THE RELIABILITY OF THE i-QUAD AND ITS PREDICTIVE UTILITY IN A MODIFIED DICTATOR GAME

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Implicit cognition refers to experiences and beliefs that influence one's behaviors but are not readily available for conscious awareness. Since it is not a conscious process, assessing implicit cognition requires indirect measures such as the Implicit Association Test (IAT) developed by Greenwald, McGhee and Schwartz.[1] The classic IAT measures two distinct associations, but the current scoring algorithm produces a single statistic based on reaction times. This statistic merges information from both associations such that we cannot tell which association is driving the effect. The Quadruple Process Model (Quad), devised by Conrey, Sherman, Gawronski, Hugenberg, and Groom, provides more informative statistics regarding implicit associations at the group level.[2] In the current study, we aimed to apply the Quad at an individual level and evaluate its effectiveness through employing a test of reliability and predictive utility through a modified dictator game.[3] We provided evidence that the i-Quad is reliable in a test-retest scenario. We also provided support for further research of the i-Quad parameters and their role in predicting prosocial behavior. Our findings add to the growing body of literature that suggests implicit biases can have a significant but subtle effect on how individuals treat one another, especially for members of minority and stigmatized groups. Moreover, the use of the i-Quad may provide deeper insights into the ways in which implicit biases affect those around us in subtle ways that we may not be aware of.

Keywords: implicit bias, prosocial behavior, Implicit Association Test, multinomial model, i-Quad

1 Anthony Greenwald, Debbie McGhee, and Jordan Schwartz, "Measuring individual differences in implicit cognition: the implicit association test," Journal of personality and social psychology 74, no. 6 (1998): 1464.

2 Frederica Conrey et al., "Separating multiple processes in implicit social cognition: the quad model of implicit task performance," Journal of personality and social psychology 89, no. 4 (2005): 469.

3 Amanda Perez, and Rodolfo Mendoza-Denton, "The Efficacy of Using Individual QUAD Model Parameters in a Linear Model," (in prep).

Look at what you're wearing today. If you are asked why you decided to wear that outfit, you might mention the weather or an event in your schedule. Such an answer would reflect your conscious thought process that helped you determine what you grabbed from your closet. What you probably wouldn't think of is how your childhood hero had a similar style that you adopted, or how someone made fun of you once for wearing a different style, or how you would dress similarly to others to avoid social rejection. While you may not have thought these things as you were getting ready this morning, they most likely had some impact on your decision. This is what's known as implicit cognition—things in the past that we are unable to consciously recognize now but are having an impact on the thoughts and decisions of today.[4]

Introduction

Our implicit cognition is not something we are consciously aware of, and thus studying it requires indirect measures. One such measure is the Implicit Association Test (IAT) created by Greenwald, McGhee and Schwartz.[5] The IAT has become the most widely used implicit cognition measurement tools, but it is not without criticisms. Opponents of the IAT cite small effect sizes, weak test-retest reliability, low ecological validity, low predictive validity, etc.[6] Others critique the scoring algorithm itself since it treats the IAT as a process-pure task and does not disentangle the two associations being tested.[7,8] The current study analyzes a new method for scoring the IAT—the Individual Quadruple Process Model (i-Quad). The i-Quad is more versatile than both the classic scoring algorithm and the Quad model due to its ability to capture both automatic and controlled processes at the individual level.[9,10] The current study will contribute to the exploration and validation of the i-Quad.

The Implicit Association Test

The Implicit Association Test (IAT) is a computer administered task developed to quantitatively measure implicit cognition (more specifically, the affective or evaluative associations between objects).[11] The IAT has participants pair stimuli, such as words or images, that rapidly appear in the center of the computer screen with the designated categories positioned on the left or right side of the screen by pressing the appropriate keys on a keyboard. One paradigm of the IAT instructs participants to pair flowers with pleasant words and insects with unpleasant words for the first half of the trials and then pair insects with pleasant words and flowers with unpleasant words for the other half. In this case, the scoring algorithm assumes that people hold negative stereotypes for insects and positive ones for flowers. Therefore, participants would be faster in pairing insects with unpleasant words, a stereotype compatible trial, and slower in pairing flowers with unpleasant words, a stereotype incompatible trial. The design of the IAT relies on the assumption that well-established associations, such as "insects" and "bad," are difficult to overcome, and therefore participants will respond more quickly in stereotype compatible trials and more slowly in stereotype incompatible trials.

The strength of the associations assessed in the compatible and incompatible trials is captured by the D-score, which is the average difference in response latency between the two trial types divided by the standard deviation in response latency across all trials.[12] A participant's D-score can range from -2 to +2. A more positive score reflects that the associations tested in the compatible trials are much stronger than the ones tested in the

4 Anthony Greenwald and Mahzarin Banaji, "Implicit social cognition: attitudes, self-esteem, and stereotypes," Psychological review 102, no. 1 (1995): 4.

