced the items to be construed as belonging to only one
respective category. Because foreigner and unpleasant were one of the compatible conditions, making British and pleasant the other compatible condition, Einstein was compatible with unpleasant. As DeHouwer suggested, the membership of the name Einstein in the foreigner category is what mattered most to participants, so once the information needed in the target item was found, the item was categorized and forgotten about. This categorization issue is not the only problem occurring with the IAT.

Karpinski and Hilton (2001) suggested that IAT results are influenced by environmental associations, which are situational associations an individual has been exposed to that are irrelevant to a personalized attitude toward the target object. Karpinski and Hilton were not convinced that the IAT measures the unconscious attitudes of participants. Rather, it may measure attitudes that are under the influence of environmental learning. They conducted three studies that systematically tested for environmental associations and investigated the relationship between the IAT and explicit attitude measures. In Study 1, participants completed a flower-insect IAT and explicit attitude measures. There was no relationship between the IAT and explicit attitude measures, suggesting that the IAT and explicit attitude measures are independent of each other.

Their second study examined the relationship of the IAT and explicit attitude measures to consumer choice behavior (Karpinski & Hilton, 2001). In one condition, participants completed an apple-candy bar IAT and explicit attitude measures, and were then to choose either an apple or a candy bar. In the other condition, participants completed only an apple-candy bar IAT before choosing either an apple or a candy bar. Once again, there was no relationship between the IAT and explicit attitude measures,
further suggesting that they are separate constructs. However, the explicit attitude measures predicted behavior, whereas the IAT did not. The explicit measures revealed the same preference for apples, candy bars, or both. The IAT revealed a high preference for apples, yet less than half of the participants chose an apple. To explain this difference, it was suggested that the IAT could be more predictive of unconscious behaviors rather than behaviors that involve selection (Karpinski & Hilton, 2001).

Study 3 was designed specifically to test the environmental association model using a youth-elderly IAT (Karpinski & Hilton, 2001). According to the model, repeated exposure to associations between concepts (i.e., compatible concept = youth and good; incompatible concept = elderly and good) would affect IAT scores, but explicit attitudes would not be changed. There was no relationship between the IAT and explicit attitude measures. However, the IAT revealed an elderly bias when presented with the incompatible manipulation and a youth bias when presented with the compatible manipulation, whereas explicit attitudes were not influenced by the manipulation. IAT scores being affected by the manipulation provided some support that environmental associations can influence and contaminate the IAT. Karpinski and Hilton created the term environmental associations, whereas other researchers (Han et al., 2010; Olson & Fazio, 2004) refer to these contaminants of the IAT as extrapersonal associations.

The Influence of Extrapersonal Associations

Similar to environmental associations, an extrapersonal association is knowledge that is relevant to the target object, but irrelevant to the individual’s personal evaluation of the object (Han et al., 2010). This information is stored in memory, but has been deemed either inconsequential, not in accordance with one’s personal preferences, or is
believed to be false. For example, an individual with an aversion to spiders likely
developed this attitude as a consequence of an incident with a spider at some point.
Reinforcement of the aversion will occur each time the individual avoids close proximity
to a spider. Positive knowledge the individual has about spiders or having close friends
who like spiders are extrapersonal associations. They are available in memory, but have
no impact on the person’s attitude about spiders.

Extrapersonal associations may influence implicit attitudes, depending on how the
latter are measured. Berdik, Wax, and Tetlock (2007) found that because negative
stereotypes of African-Americans already exist in the United States, they can influence
implicit attitude measures. As a result, there are individuals who discriminate, yet deny
that they are prejudiced. On the other hand, some individuals may be aware of societal
stereotypes, yet are not personally prejudiced or do not actually discriminate. This
illustrates how certain attitudes and behaviors can be consciously controllable. Some
researchers suspect that the IAT measures extrapersonal associations, and may not reflect
an individual’s true attitudes (Han et al., 2010; Olson & Fazio, 2004).

Societal influences and persuasive messages can be compelling and influence
attitudes (Han et al., 2010). Interactions that contribute to personal attitudes can occur on
individual, communal, and national levels. It is when individual attitudes differ from
cultural and societal views that these views become extrapersonal in nature (Han et al.,
2010; Olson & Fazio, 2004). A personalized version of the IAT was created to minimize
the effects of these extrapersonal associations.
Personalizing the IAT

Olson and Fazio (2004) created the personalized IAT (PIAT) in an attempt to reduce the explicit demand put upon participants to categorize items in accordance with stereotypes. Specifically, they addressed procedural problems with the IAT and modified category labels in an attempt to reduce the influence of attitude-irrelevant information on implicit attitudes (Han et al., 2010; Olson, Crawford, & Devlin, 2009; Olson & Fazio, 2004). One problem with the IAT procedure is that it provides error feedback when a participant makes a mistake, suggesting that a standard, and typically stereotypical (e.g., flower = pleasant), response is necessary. The error feedback was removed from the PIAT, thereby decreasing the sense of a requirement for standard responding. The PIAT also replaces the “pleasant” and “unpleasant” category labels used in the IAT with “I like” and “I don’t like.” These changes were intended to focus attention on personal likes and dislikes while categorizing (Han et al., 2010; Olson & Fazio, 2004). The ambiguity of the IAT category labels leave them open to interpretation and allow the activation of any accessible information in memory, rather than personal attitudes, to drive the categorization task (Han et al., 2010). Accessible information may not be consistent with the personal attitudes of the participant. By modifying the category labels to “I like” and “I don’t like,” the participant will not have to wonder whose perspective to consider when categorizing (Olson & Fazio, 2004). The category labels and error feedback likely facilitated contamination of IAT results by increasing the accessibility of extrapersonal associations.

Four studies were conducted by Olson and Fazio (2004) to provide evidence supporting the modifications to the IAT. In Study 1, participants took both a race IAT
and PIAT. For the PIAT, the stimulus items that were categorized were changed to idiosyncratic items that had no obvious normative appraisal (e.g., coffee, storms, garlic). Since the stimulus items were not identical in both IATs, they could not be compared. Response latencies were slower for the PIAT due to the use of non-normative stimulus items. They were not as easy to categorize as items that are universally pleasant or unpleasant. However, compared to the IAT, the PIAT showed significantly less negativity toward Blacks, using Greenwald et al.’s (1998) original scoring procedure. The results were confirmed upon using Greenwald et al.’s (2003) improved scoring algorithm, which is used in the present study (see Method section below). These findings show that the PIAT is successful at reducing the amount of racial prejudice for this type of implicit attitude test.

The second study extended Study 1 by making two adjustments: a between-subjects design was employed, and the IAT and PIAT used identical stimuli (i.e., universally pleasant and unpleasant items; Olson & Fazio, 2004). Participants were randomly assigned to complete either the IAT or PIAT. As with Study 1, compared to the IAT, the PIAT revealed significantly less racial prejudice using Greenwald et al.’s (1998) original scoring procedure. However, there were no significant IAT/PIAT differences in explicit attitudes using Greenwald et al.’s (2003) algorithm. Interestingly, participants given the PIAT responded with comparable reaction times as those taking the IAT, yet the PIAT reflected a reduction of prejudice. These results suggest that the change in error feedback and the “I like” and “I don’t like” labels induce a level of personalization for the PIAT and effectively attenuates the effects of extrapersonal associations.
Explicit attitude and behavioral measures were introduced in Study 3, which predicted stronger correlations of these measures with the PIAT than the IAT (Olson & Fazio, 2004). Participants completed an apple-candy bar IAT or PIAT and explicit attitude measures, indexing favorable attitudes toward apples and candy bars. As in Study 1, the stimulus items differed for the IAT (e.g., freedom, abuse) and the PIAT (e.g., Snickers, cider). The PIAT correlated significantly with the explicit attitude measures using Greenwald et al.’s (1998) scoring method and the updated algorithm (Greenwald et al., 2003). However, the IAT correlated only weakly with all of the explicit attitude measures. Three of the six explicit attitude measures revealed a significant preference for apples over candy bars, although all showed at least a small preference for apples. Participants completing the IAT had a greater preference for apples over candy bars. In contrast, the PIAT revealed equal preference for apples or candy bars, suggesting that participants’ personal preference of apples or candy bars was not subject to social desirability effects.

Their final study aimed to extend the findings of the PIAT-explicit attitude correlations to another area (Olson & Fazio, 2004). They expected to demonstrate that the personalized category labels and removal of error feedback were sufficient enough to increase the correlation of the PIAT with explicit attitudes. Participants completed an IAT or PIAT, explicit attitude and behavioral intention measures about voting behavior during the 2000 presidential election. The PIAT had larger significant correlations with all of the explicit attitude measures than the IAT using the original and new scoring procedures (Greenwald et al., 1998; Greenwald et al., 2003, respectively). The PIAT was also significantly correlated with behavioral intention using both scoring algorithms,
whereas the IAT was not. Voting behavior did not correlate significantly with either implicit measure, but was stronger for the PIAT than the IAT. This study confirmed the expectation that the PIAT would reduce the influence of extrapersonal associations by correlating more strongly with explicit attitudes, behavioral intentions, and voting behaviors.

In summary, Olson and Fazio’s (2004) research on modifications to the IAT revealed that the IAT has the potential to be influenced by extrapersonal associations. Both within- and between-subjects studies have found that extrapersonal associations influence the IAT by evoking stronger biases toward societal stereotypes. Throughout the studies, error rates for the IAT and the PIAT were equivalent, suggesting that response accuracy was not a factor for significant differences between the IAT and PIAT scores. The two keystrokes needed to categorize items were used equally throughout the experiment, ensuring that both were used. Studies 1 and 3 used different stimulus items for the IAT and PIAT, whereas Studies 2 and 4 used the same items for the IAT and PIAT. Consequently, the response latencies for the PIAT in Studies 1 and 3 were larger than the latencies for the IAT. This produced a main effect for IAT type (i.e., the IAT or PIAT) in Study 1 only. Despite the larger response times, the PIAT resulted in less prejudiced attitudes and higher correlations with explicit attitude measures. These findings show that the combination of changing category labels and removing error feedback is enough to reduce extrapersonal associations in the IAT, making the PIAT a more viable candidate for assessing personal implicit attitudes.
The Present Research

The present study used the IAT and PIAT to investigate implicit attitudes about men and women STEM scientists (i.e., college professors), and were administered in an academic setting. Nosek et al. (2009) gathered data from Project Implicit and discovered that people generally have a stronger association of men with science than women with science. These stereotypes may be one reason fewer women are drawn to STEM careers (Bilimoria, Joy, & Liang, 2008; Nosek et al., 2009). Women who believe that women do not perform well in science and mathematics are less interested in pursuing these classes or careers. This is not to say that women do not succeed in STEM fields, but there are clear sex differences in STEM involvement and performance. The difference in women’s success, involvement, and performance is at the academic and organizational level (Bilimoria et al., 2008). Even though a larger number of women are earning advanced science and engineering degrees, these women are not entering the workforce. For the present study, we investigated a gender-science bias theme for all measures.

The correlations of the IAT and PIAT with explicit attitude and behavioral measures were evaluated to determine which implicit test may be more reflective of gender bias. It was expected that, because stereotypes about men and women scientists exist, there would be a difference between the implicit measures, which are articulated in the following hypotheses:

*Hypothesis 1:* The PIAT-explicit attitudes correlations would reflect less gender bias than the IAT-explicit attitudes correlations.

*Hypothesis 2:* The PIAT-behavioral measures correlations would reflect less gender bias than the IAT-behavioral measures correlations.
Hypothesis 3: The PIAT-IUR correlations would reflect less gender bias than the IAT-IUR correlations.
II. METHOD

Participants and Design

Participants included 52 introductory psychology students (Caucasian \( n = 20, \) 38%), African-American \( n = 8, \) 15%), Asian or Pacific Islander \( n = 3, \) 6%), Hispanic/Latino \( n = 1, \) 2%), and 20 \( (38\%) \) of mixed or unreported ethnic background) at a Midwestern university from STEM related majors. The sample consisted of 31 women \( (60\%) \) and 21 men \( (40\%) \) with a mean age of 21 (see Table 1 for means and standard deviations). The sample included a higher number of freshmen \( (n = 16, \) 31%), whereas seven were sophomores \( (14\%) \), nine were juniors \( (17\%) \), three were seniors \( (6\%) \), and two reported other \( (4\%) \). Past research reporting correlations of the IAT and PIAT with explicit measures were used to determine power (significant correlation ranges were .32 to .67 and .38 to .69; Karpinski & Hilton, 2001, Olson & Fazio, 2004). Participation in the study was voluntary and all participants received partial course credit. This research was funded by the National Science Foundation (ADVANCE HRD 081098) and was part of a larger study. The present study employed a between-subjects design where participants were randomly assigned to their IAT or PIAT task group.
Table 1