5 Greenwald, "Measuring individual differences in implicit cognition: the implicit association test," 1464.

6 Frederick Oswald et al., "Predicting ethnic and racial discrimination: A meta-analysis of IAT criterion studies," Journal of personality and social psychology 105, no. 2 (2013): 171.

7 Conrey, "Separating multiple processes in implicit social cognition: the quad model of implicit task performance," 469.

8 Perez, "The Efficacy of Using Individual QUAD Model Parameters in a Linear Model," (in prep).

9 Anthony Greenwald, Brian Nosek, and Mahzarin Banaji, "Understanding and using the implicit association test: I. An improved scoring algorithm," Journal of personality and social psychology 85, no. 2 (2003): 197.

10 Conrey, "Separating multiple processes in implicit social cognition: the quad model of implicit task performance," 469.

11 Greenwald, "Measuring individual differences in implicit cognition: the implicit association test," 1464.

12 Greenwald, "Understanding and using the implicit association test: I. An improved scoring algorithm," 197.

incompatible trials, which is interpreted as the strength of one's implicit bias.[13,14,15] While the IAT and the D-score have been monumental and opened many doors in the field of psychology, the measure still has potential for growth and improvement.

Studies have demonstrated that the D-score can be manipulated by cognitive states, priming, and faking attempts, which raises questions regarding its reliability.[16,17,18,19,20,21] In addition, the D-score is unable to distinguish which association is driving the effect. For example, research shows that scores for the Race IAT, which asks participants to pair positively and negatively valenced words with the racial categories of White and Black, may be motivated by a pro-White bias as opposed to the familiarity with white names or an anti-Black bias.[22,23]

The i-Quad Model

Conrey et al. took a different approach and criticized the IAT D-score because it does not take into account the multiple cognitive processes that take place during the IAT.[24] They extended Batchelder and Riefer's work and applied a multinomial processing tree to implicit tasks, including the IAT and a sequential priming task, via the quadruple process model (Quad).[25] The Quad model has four parameters, each representing a distinct cognitive process that occurs during implicit tasks. These cognitive processes are categorized as either automatic or controlled. Automatic processes happen quickly and without our conscious awareness. They are acquired through consistent practice and are difficult to change or overcome. Controlled processes, on the other hand, are purposeful and reflect our conscious awareness. They require effort and mental resources and are able to be manipulated.[26] We know that our brain automatically processes stimuli prior to our conscious knowledge and that those implicit associations can moderate downstream controlled processes.[27,28] The Quad model provides a more nuanced way of analyzing the IAT by dissociating the controlled and automatic processes and providing meaningful insights into the mechanisms behind implicit bias (Figure 1).

The first parameter of the model is association activation (AC), which is the likelihood that the automatic association is activated when the stimulus appears. The second parameter is discriminability (D), which is the likelihood that the correct answer can be detected. This is the first controlled process within the task and is most affected by motivation, cognitive load, and distraction. The third parameter is overcoming bias (OB),

13 Greenwald, "Measuring individual differences in implicit cognition: the implicit association test," 1464.

14 Greenwald. "Understanding and using the implicit association test: I. Amn improved scoring algorithm," 197.

15 Kristin Lane et al., "Understanding and using the implicit association test: IV," Implicit measures of attitudes (2007): 59-102.

16 Irene Blair, "The malleability of automatic stereotypes and prejudice," Personality and social psychology review 6, no. 3 (2002): 242-261.

17 Nilanjana Dasgupta and Anthony Greenwald, "On the malleability of automatic attitudes: combating automatic prejudice with images of admired and disliked individuals," Journal of personality and social psychology 81, no. 5 (2001): 800.

18 Irene Blair, Jennifer Ma, and Alison Lenton, "Imagining stereotypes away: the moderation of implicit stereotypes through mental imagery," Journal of personality and social psychology 81, no. 5 (2001): 828.

19 Klaus Fiedler and Matthias Bluemke, "Faking the IAT: Aided and unaided response control on the Implicit Association Tests," Basic and Applied Social Psychology 27, no. 4 (2005): 307-316.

20 Klaus Fiedler, Claude Messner, and Matthias Bluemke, "Unresolved problems with the "I", the "A", and the "T": A logical and psychometric critique of the Implicit Association Test (IAT)," European Review of Social Psychology 17, no. 1 (2006): 74-147.

21 Lois James, "The stability of implicit racial bias in police officers," Police Quarterly 21, no. 1 (2018): 30-52.

22 Nilanjana Dasgupta et al., "Automatic preference for White Americans: Eliminating the familiarity explanation," Journal of Experimental Social Psychology 36, no. 3 (2000): 316-328.

23 Perez, "The Efficacy of Using Individual QUAD Model Parameters in a Linear Model," (in prep).

24 Conrey, "Separating multiple processes in implicit social cognitions: the quad model of implicit task performance," 469.