*Means (Standard Deviations) for Major Variables and Demographics for the Sample and by Task Condition*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample (N = 52)</th>
<th>IAT (n = 26)</th>
<th>PIAT (n = 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>21.05 (4.00)</td>
<td>20.75 (2.57)</td>
<td>21.29 (4.87)</td>
</tr>
<tr>
<td>Sex</td>
<td>1.41 (.50)</td>
<td>1.32 (.48)</td>
<td>1.50 (.51)</td>
</tr>
<tr>
<td>IAT/PIAT D score</td>
<td></td>
<td>-.37 (.41)</td>
<td>-.07 (.39)</td>
</tr>
<tr>
<td>IUR</td>
<td>3.69 (.62)</td>
<td>3.86 (.59)</td>
<td>3.51 (.60)</td>
</tr>
<tr>
<td>Explicit measures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>4.21 (.79)</td>
<td>4.40 (.60)</td>
<td>4.03 (.92)</td>
</tr>
<tr>
<td>Favorable (10-point)</td>
<td>8.63 (1.52)</td>
<td>8.58 (1.45)</td>
<td>8.69 (1.62)</td>
</tr>
<tr>
<td>Associate with STEM</td>
<td>2.96 (.85)</td>
<td>2.83 (.56)</td>
<td>3.10 (1.05)</td>
</tr>
<tr>
<td>Likeable</td>
<td>3.68 (.75)</td>
<td>3.69 (.66)</td>
<td>3.67 (.84)</td>
</tr>
<tr>
<td>Donations</td>
<td>.20 (.74)</td>
<td>.08 (.27)</td>
<td>.31 (1.00)</td>
</tr>
<tr>
<td>Volunteer hours</td>
<td>.58 (1.49)</td>
<td>.31 (1.09)</td>
<td>.85 (1.78)</td>
</tr>
<tr>
<td>Brochure taken</td>
<td>.54 (.50)</td>
<td>.54 (.51)</td>
<td>.54 (.51)</td>
</tr>
<tr>
<td>Behavioral Composite</td>
<td>1.31 (1.88)</td>
<td>.92 (1.47)</td>
<td>1.70 (2.17)</td>
</tr>
</tbody>
</table>

*Note.* Sex, 1 = women, 2 = men.

**Materials**

**The IAT.** Participants categorized a variety of items using Inquisit 3.0 software. Procedures were adapted from Greenwald et al. (1998). There were 7 blocks consisting of 180 trials total (see Table 2). A set of instructions presented on the computer screen preceded each block informing participants that they would be presented with a set of words to classify into groups, where the category labels were located, and the two
keyboard keys to use for responding (I and E). On a given trial, a stimulus item was presented in the center of the screen. The participant categorized the word by pressing either the E key if it belonged in the category on the left side of the screen or the I key if it belonged in the category on the right. Participants received feedback (i.e., a red X through the incorrectly categorized stimulus item that disappeared once the correct response was selected) in every block for incorrect responses.

Table 2

*Sequence of Trial Blocks for the STEM Scientist (Man vs. Woman) IAT*

<table>
<thead>
<tr>
<th>Block</th>
<th># of trials</th>
<th>Function</th>
<th>Items assigned to left category</th>
<th>Items assigned to right category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>Practice</td>
<td>Man scientist</td>
<td>Woman scientist</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>Practice</td>
<td>Pleasant</td>
<td>Unpleasant</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>Practice</td>
<td>Pleasant + Man scientist</td>
<td>Unpleasant + Woman scientist</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>Test</td>
<td>Pleasant + Man scientist</td>
<td>Unpleasant + Woman scientist</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>Practice</td>
<td>Woman scientist</td>
<td>Man scientist</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>Practice</td>
<td>Pleasant + Woman scientist</td>
<td>Unpleasant + Man scientist</td>
</tr>
<tr>
<td>7</td>
<td>40</td>
<td>Test</td>
<td>Pleasant + Woman scientist</td>
<td>Unpleasant + Man scientist</td>
</tr>
</tbody>
</table>

*Note.* The PIAT replaced the categories pleasant and unpleasant with “I like” and “I don’t like” respectively.

Blocks 1 and 5 were for practice categorizing “man scientist” (e.g., Chemistry Professor Christopher Smith) and “woman scientist” (e.g., Biochemistry Professor Christine Reed; see Appendix A for all stimulus items; first name stimuli from www.ssa.gov, profession stimuli from R. Fazio & T. Schneider, personal communication, December 15, 2009). Block 2 was for practice categorizing items as “pleasant” (e.g.,
laughter) and “unpleasant” (e.g., agony). The items presented (adapted from Greenwald et al., 1998; Nosek, Banaji, & Greenwald, 2002) were universally pleasant or unpleasant. Block 3 was practice with combined categories (e.g., man scientist and unpleasant) and Block 4 was a test of Block 3. Block 5 reversed the Block 1 category labels. Block 6 was designed as practice with the combined categories and Block 7 was a test of Block 6. Stimulus items were randomly set for each trial. The block categories were randomized so that 50% of the time, the category labels from Blocks 1, 3, and 4 were switched with Blocks 5, 6, and 7, respectively. This allowed half of the participants to receive the compatible items (i.e., man scientist and pleasant vs. woman scientist and unpleasant) first, and half to receive the compatible items last.

The IAT was scored using the improved algorithm by Greenwald et al. (2003; see Table 1 for mean and standard deviation). All trials from Blocks 3, 4, 6, and 7 (the combined category blocks) were used. Trials with response latency over 10,000 milliseconds (ms) were eliminated and replaced with the block mean. Latency more than 10,000 ms indicated the participant was distracted or did not understand the task directions. Participants with latency less than 300 ms more than 10% of the time were eliminated as well. Latency less than 300 ms was not enough time to read, comprehend, and categorize an item (Greenwald et al., 2003). The optimal response time was between 300 and 3,000 ms. A mean for each block was computed using correct response latencies. A pooled standard deviation was computed for Blocks 3 and 6 (the practice blocks with combined categories), and for Blocks 4 and 7 (the repeated blocks with combined categories). Two mean differences were computed: Block 6 minus Block 3, and Block 7 minus Block 4. Each difference was divided by its associated pooled

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standard deviation and the two quotients were averaged to determine a final score. The final $D$ score was the difference in average latency between the compatible (e.g., Blocks 6 and 7) and incompatible (e.g., Blocks 3 and 4) conditions (Greenwald et al., 1998), which assessed the participant’s implicit attitude toward the categories being studied.

The difference between the present $D$ score and Cohen’s $d$ (Cohen, 1977) is that the standard deviation in the denominator of the $D$ was calculated using scores in both IAT conditions, ignoring the association with either condition, while the $d$ standard deviation is a pooled within-treatment standard deviation. Given the category ratings in the proposed IAT, higher scores indicated more positive attitudes toward women scientists. For example, higher scores in the woman scientist/pleasant condition than the man scientist/unpleasant condition indicated a stronger association between women scientists and pleasant items, thus a more positive attitude toward women scientists.

**The PIAT.** The materials, procedures, and scoring for the PIAT were similar to the IAT (see Table 1 for mean and standard deviation). However, the labels pleasant and unpleasant were replaced with “I like” and “I don’t like.” Participants received feedback for incorrect responses only in Blocks 1 and 5 to ensure they understood the categorization instructions. This method differs from the one used by Olson and Fazio (2004) in that they did not provide error feedback for any trials to encourage personalization of the tasks.

**Explicit Attitude Measures.** Participants completed explicit attitude measures toward men and women scientists (adapted from Olson & Fazio, 2004; see Appendix B for full listing). Explicit measures include the following: five semantic differential items (e.g., Bad-Good, using a 5-point rating scale ranging from 1 (Bad) to 5 (Good)), a feeling
thermometer ("Please rate on a scale of 1 (unfavorable) to 10 (favorable) how you feel about the following groups."), an attitude measure (e.g., “I dislike women scientists.”) using a 5-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree)), and an intention measure (e.g., “I have taken a science course from a male professor,” with the answer options yes or no). Appropriate items were reverse-scored so that higher scores reflect a more favorable attitude toward women scientists.

A Principal Axis Factor analysis (PAF) with a Varimax rotation of the 15 Likert-type scale items from the explicit attitude survey was conducted. Using the criterion of Eigenvalues exceeding 1, it was determined that six underlying constructs existed. To be included in a factor, an item needed to load high (> .40) and have lower loadings on all other factors (> .30; Tabachnick & Fidell, 1989; see Table 1 for means and standard deviations).

Three of the semantic differential items loaded onto a factor, relating to feelings about women scientists, and was labeled “Good.” It consists of the items Bad – Good, Pleasant – Unpleasant (reverse-scored), and Wise – Foolish (reverse-scored) and was reliable (IAT group α = .80, PIAT group α = .85).

The two items that loaded onto another factor identified gender associations of scientists (i.e., “I associate women with the area of science,” “I associate men with the science domain” (reverse-scored)). This factor was labeled “Associate with STEM,” but only the PIAT group (r = .63) was reliable (IAT group r = .13), using r = .40 as the criterion.

Two items loaded onto another factor and identified likeable properties of women scientists. It includes the items Ugly – Beautiful and Awful – Nice (IAT group r = .37,
PIAT group \( r = .58 \) and was labeled “Likeable.” Other factors determined by PAF were not used because their use in the factor analysis was not in accordance with how the items were used in this study or were deemed inconsequential. The one single item that was used favorability of women scientists and was labeled “Favorable” (i.e., “Please rate on a scale on 1 (unfavorable) to 10 (favorable) how you feel about the following group: Women scientists”).

**Demographics.** Participants’ sex, age, rank, and ethnic background were collected.

**Behavioral Measures.** Participants were invited to donate money (i.e., Donations) to the Women in Science Giving Circle, an on-campus organization designed to enhance the education and professional success of STEM (and Medicine) women students and faculty. Participants were also offered the opportunity to donate time (i.e., Volunteer hours) to the organization via a sign-up sheet, as well as take a brochure (i.e., Brochures taken) explaining the Giving Circle. The researcher was able to see and record participants’ behavior. A composite score was computed from these three behavioral measures by assigning a “1” to each behavior completed and summing these (see Table 1 for means and standard deviations).

**Instant Uncontrollable Reactions Questionnaire.** Participants completed a 12-item IUR (R. H. Fazio, personal communication, December 8, 2009; see Appendix C for full item listing; see Table 1 for means and standard deviations) to explicitly assess immediate reactions to questions involving interactions with women scientists (IAT group \( \alpha = .67 \), PIAT group \( \alpha = .70 \)). An example question is “When encountering an intelligent woman scientist, I have, for a split second, been surprised.” Participants rated
items on a 5-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree). Appropriate items were reverse-scored so that higher scores reflected a more favorable attitude toward women scientists.

**Procedure**

Participants were run individually by a female research assistant (RA) wearing a white laboratory coat to standardize gender and appearance. The RA collected the participants from a waiting room and brought them to a table in the laboratory. After obtaining informed consent, participants were seated at the computer station and informed that they were participating in a categorization task. Participants were randomly assigned to complete either the IAT or PIAT and received all instructions from a computer screen. All responses were provided and recorded via the computer keyboard. After the categorization task, participants were administered the IUR questionnaire and then the explicit attitude measures. After completion, the RA asked the participants what they believed the purpose of the study was and invited them to donate money, time, and/or take a brochure for the Women in Science Giving Circle. On their way out of the laboratory, the RA debriefed all participants.
III. RESULTS

Analysis of Error Rates

Participants received error feedback throughout the IAT, but for only two blocks during the PIAT. The error rate for the present study for the both the IAT and PIAT appeared to be similar to past research. Greenwald et al. (1998) and Karpinski and Hilton (2001) reported IAT error rates around 4%, whereas Nosek and Hanson (2008) averaged 9.2% for the IAT and 11.9% for the PIAT. For the present study, error rates for the IAT ($M = 7.56, SD = 5.40$) and PIAT ($M = 5.71, SD = 5.50$) were not significantly different ($p < .20$).