25 William Batchelder and David Riefer, "Theoretical and empirical review of multinomial process tree modeling," Psychonomic Bulletin & Review 6, no. 1 (1999): 57-86.

26 Walter Schneider and Richard Shiffrin, "Controlled and automatic human information processing: I. Detection, search, and attention," Psychological review 84, no. 1 (1977): 1.

27 Arne Öhman and Joaquim Soares, "" Unconscious anxiety": phobic responses to masked stimuli," Journal of abnormal psychology 103, no. 2 (1994): 231.

28 Arne Öhman, Anders Flykt, and Francisco Esteves, "Emotion drives attention: detecting the snake in the grass," Journal of experimental psychology: general 130, no. 3 (2001): 466.

which is the likelihood that the bias from the activated association (AC) can be overcome in favor of the correct answer. Overcoming bias (OB) is another controlled process within the task and therefore can also be affected by motivation and cognitive load. The fourth parameter is guessing (G), which is the likelihood that external bias, such as the preference for the right hand over the left hand, drives the response. This could be either an automatic or a controlled process, depending on whether one is unconsciously or consciously favoring one hand over the other. These mental processes occur in the sequences outlined by each branch of the multinomial processing tree.

To illustrate the Quad model pathways further, let's consider a thought experiment. Imagine you are hiking through the hills when you see a slender, coiled object on the ground ahead of you. You feel your body tense and you stop walking, directing all your attention towards the object. You quickly realize it's a piece of rope and not a snake. You then can relax your body and continue down your path. In this instance, an association between this object and the concept of "danger" is automatically activated (AC) just milliseconds before you consciously recognize what the object is. You then determine it is a rope and not a snake (D), which allows you to overcome the object's association with danger and respond without fear (OB). This scenario is analogous to a stereotype incompatible trial in the IAT, in which the correct answer is inconsistent with the association that is activated. If it had indeed been a snake, then the scenario would be analogous to a stereotype compatible trial and your fear activation would drive a correct response.

While the Quad model provides a more detailed understanding of the IAT, it is limited in what it can explore since the group-level estimates cannot be linked to individual traits or behaviors. The i-Quad,[29] however, fits the Quad Model on an individual level in order to derive each participant's unique parameter estimates. Individual parameter estimates capture both automatic and controlled processes for each association tested in the IAT and therefore can be tested against individual behaviors.

In order to understand the advantages of the i-Quad, we must first consider what the IAT intends to measure and what it actually measures. Revisiting Greenwald's theory,[30] the IAT measures the strength of one's automatic associations quantitatively through the D-score. As literature has informed us, implicit cognition is an automatic response.[31,32] Yet the D-score is a function of response latency, which in turn is dependent on a sequence of cognitive and physical events to occur from the moment the stimulus appears on screen to the moment the participant presses the keyboard. In creating a single statistic, the D-score treats the IAT as a process pure task resulting from one distinct cognitive event and conflates the various processes within the task. As a result, the strength of a participant's "implicit bias" reflects the difference in the speed of this entire sequence of events between compatible and incompatible trials, which can vary with the blink of an eye. Though some studies have supported the D-score to be a reliable measure,[33] the i-Quad model may be a more valid assessment of one's implicit bias since, by design, it dissociates the multiple processes and computes the probability that an association is activated within the sequence of cognitive events. The D-score is unable to disentangle the automatic and controlled processes, which highlights weaker construct validity with the current methods of scoring the IAT. The i-Quad, being a new tool with which to analyze IAT data, requires rigorous testing and validation. Perez and Mendoza-Denton clearly illustrate the construct validity of the i-Quad and how the parameters vary meaningfully with the D-score.[34] The next step is to establish its reliability across time.

Analysis

Unlike the D-score, which uses response latencies, the i-Quad uses error rates. To score the IAT with the i-Quad, we must fit the observed proportions of correct and incorrect answers to the model. Each of the four parameters is a node on the multinomial processing tree and each pathway predicts either a correct or incorrect response for that trial. The probability of a correct answer is calculated through an equation that compounds the different pathways

29 Perez, "The Efficacy of Using Individual QUAD Model Parameters in a Linear Model," (in prep).

30 Greenwald, "Measuring individual differences in implicit cognition: the implicit association test," 1464.

31 Anthony Greenwald, "What cognitive representations underlie social attitudes?," Bulletin of the Psychonomic Society 28, no. 3 (1990): 254-260.