Olson and Fazio (2004) omitted participants with a 20% or more error rate. The present sample included one person with an error rate of 27%, but due to the small sample size and the fact that the correlation patterns did not change with this person removed, no participants were omitted.

Effects of IAT Condition

Following steps from Greenwald et al.’s (2003) improved scoring procedure, a block mean of raw latencies was computed for blocks 3, 4, 6, and 7. Latencies over 10,000 ms were replaced with their respective block mean + 600 ms. Using these latencies, Blocks 3 and 4 were added together and averaged, as were latencies for Blocks 6 and 7. This allowed the 20 trials from practice Blocks 3 and 6 to be weighted properly with the 40 trials from the test Blocks 4 and 7. The purpose of the new weighted mean
for the two blocks was to test for an effect when receiving either the compatible (i.e., woman scientist and pleasant/I like) or incompatible (i.e., woman scientist and unpleasant/I don’t like) items first. These block types are referred to as woman/+ (i.e., compatible) and woman/- (i.e., incompatible). The two new means were then entered into a 2 (condition: IAT vs. PIAT) X 2 (order: compatible first vs. incompatible first) multivariate analysis of variance (MANOVA) with compatible latencies (woman/+)) versus incompatible latencies (woman/-).

There was a significant effect of IAT condition for woman/-, $F(1, 48) = 6.83, p < .05$, such that regardless of order, participants responded more slowly while performing the PIAT woman/- ($M = 1230.06, SD = 373.57$) relative to the IAT woman/- ($M = 1000.02, SD = 303.26$). Overall, participants were slower to respond in the woman/+ ($M = 1209.32, SD = 376.29$) relative to the woman/- ($M = 1115.04, SD = 356.34$) block.

For the traditional IAT, the mean response latency for the woman/+ ($M = 1166.69, SD = 382.26$) was slower than the woman/- ($M = 1000.02, SD = 303.26$). For the PIAT, the mean response latency for the woman/+ ($M = 1251.95, SD = 372.75$) was also slower than the woman/- ($M = 1230.06, SD = 373.57$). By subtracting the mean response latencies of the compatible blocks from the incompatible blocks, it appears that the PIAT ($M = 21.89, SD = .82$) produced less bias toward women scientists than the IAT ($M = 166.67, SD = 79.00$), although this was not significant ($p > .10$).

Explicit Attitude Measures

Hypothesis 1 stated that the PIAT-explicit attitudes correlations would reflect less gender bias than the IAT-explicit attitudes correlations. To investigate Hypothesis 1, bivariate correlations were calculated between the PIAT $D$ scores and the explicit
attitudes and the IAT $D$ scores and explicit attitudes (see Table 3). The PIAT $D$ scores revealed no significant relationships with explicit attitudes, whereas the IAT $D$ scores had two significant negative relationships with Good ($r = - .44, p < .05$) and Associate with STEM ($r = - .39, p < .05$). For each task group, there were few significant correlations amongst explicit attitudes. However, there was one significant correlation of Likeable with Associate with STEM for both the IAT ($r = .39, p < .05$) and PIAT ($r = .54, p < .01$) groups.

Table 3

**Correlations among Explicit Attitudes, Instant Uncontrollable Reactions (IUR), and the IAT and PIAT $D$ Scores by Task Group**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good</th>
<th>Favorable</th>
<th>Good</th>
<th>Favorable</th>
<th>Good</th>
<th>Favorable</th>
<th>Good</th>
<th>Favorable</th>
<th>Good</th>
<th>Favorable</th>
<th>Good</th>
<th>Favorable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>($\cdot 80, .85$)</td>
<td>.36</td>
<td>.29</td>
<td>.30</td>
<td>.31</td>
<td>.32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Favorable</td>
<td>.40*</td>
<td>-</td>
<td>.46*</td>
<td>.33</td>
<td>.40*</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate with STEM</td>
<td>.23</td>
<td>.15</td>
<td>($\cdot 23, .76$)</td>
<td>.54**</td>
<td>.42*</td>
<td>-.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likeable</td>
<td>.28</td>
<td>.27</td>
<td>.39*</td>
<td>($\cdot 54, .73$)</td>
<td>.81**</td>
<td>-.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IUR</td>
<td>.23</td>
<td>.45*</td>
<td>.48*</td>
<td>.57**</td>
<td>($\cdot 69, .70$)</td>
<td>-.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IAT $D$ score</td>
<td>-.44*</td>
<td>-.14</td>
<td>-.39*</td>
<td>-.28</td>
<td>-.08</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.** $**p < .01, *p < .05. IAT (n = 26) = bold, PIAT (n = 26) = not bold.

Cronbach’s alphas are on the diagonal.

Correlation coefficients were transformed into $z$ scores using Fisher’s $z$ and $z$-tests were conducted to test differences between PIAT-explicit attitude correlations and IAT-explicit attitude correlations (http://faculty.vassar.edu/lowry/rdiff.html). A
significant z score demonstrates that a difference exists between the two correlation coefficients, which would support Hypothesis 1. Table 4 presents z scores. There was a significant difference between implicit-explicit correlations for the task groups for the correlation of the D scores and the explicit measure Good (z = 2.73, p < .01) and the D scores and the explicit measure Associate with STEM (z = 1.29, p < .05), partially supporting Hypothesis 1.

Table 4
Z Scores Comparing Task Groups on Explicit Attitudes, Instant Uncontrollable Reactions (IUR), and the IAT and PIAT D Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good</th>
<th>Favorable</th>
<th>Associate with STEM</th>
<th>Likeable</th>
<th>IUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Favorable</td>
<td>-.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate with STEM</td>
<td>.22</td>
<td>1.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likeable</td>
<td>.07</td>
<td>.22</td>
<td>.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IUR</td>
<td>.29</td>
<td>-.21</td>
<td>-.26</td>
<td>1.63*</td>
<td></td>
</tr>
<tr>
<td>D score</td>
<td>2.73*</td>
<td>.68</td>
<td>1.29*</td>
<td>.00</td>
<td>-.31</td>
</tr>
</tbody>
</table>

*Note.* **p < .01, *p < .05, N = 52. A negative number denotes a larger IAT r coefficient.