32 Greenwald, "Implicit social cognition: attitudes, self-esteem, and stereotypes," 4.

33 Lane, "Understanding and using the implicit association test: IV," 59-102.

34 Perez, "The Efficacy of Using Individual QUAD Model Parameters in a Linear Model," (in prep).

through which a correct answer can be attained, as with an incorrect answer. For example, in an IAT capturing the Black-weapon and White-harmless object stereotypes, the probability an incorrect answer in a compatible trial is represented by the equation p(incorrect | Black, compatible) = (1-AC) × (1-D) × (1-G). This is because the only pathway towards this outcome is 1) the Black face does not activate an association, 2) the correct answer cannot be discriminated, and 3) the participant guesses incorrectly. For the Weapon IAT, there are 4 classes of stimuli (i.e. Black face, White face, images of weapons, and images of harmless objects), two different trial types (i.e. compatible and incompatible), and two different outcomes (i.e. correct and incorrect). So, all together we have 4 × 2 × 2 = 16 equations. We then perform maximum likelihood estimation on each formula to derive an estimate of the parameters. This is done at an individual level to achieve participant-specific estimates. See Appendix A for a more detailed description of the methods.

Test-Retest Reliability

Implicit bias has been theorized and studied as both a stable trait and a situation-specific variable.[35,36] This dichotomy poses an issue for the reliability of implicit tasks since trait-like variables imply high consistency across time as opposed to state-like variables that imply variability from one moment to the next. In order to become a reliable measure of implicit bias, the IAT and the i-Quad must produce similar results across time. Many studies have found that the results of the IAT, namely the D-score, are susceptible to varying levels of cognitive load,[37] priming effects, and the changes in exposure to different groups or ideas over long periods of time which suggest a low test-retest reliability.[38] Lane et al. took data from 20 studies that utilized the IAT and found the test-retest reliability measure ranged from r = .25 to r = .69 with a mean of r = .50.[39] If the i-Quad is a valid measure, we would expect the AC parameter to be reliable in a test-retest scenario. This is because the i-Quad dissociates the automatic and controlled processes such that we can expect the association activation to be stable, consistent with Schneider and Shiffrin's conceptualization of automatic processes.[40] If valid, we also expect the controlled parameters of the i-Quad (D, OB, and G) to be reliable in a test-retest scenario. Discriminability (D) and overcoming bias (OB) should remain stable only if we are successful at not altering cognitive load and attention during the IATs. Though we cannot account for changes in individual motivation to perform on the task, we assume motivation, as well as cognitive load and attention, will remain constant throughout the 25-minute period in which the IATs are assessed (each IAT takes on average less than 5 minutes to complete). Guessing should also be reliable since we are not asking participants to consciously alter their handedness between IATs and any unconscious handedness should remain stable from IAT 1 to IAT 2. By holding all variables constant, our methodology tests whether the i-Quad is a reliable measure in and of itself between IAT 1 and IAT 2.

Hypothesis 1: The IAT, scored through the i-Quad model, is reliable in a test-retest scenario.

Prosocial Behavior

Implicit bias has been linked to a variety of behaviors. Influential findings regarding this topic include: 1) Subliminal priming of Black faces predicts more hostile verbal behavior towards a partner in a subsequent task;[41]

35 Blair, "The malleability of automatic stereotypes and prejudice," 242-261.

36 Nilanjana Dasgupta, "13 Mechanisms Underlying the Malleability of Implicit Prejudice and Stereotypes," Handbook of prejudice, stereotyping, and discrimination (2009): 267.

37 Florian Schmitz et al., "When scoring algorithms matter: Effects of working memory load on different IAT scores," British Journal of Social Psychology 52, no. 1 (2013): 103-121.

38 Dasgupta, "On the malleability of automatic attitudes: combating automatic prejudice with images of admired and disliked individual," 800.

39 Lane, "Understanding and using the implicit association test: IV," 59-102.

40 Schneider, "Controlled and automatic human information processing: I. Detection, search, and attention," 1.

41 Mark Chen and John Bargh, "Nonconscious behavioral confirmation processes: The self-fulfilling consequences of automatic stereotype activation," Journal of Experimental Social Psychology 33, no. 5 (1997): 541-560.

2) Implicit bias, as measured by the Race IAT, predicts nonverbal friendliness towards a Black partner;[42] 3) Implicit racial bias predicts less effective medical treatment of Black patients compared to White patients.[43] While the literature on implicit bias and its behavioral correlates is growing, few studies look more closely at the links between implicit bias and prosocial behavior.

Prosocial behaviors are actions that benefit others at the cost to oneself. There are various explanations for prosocial behavior ranging from evolutionary theory to individual personality differences.[44] A large body of literature also supports the hypothesis that we exhibit more prosocial behavior towards our in-groups than out-groups.[45] Examples in the areas of history, literature, and science illustrate our tendency to grant affordances to our in-groups through political spoils, nepotism, and even allocation of rewards.[46] Stepanikova, Triplett, and Simpson investigated whether implicit bias, measured by the Race IAT, could influence this phenomenon.[47] They chose a modified version of the dictator game to assess prosocial behavior. The dictator game is a commonly used measure in the field of Behavioral Economics to test altruism. In the classic paradigm, participants in one room are individually given $10, which they can divide between themselves and an anonymous individual in a neighboring room.[48,49] The dictator game is a thoroughly evaluated test of prosocial behavior, and research has shown that variations in methodology and design—such as perceived anonymity, wording effects, and given information—can affect outcomes.[50,51,52,53,54] Stepanikova et al. found that the D-score was capable of predicting the donation amounts in a dictator game such that those with a strong "anti-Black bias" were less generous to a Black partner than a White partner in a between-subjects design.[55] Though their findings support the idea that implicit biases can affect prosocial behavior, a more accurate interpretation of their results would acknowledge that the Race IAT is motivated by a pro-White bias as opposed to an anti-Black bias.[56,57] Therefore, the question remains whether an anti-Black bias can predict a similar outcome.

The i-Quad, with its ability to estimate association activation at the individual level, is a great asset for exploring this question. We will test the predictive utility of the i-Quad in a modified dictator game. The parameter estimates generated by the i-Quad can be paired with the dictator game outcomes such that we can observe the individual differences between those paired with a White partner against those with a Black Partner. If the i-Quad is a valid measure, we expect that high activation of Black-weapons bias (ACBW) will predict less generosity towards a Black partner than a White partner in a modified dictator game. We also expect that the ability to overcome bias (OB) will impact dictator game outcomes. OB reflects the inhibition of AC, so those with high

42 John Dovidio, Kerry Kawakami, and Samuel Gaertner, "Implicit and explicit prejudice and interracial interaction," Journal of personality and social psychology 82, no. 1 (2002): 62.

43 Alexander Green et al., "Implicit bias among physicians and its prediction of thrombolysis decisions for black and white patients," Journal of general internal medicine 22, no. 9 (2007): 1231-1238.

44 Louis Penner et al., "Prosocial behavior: Multilevel perspectives," Annu. Rev. Psychol. 56 (2005): 365-392.

45 Brian Mullen, Rupert Brown, and Colleen Smith, "Ingroup bias as a function of salience, relevance, and status: An integration," European Journal of Social Psychology 22, no. 2 (1992): 103-122.

46 Henri Tajfel, "Experiments in intergroup discrimination," Scientific American 223, no. 5 (1970): 96-103.

47 Irena Stepanikova, Jennifer Triplett, and Brent Simpson, "Implicit racial bias and prosocial behavior," Social Science Research 40, no. 4 (2011): 1186-1195.

48 Robert Forsythe et al., "Fairness in simple bargaining experiments," Games and Economic behavior 6, no. 3 (1994): 347-369.

49 Elizabeth Hoffman et al., "Preferences, property rights, and anonymity in bargaining games," Games and Economic behavior 7, no. 3 (1994): 346-380.

50 Due to the effects other studies have reported regarding the design of the dictator game, we have included the instructions for our study in Appendix B.

51 Ibid, 346-380.

52 Elizabeth Hoffman, Kevin McCabe, and Vernon Smith, "Social distance and other-regarding behavior in dictator games," The American economic review 86, no. 3 (1996): 653-660.

53 Catherine Eckel and Philip Grossman, "Are women less selfish than men?: Evidence from dictator experiments," The economic journal 108, no. 448 (1998): 726-735.

54 John List, "On the interpretation of giving in dictator games," Journal of Political economy 115, no. 3 (2007): 482-493.

55 Stepanikova, "Implicit racial bias and prosocial behavior," 1186-1195.

56 Brian Nosek, Mahzarin Banaji, and Anthony Greenwald, "Harvesting implicit group attitudes and beliefs from a demonstration web site," Group Dynamics: Theory, Research, and Practice 6, no. 1 (2002): 101.

57 Perez, "The Efficacy of Using Individual QUAD Model Parameters in a Linear Model," (in prep).

OB are both motivated to control and successful at controlling their behavior. Therefore, they should give more to their partner relative to those with low OB in the modified dictator game. We expect discriminability (D) and guessing (G) to have no influence on the donation amount. D and OB represent processes that are specific to the implicit tasks and should not generalize to tasks independent from the IAT. Moreover, an individual's ability to determine the correct response in the IAT, as well as their handedness bias, should have no bearing on dictator game outcomes.

Hypothesis 2: Those with high measured implicit bias will act less prosocially towards a Black partner than they would a White partner in a modified dictator game.

Methods

Participants

Ninety-six undergraduate students from the University of California, Berkeley elected to participate in the study through the UC Berkeley Research Participation Program (RPP) in exchange for course credit. This study was one of many studies listed on the RPP Portal and was titled "Puzzle Solving and Image Pairing." In addition to course credit, all participants received a $1 cash bonus for completing the dictator game. Participants ranged from 18 to 31 years of age (M = 21, SD = 2.4). Of the 96 participants, 63 self-identified as female, 32 as male, and 2 as gender non-binary. 23 participants self-identified as White, 42 as East Asian, 11 as South Asian, 8 as Hispanic or Latino, 2 as Native Hawaiian or other Pacific Islander, 5 as more than one race (Black/White), and 5 as Other.