**Behavioral Measures**

Hypothesis 2 stated that the PIAT-behavioral measures correlations would reflect less gender bias than the IAT-behavioral measures correlations. To investigate Hypothesis 2, bivariate correlations were calculated between the PIAT D scores and behavioral measures and the IAT D scores and behavioral measures (see Table 5). Only the PIAT D scores-Donation correlation was significant (r = .40, p < .05). Also, both
task groups had a few significant and marginally significant correlations amongst behavioral measures.

Table 5

*Correlations among Behavioral Measures, Instant Uncontrollable Reactions (IUR), and the IAT and PIAT D Scores by Task Group*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Donations</th>
<th>Volunteer hours</th>
<th>Brochures taken</th>
<th>Composite</th>
<th>IUR</th>
<th>PIAT D score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donations</td>
<td>-</td>
<td>-.09</td>
<td>-.21</td>
<td>.34†</td>
<td>-.50**</td>
<td>.40</td>
</tr>
<tr>
<td>Volunteer hours</td>
<td>.46**</td>
<td>-</td>
<td>.45*</td>
<td>.88**</td>
<td>.35†</td>
<td>-.06</td>
</tr>
<tr>
<td>Brochure taken</td>
<td>.27</td>
<td>.27</td>
<td>-</td>
<td>.51**</td>
<td>.16</td>
<td>.02</td>
</tr>
<tr>
<td>Composite</td>
<td>.62**</td>
<td>.92**</td>
<td>.59**</td>
<td>-</td>
<td>.10</td>
<td>.14</td>
</tr>
<tr>
<td>IUR</td>
<td>.17</td>
<td>.36†</td>
<td>.17</td>
<td>.36†</td>
<td>-</td>
<td>-.17</td>
</tr>
<tr>
<td>IAT D score</td>
<td>.10</td>
<td>-.13</td>
<td>.13</td>
<td>-.03</td>
<td>-.08</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.** p < .01, * p < .05, † p < .10. IAT (n = 26) = bold, PIAT (n = 26) = not bold.*

Correlation coefficients were transformed into z scores using Fisher’s z and z-tests were conducted to determine if there was a significant difference between the task groups between the correlation coefficients of the behavioral measures with each other and the IAT and PIAT D scores (see Table 6). There was a significant difference between task groups for the correlation of Donations and Volunteer hours (z = -1.99, p < .01), and Donations and Brochures taken (z = -1.66, p < .01). However, Hypothesis 2 was not supported because there were no significant differences between task groups for the D scores.
Table 6

Z Scores Comparing Task Groups on Behavioral Measures, Instant Uncontrollable Reactions (IUR), and the IAT and PIAT D Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>Donations</th>
<th>Volunteer hours</th>
<th>Brochures taken</th>
<th>Composite</th>
<th>IUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donations</td>
<td>-1.99**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volunteer hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brochures taken</td>
<td>-1.66**</td>
<td>.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composite</td>
<td>-1.26</td>
<td>-.72</td>
<td>-.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IUR</td>
<td>-2.44**</td>
<td>-.04</td>
<td>-.03</td>
<td>-.94</td>
<td></td>
</tr>
<tr>
<td>D scores</td>
<td>1.10</td>
<td>.24</td>
<td>-.38</td>
<td>.58</td>
<td>-.31</td>
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</table>

Note. **p < .01, *p < .05, N = 52. A negative number denotes a larger IAT r coefficient.

Instant Uncontrollable Reactions

Hypothesis 3 stated that the PIAT-IUR correlation would reflect less gender bias than the IAT-IUR correlation. To investigate Hypothesis 3, bivariate correlations were calculated between the IUR and the IAT and PIAT D scores (see Table 3). There were no significant correlations.

However, the IUR was correlated with many explicit attitude and behavioral measures. Table 3 shows there were significant correlations for both task groups of the IUR and the explicit measures Favorable (IAT r = .40, p < .05; PIAT r = .40, p < .05), Associate with STEM (IAT r = .48, p < .05; PIAT r = .42, p < .05), and Likeable (IAT r = .57, p < .01; PIAT r = .81, p < .01). Table 4 shows the z scores. These revealed a significant task group difference for the IUR and Likeable (z = 1.63, p < .05).
Table 5 presents bivariate correlations of the IUR and behavioral measures. The IUR had a significant negative relationship with Donations for the PIAT group ($r = -0.50$, $p < .01$), while having only two marginal effects for the IAT group (i.e., Volunteer hours, Donations). Table 6 presents $z$ scores revealing a significant task group difference between the IUR and Donations ($z = -2.44$, $p < .01$).
IV. DISCUSSION

Findings somewhat predicted the hypothesis that the relationship between the PIAT and explicit attitudes would reflect less gender bias than that of the IAT and explicit attitudes. Even though the PIAT-explicit measures correlations were not significant, they were less negative, than the IAT-explicit measures. The IAT showed an inverse relationship with the explicit measures, suggesting that implicit attitudes fit with the stereotype that men are more associated with STEM fields than women, whereas explicit attitudes better associated women with STEM. Moreover, the first hypothesis was most directly supported by significant differences between the IAT and PIAT and their relationship with feelings about scientists and their association with STEM fields. The PIAT revealed more good feelings toward women scientists and their association with STEM than the IAT. These results suggest that extrapersonal associations contaminated the IAT scores more than the PIAT scores.

In addition, response latencies between the IAT and PIAT were significantly different. Even though the incompatible items required less time to categorize in both the IAT and PIAT, the latencies in the IAT were significantly shorter. This suggests influence of extrapersonal associations, which in this case, are stereotypes associating men with STEM fields more than women. Participants required more time to process the PIAT items, suggesting the use of more time for reflection and successful personalizing of the categories. However, latencies for this study were larger than those found in past...
research. The latency of Olson and Fazio’s (2004) experiments ranged from 669.68 ms ($SD = 123.88$) to 950.89 ms ($SD = 197.28$). This may have been due to the length of the stimulus items in the present study. This study used items such as “Biochemistry Professor Christine Reed,” whereas other studies used one word items such as “tree.” Then again, instead of looking at the entire stimulus item during the categorization task, perhaps only gender was sought out, as suggested by DeHouwer (2001). This would disallow the scientist aspect of the items to be fully captured.