Design

The reliability of the i-Quad was tested within subjects to measure the test-retest reliability of five parameters: activation of the association between White faces and harmless objects (ACWH), activation of association between Black faces and weapons (ACBW), discriminability (D), overcoming bias (OB), and guessing (G). To assess the predictive utility of the i-Quad, participants were randomly assigned to one of two conditions: Condition A—Black partner, "Darnell" (n = 49) or Condition B—White partner, "Greg" (n = 47). These names were chosen because they are generally associated with Black and White individuals.[58,59] Using the names, as opposed to explicitly stating race, also reduces the influence of social desirability on the participants' answers.

Procedure

Upon entering the study room, participants were ushered into a private cubicle with a computer. They read the study instructions and gave consent to participate. Study procedures and instructions were given by the InquisitWeb platform on the screen. Participants were first asked to fill out demographic information before completing IAT 1. Each IAT was divided into seven blocks, described in Table 1. Response latencies from blocks 3-4 and 6-7 were used to calculate the D-score. For the i-Quad, data from all 7 blocks were used since maximum likelihood estimation requires numerous data points to produce parameter estimates. Trials were counterbalanced so that participants encountered either the stereotype compatible or the stereotype incompatible condition first in blocks 3 and 4, followed by the opposite in blocks 6 and 7.

After completing IAT 1, participants were each handed a puzzle and were asked to solve it individually for 15 minutes. We chose the IQ Puzzler Pro from SmartGames since it is compact and has numerous puzzle arrangements that can keep participants occupied for the required duration. This puzzle was intended to be a filler task between IAT 1 and IAT 2. At the end of this interval, the puzzles were set aside and participants were prompted to complete IAT 2. Participants next completed the Social Value Orientation measure and were given

58 Greenwald, "Measuring individual differences in implicit cognition: the implicit association test," 1464.

59 Jason Okonofua and Jennifer Eberhardt, "Two strikes: Race and the disciplining of young students," Psychological science 26, no. 5 (2015): 617-624.

another 10 minutes to work on the puzzle before they were asked to play the dictator game.[60]

For the dictator game, participants were physically handed an envelope with 10 coins (each coin deemed equivalent to 1 dollar) and two other envelopes, one labeled as "Self" and one labeled as "Partner." The coins and the envelopes were included to make the task feel more realistic since we did not use real cash like the original paradigm. Game instructions stated they could donate any number of coins, or none, to their assigned partner. At this time, we notified participants that they were eligible for a cash bonus for completing the task as encouragement for them to take it more seriously. The computer platform gave them the name of their partner. Condition A saw the name "Darnell" while Condition B saw the name "Greg," although it was intended to feel randomized. Participants then entered their game donation decision into the computer and notified the experimenter, who then brought over a box for them to place their envelopes into (see Appendix B for full instructions). We also collected measures of internal motivation to respond without prejudice, external motivation to respond without prejudice,[61] contact with Black persons, explicit attitudes towards Blacks (feeling thermometer), and a manipulation check.

Measures

Weapons IAT

Perez & Mendoza-Denton found that the association between White and pleasant in the widely used Race IAT is stronger than the association between Black and unpleasant.[62] Therefore, the results from the Race IAT may identify a pro-White bias. The Weapon IAT, on the other hand, is driven by a strong association of Black persons and weapons as opposed to White persons and harmless objects. For this reason, we choose to use the Weapon IAT since it may be tapping into a more powerful stereotype that places Blacks at a disadvantage relative to whites, and indicates anti-Black bias.

Results

i-Quad Model and Reliability

We ran the i-Quad parameters from IAT 1 and IAT 2 through a paired sample t-test and found all parameters, with the exception of discriminability (D), to be consistent.[63] This supported but did not confirm Hypothesis 1. Results are reported below in Table 2. A paired sample t-test revealed that the D-Score from IAT 1 ($M = 0.35$, $SD = 0.39$) and IAT 2 ($M = 0.2$, $SD = 0.37$) was not reliable ($t(96) = 3.710$, $p < 0.01$, $d = 0.376$).[64]

Manipulation Check

As a manipulation check, each participant was asked to both recall the name of their partner and indicate their presumed race. Of the forty-nine participants partnered with Darnell, only one did not remember the name. Thirty-seven accurately assumed Darnell to be Black, three assumed Hispanic or Latino, and nine assumed White. Of the forty-eight participants partnered with Greg, all remembered the name. Forty-two accurately assumed Greg to be White, three assumed Black, and two assumed Hispanic or Latino. In order to properly test the effect of implicit bias as measured by AC of Black-weapons (ACBW) on prosocial behavior, we excluded all participants that did not accurately assume Darnell to be Black and Greg to be White (Darnell $n = 37$, Greg $n = 42$).[65]

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60 Van Lange et al., "Development of prosocial, individualistic, and competitive orientations: theory and preliminary evidence," Journal of personality and social psychology 73, no. 4 (1997): 733.

61 Ashby Plant and Patricia Devine, "Internal and external motivation to respond without prejudice," Journal of personality and social psychology 75, no. 3 (1998): 811.

62 Perez, "The Efficacy of Using Individual QUAD Model Parameters in a Linear Model," (in prep).

63 Since we are testing the reliability of scores within individuals on a single parameter and not the relationship between parameters across the sample, we opted to use a paired-sample t-test over Pearson's correlation.

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65 Data analyses prior to excluding participants are reported in Appendix D.

Prosocial Behavior

On average, participants donated more to Darnell (M = $4.86, SD = $2.55) than to Greg (M = $4.02, SD = $1.72), which was found to be a small but not significant effect (t(61) = 1.695, p = 0.095, d = 0.391). We used linear regression to determine whether the interaction between ACBW and partner name had an effect on donation amount. In addition to the interaction, we included the four other i-Quad parameters (ACWH, G, D, OB) as well as the D-score to test whether the interaction term of ACBW × partner name was the key predictor.[66] We found a marginal interaction effect of ACBW × partner name on donation amount suggesting that those with high activation of Black-weapon bias gave more to Greg (see Table 3). OB did not control for this relationship as we expected. However, D and G met our expectations and had no significant effects. Though evidence encourages further research, Hypothesis 2 was rejected since the interaction of ACBW × partner name was not significant and OB did not control for outcomes.

We include analyses of both the i-Quad parameters and the D-score since these two scoring methods have not yet been compared in this way. They each score the IAT differently (error rates vs. response latencies) and can therefore unlock unique information surrounding implicit bias. It is thus important to understand the strengths and weaknesses of each. We tested whether the D-score alone could also predict outcomes but found no main effect (b = -0.067, p = 0.929) and no interaction effect with partner name (b = 0.343, p = 0.651), (R^2 = 0.001, F(3, 75) = 1.051, p = 0.375). The outcomes of both ACBW and the D-score in predicting donation amounts are represented in Figure 3.

Exploratory Analyses

Our first exploratory measure was Social Value Orientation (SVO). Participants were labeled with a Social Value Orientation of either prosocial, individualistic, or competitive when they selected 6 or more corresponding answer choices out of the 9 questions (see Appendix C). Prosocials are characterized as maximizing joint outcomes, individualists are characterized as maximizing their personal outcomes irrespective to others, and competitors are characterized as maximizing their personal outcomes relative to others. In this sample, 44 participants were labeled as prosocial, 30 were labeled as individualistic, 14 were labeled as competitive and 8 participants did not qualify for a specific Orientation. We found that Social Value Orientation alone did not predict the donation amount, R^2 = 0.038, F(2, 72) = 2.48, p = 0.09. We then aggregated the Individualistic and Competitive participants into a "proself" group, similar to Stepanikova et al., and compared the dictator game outcomes prosocial vs. proself.[67] This comparison did significantly predict donation amounts such that prosocials gave significantly more than proselves (b = 1.02, p = 0.032), R^2 = 0.048, F(1, 73) = 4.74, p = 0.032.

Expanding upon our main model, we controlled for this new SVO categorization in the interaction of ACBW × partner name on donation amount. With this model we found a significant main effect of prosocial participants such that prosocials donated more to their partner, in comparison to proselves, regardless of their partner's race (b = 1.00, p < 0.05). The marginal interaction of ACBW × partner name became negligible (b = 3.304, p = 0.230), R^2 = 0.066, F(4, 68) = 2.28, p = 0.069. We next examined whether the interaction between SVO categorization and partner name could predict donation amounts and found no significant effects of name (b = -0.685, p = 0.314), prosocial SVO (b = 1.00, p = 0.159), or the interaction term (b = 0.069, p = 0.942), R^2 = 0.046, F(3, 71) = 2.205, p = 0.094.

Other exploratory measures we collected included internal motivation to respond without prejudice (IMS), external motivation to respond without prejudice (EMS), and explicit attitudes towards Blacks (feeling thermometer). While we found a main effect of IMS on donation amount (b = 0.61, p < 0.05), there was no interaction effect with partner name (b = 0.20, p = 0.475), R^2 = 0.070, F(3, 75) = 2.966, p = 0.037. EMS did not hold predictive power over donation amount, which is consistent with our expectations since this task was designed to be anonymous (R^2 = 0.008, F(3, 75) = 1.224 p = 0.307). Testing the interaction between partner name

66 We opted to use IAT 2 for the following analyses since it was most recent in relation to the dictator game.

67 Stepanikova, "Implicit racial bias and prosocial behavior," 1186-1195.

and our third exploratory measure, effect of explicit attitudes towards Blacks on donation amount, we found no significant effects ($R^2 = 0.010$, $F(3, 75) = 1.272$, $p = 0.29$).