There was convergence with the IAT and liking women scientists correlation and the PIAT and liking women scientists correlation ($r = -.28$, $ns$ for both). This relationship may be explained in part by research concerning gender, self-monitoring, and masculinity. Researchers found that women who can be confident and assertive, yet have the flexibility to use these more masculine traits only when needed, earned more promotions than men and other women who were more consistently masculine or consistently feminine (O’Neill & O’Reilly, 2010). Women who put forth extreme femininity were seen as more nice, but less competent and incapable of becoming successful managers. This suggests that the explicit liking of scientists may not be a factor that would strongly influence implicit attitudes toward them.

Results did not support expectations of less gender bias in the relationship between the PIAT and behaviors than the IAT and behaviors. However, the PIAT correlated significantly with making donations, meaning that more favorable implicit attitudes about women scientists were related to donating to a women in science organization. Even though the PIAT was correlated with one behavioral measure and had more positive correlations, there were no significant findings between the task groups and
an assumption cannot be made about the IAT or PIAT being a better predictor of behaviors.

The results found for the relationship between the PIAT and Instant Uncontrollable Reactions (IUR) questionnaire and the IAT and IUR were not supported, but the IUR correlated significantly with many explicit attitude measures. While there was a significant difference between the IAT and PIAT groups for relationships between the IUR and liking women scientists, there were also significant relationships per task group with the IUR and having favorable feelings toward women scientists, and associating women with STEM. It is interesting that the IUR reflects a positive bias toward women in science, yet has a negative relationship with donating to women in science organizations (in the PIAT group). For the PIAT group, latency analyses suggest that more time is being used to reflect and associate women with science. Perhaps the IUR illuminates automatic reactions and acknowledgment of a negative reaction could lead to donating more money. To understand if this is the case, future research would be needed. Results also showed positive marginal relationships between the IUR and volunteer hours for both the IAT and PIAT groups. From the results of this study, it is clear that the IUR could be a beneficial addition to the measurement of explicit attitudes.

Perhaps stronger correlations between the PIAT and explicit attitudes and the IUR could have been obtained if the PIAT used in this study had completely omitted error feedback. Nosek and Hansen (2008) reported that personalizing the category labels and providing no error feedback led participants to categorize the stimuli based on their explicit evaluation rather than the categorization rules. Therefore, the relationship
between the PIAT and self-reported attitudes was enhanced. However, feedback was used in the present study to ensure that the participants were aware of the task rules.

Order of the administration of the tasks (i.e., IAT first, then explicit attitude measures) may have influenced ratings on the explicit attitude measures and the IUR. McConnell and Leibold (2001) reported that the IAT methodology is obvious and sensitizes participants to the purpose of the overall study. The authors administered the IAT second to decrease the chance that concerns for social desirability, instead of personal attitudes, would influence participants’ subsequent explicit attitudes. Project Implicit also gives their explicit attitude measures before administering the IAT. On the contrary, Wilson et al. (2000) stated that an explicit attitude will override an implicit one, called automatic overriding, if the explicit attitude is easier to retrieve from memory than the implicit attitude. A large number of researchers (e.g., Han et al., 2010; Karpinski & Hilton, 2001; Olson & Fazio, 2004) have administered the explicit measures after the IAT so the explicit measures do not prime the participant to think about their attitudes about a particular topic before the IAT. This exposure could filter into the IAT, contaminating the results. In order to properly test this, Project Implicit could give the explicit measures randomly before or after the IAT. Research could then help to discern whether automatic overriding does, in fact, affect the IAT.

In summary, the results of this study did find partial support for the use of a personalized version of the IAT to reduce extrapersonal associations during implicit attitude measuring. This version of the IAT and PIAT, as well as implementation of the IUR as a new explicit attitude measure, could further our understanding about bias toward women scientists. The present findings also add to the research already
established about the PIAT and IAT’s capabilities of measuring implicit attitudes (e.g., Han et al., 2010; Nosek & Hanson, 2008; Olson & Fazio, 2004).

Limitations

The first limitation of this study was the small sample size. It was estimated that this study would need a sample size of 46 participants per condition to have 80% power. However, the subject pool was restricted to STEM students within a limited participant pool and because this was part of a larger study, the sample size was predetermined. It also could have been advantageous to measure attitudes of students who are not as familiar with STEM-related fields. Even though the sample size for this research was small, it is important to note that the scales were reliable, and results revealed some expected significant relationships among measures.

Low statistical power may have hindered the ability to yield stronger correlations. The small sample size could have induced relatively low power for detecting even a medium effect size between the task groups. G*Power 3.1.0 was used to conduct post hoc power analyses (alpha < .05, two-tailed) and find a range of power per hypothesis. Using the highest and lowest pair of correlations of the PIAT and IAT with explicit attitudes, the range of power was .77 to .05. This makes sense considering Hypothesis 1 was partially supported. The range of power for the relationship between the PIAT and IAT and behavioral measures, was .19 to .05, while the PIAT and IAT and IUR relationship produced almost no power (.05).

Another limitation may be that the PIAT in this study gave error feedback. Past research eliminated all error feedback on the PIAT (Olson & Fazio, 2004). However,
there was a concern that the participants would not understand the categorization task. Providing error feedback may have affected the strength of our results.

**Implications and Future Research**

This research contains both theoretical and practical implications. This study could be used for measuring young adults’ attitudes about women scientists. By measuring young adults’ attitudes before they become scientists in a STEM field, and making them aware of stereotypes and social desirability demands, their workplace biases may be reduced. This particular PIAT could establish a starting point by which to resolve the persistent gender gap in STEM fields (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine of the National Academies, 2007). By measuring young people’s views about women in STEM careers, researchers could begin to see what changes to make, environmentally, through persuasive messages. Eventually, the information gathered from the PIAT could be used as a basis for diversity workshops for those in the STEM workplace.

Currently, Project Implicit is focused exclusively on IATs. If the Project Implicit team would incorporate PIAT versions of many IAT topics, the abundant sample size that could accumulate over the years, and in so many countries, could help to further elucidate differences between the IAT and the PIAT. Perhaps the IAT is better equipped to measure certain attitudes, whereas the PIAT is better with other attitudes. With the large sample size this website attracts, research could examine theoretical differences between the IAT and PIAT.
V. CONCLUSION

This research provides additional support for the use of the PIAT in measuring implicit attitudes by the direction of the relationships more than the significant values between the IAT and PIAT with the explicit attitude and behavioral measures. The performance of the IUR is also an important element of this study. The extent of its correlation with other explicit attitude measures cannot be ignored. Accurate assessment of attitudes is required to determine factors that predict behaviors and might pose barriers (e.g., gender gaps in promotion, salary, retention, and occupational participation) that keep women excluded from the STEM workplace. Using implicit attitude measures is one step toward improving gender representation and inclusion and might positively impact women scientists’ role in the workplace.
REFERENCES


APPENDIX A

(Personalized) Implicit Association Test Stimuli List

Man scientist/Woman scientist stimulus items:

Chemistry Professor Christopher Smith
Biochemistry Professor Christine Reed
David Johnson, PhD, Psychology
Dawn Jones, PhD, Neuroscience
Assistant Professor of Biology James Reed
Assistant Professor of Biophysics Jennifer Jackson
Dr. Michael Jones, Engineering
Dr. Michelle Smith, Mechanical Engineering
Physicist, Steven Jackson
Astronomer, Susan Johnson
Mark Williams, PhD, Cell Biology
Mary Williams, PhD, Physiology
Scott Davis, Director of Computer Science
Stephanie Davis, Director of IT
Dr. Timothy Miller Statistician
Dr. Tammy Miller, Mathematician

Unpleasant/Pleasant (PIAT- I don’t like/I like) stimulus items:

joy, love, peace, freedom, friend, laughter, vacation, heaven
agony, poison, abuse, failure, evil, war, crash, stink

First name stimuli taken from Social Security website
http://www.ssa.gov/OACT/babynames/


Professions: suggested by Drs. Russ Fazio and Tamera Schneider
APPENDIX B

Explicit Attitude Measures

There are no right or wrong answers. Please circle which number best reflects your beliefs.

I think that women scientists are:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Bad</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Pleasant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unpleasant</td>
</tr>
<tr>
<td>Wise</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Foolish</td>
</tr>
<tr>
<td>Ugly</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Beautiful</td>
</tr>
<tr>
<td>Awful</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Nice</td>
</tr>
</tbody>
</table>

Please rate on a scale on 1 (unfavorable) to 10 (favorable) how you feel about the following groups.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women scientists</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Men scientists</td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

Please rate your agreement with the following statements by circling the appropriate number.

<table>
<thead>
<tr>
<th>Statement</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>neutral</th>
<th>agree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I dislike women scientists.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I would take a science course offered</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>by a female professor.</td>
<td></td>
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<tr>
<td>I dislike men scientists.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I associate men with the science domain.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I would take a science course offered</td>
<td>1</td>
<td>2</td>
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<tr>
<td>by a male professor.</td>
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<tr>
<td>I associate women with the area of science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>I have taken a science course from a male professor.</td>
<td>Yes</td>
<td>No</td>
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</table>
I have taken a science course from a woman professor.  Yes  No

Ethnic background:  ___African American  ___American Indian or Alaskan Native
                   ___Asian or Pacific Islander  ___Hispanic/Latino
                   ___Caucasian (white, non Hispanic)  Other___________________

Age _________

Class rank: ___Freshman  ___Sophomore  ___Junior  ___Senior  ___Other

Sex:  ____female  ____male
APPENDIX C

Instant Uncontrollable Reaction Questionnaire

Sometimes our responses (our thoughts or feelings) are consistent with our values and beliefs; however, other times they are not. For instance, you might find that your initial response to something may not be in line with how you actually feel. Situations in which people might experience conflicting reactions between what they MOMENTARILY think and what they NORMALLY think may involve interactions with women scientists. For example, a person may have a split second negative or surprised reaction when s/he learns that a woman is a scientist. To have such a reaction is entirely normal because we live in a society in which certain genders are stereotypically in traditional gender-related careers.

We are interested in the situations in which spontaneous or momentary thoughts might “pop” into your head despite the fact that these thoughts do not represent your true feelings. However, we are only interested in the experiences you have had in the last year or two. Please answer the following questions honestly by circling the number that indicates the extent to which you agree or disagree with each statement.

1. When encountering an intelligent woman scientist, I have, for a split second, been surprised.
   
   1 2 3 4 5
   Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree

2. I have never involuntarily had negative thoughts about women scientists.

   1 2 3 4 5
   Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree

3. When I learn that a woman scientist was given tenure or promoted, for a moment I think it is because of her gender.

   1 2 3 4 5
   Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree
4. When I hear that a woman scientist is having career/personal issues, I might involuntarily think “how typical.”

   1 Strongly disagree  2 Somewhat disagree  3 Neither agree nor disagree  4 Somewhat agree  5 Strongly agree

5. At times I think, for a split second, that women scientists do not work as hard as they should.

   1 Strongly disagree  2 Somewhat disagree  3 Neither agree nor disagree  4 Somewhat agree  5 Strongly agree

6. I have never, even for a brief moment, caught myself thinking that women don’t belong in science-related careers.

   1 Strongly disagree  2 Somewhat disagree  3 Neither agree nor disagree  4 Somewhat agree  5 Strongly agree

7. I have never, even for a brief moment, thought that women get promoted as scientists because they “know someone.”

   1 Strongly disagree  2 Somewhat disagree  3 Neither agree nor disagree  4 Somewhat agree  5 Strongly agree

8. When I notice that a woman scientist is very feminine, I might, for an instant, think that she should try to be more masculine.

   1 Strongly disagree  2 Somewhat disagree  3 Neither agree nor disagree  4 Somewhat agree  5 Strongly agree

9. Now and then, I wonder how women scientists balance career and family.

   1 Strongly disagree  2 Somewhat disagree  3 Neither agree nor disagree  4 Somewhat agree  5 Strongly agree

10. I have refused to enroll in a science course because of the professor’s gender.

    1 Strongly disagree  2 Somewhat disagree  3 Neither agree nor disagree  4 Somewhat agree  5 Strongly agree
11. I have never, even for a brief moment, thought that women scientists are successful because they “know someone.”

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<tr>
<th></th>
<th>Strongly disagree</th>
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12. I have never, even for a split second, caught myself assuming that women students on campus are likely to be enrolled in arts or humanities programs.

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<tr>
<th></th>
<th>Strongly disagree</th>
<th>Somewhat disagree</th>
<th>Neither agree nor disagree</th>
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