We also collected data on participant's amount of contact with Black persons. Survey questions assessed the number and percentage of weekly interactions with Black persons, the number of Black friends, and the quality of their closest relationship with a Black person. The amount of weekly interactions with Black persons ($R^2 = 0.018$, $F(3, 75) = 1.494$, $p = 0.223$) and percentage of weekly interactions ($R^2 = 0.015$, $F(3, 75) = 0.400$, $p = 0.753$) did not predict donation amount. The number of Black friends also did not predict donation amount ($R^2 = 0.000$, $F(3,76) = 0.010$, $p = 0.916$). Participants selected one of the following options to describe friend quality: No Black Friends, Stranger, Acquaintance, Friend, Good Friend, and Very Good Friend. With these six levels, the quality of friendship failed to predict donation amount ($R^2 = 0.025$. $F(5, 73) = 0.378$, $p = 0.861$). To increase power, we aggregated data into three groups, the first being "distant" relationships with Black persons (No Black Friends, Stranger, and Acquaintance) ($n = 31$), the second being the group who described the relationship as "Friend" ($n = 24$), and the third being close relationships (Good Friend, and Very Good Friend) ($n = 24$). We ran the model with the three new levels and found a significant interaction such that those with distant relationships with Black persons gave less to Darnell ($b = -1.77$, $p < 0.05$), $R^2 = 0.114$, $F(5, 73) = 3.008$, $p = 0.015$).

Analyses with Control Variables

Our control analyses indicated that age ($b = 0.160$, $p = 0.106$), gender ($b = -0.212$, $p = 0.424$), and income ($b = 0.274$, $p = 0.233$) did not affect donation amount ($R^2 = 0.017$, $F(3,74) = 1.444$, $p = 0.236$). There were no main effects of race nor interactions effects with partner name on donation amounts[68] ($R^2 = 0.077$, $F(12,66) = 1.548$, $p = 0.129$). We also considered perceived anonymity ($R^2 = 0.009$, $F(3, 75) = 1.25$, $p = 0.297$) and believability of being paired with a real partner ($R^2 = 0.016$, $F(3, 75) = 1.432$, $p = 0.240$) as covariates, but these too did not predict donation amount. There was also a significant difference in warmth towards partner as a function of partner name such that participants felt warmer to Darnell ($t(73) = 2.783$, $p = 0.006$). Warmth towards partner ($b = 0.690$, $p < 0.01$) also significantly predicted donation amount ($R^2 = 0.116$, $F(1, 77) = 11.26$, $p < 0.01$). Model fit, however, was not significantly improved by adding the interaction effect of perceived warmth and partner name ($F = 1.638$, $p = 0.201$). Further investigating this relationship,we regressed the believability measure on warmth towards partner and found a significant effect ($b = 0.280$, $p < 0.05$) such that the more they believed they were paired with a real individual, the more they donated ($R^2 = 0.058$, $F(1, 77), = 5.804$, $p < 0.05$). Believability alone, however, was not found to predict donation amount ($R^2 = 0.002$, $F(1, 77), = 0.215$, $p = 0.643$).

Considering many of our exploratory analyses predicted dictator game outcomes regardless of race, we considered the possibility of an underlying phenomenon. A correlation matrix revealed that donation amount, internal motivation to respond without prejudice, and warmth towards partner were significantly correlated with each other (Table 4).

Discussion

Principal Findings & Implications

i-Quad

One of the key findings of this study is the reliability of the i-Quad. Automatic activation of the Black-weapon association (ACBW) and the White-harmless object association (ACWH) was stable across time, which suggests that implicit bias did not significantly change between IAT 1 and IAT 2. This finding is consistent with the theory of implicit bias as an automatic process as automatic processes are not easily changed or manipulated (Schnieder & Shiffrin, 1977). Overcoming bias (OB) was found to be stable, showing that participants were just as successful in overcoming the activated associations in IAT 2 as they were in IAT 1. This is consistent with our expectations

68 There was a significant interaction with Partner name "Darnell" and Race "Other," but we determined this to be negligible due to the size of group "Other" ($n = 3$).

since there were no manipulations affecting cognitive load. The guessing parameter (G) also did not change. This is consistent with our expectations since there was no hypothesized effect on external response bias (handedness). Discriminability (D) varied significantly such that participants' abilities to discern the correct answer worsened from IAT 1 to IAT 2. Discriminability (D) is theorized as the parameter most affected by motivation, distraction, and cognitive load. Although it was not expected for it to vary after 15 minutes of puzzle solving, it is not inconsistent with the parameters' attributes.

We found that Greenwald and colleagues' D-score was not stable across time.[69] Scores significantly decreased from IAT 1 to IAT 2. One potential interpretation of this change is that participants significantly decreased levels of implicit association between Black people and weapons within 15 minutes. However, this interpretation is inconsistent with the theory of implicit bias as an automatic process. In contrast, it illustrates the weakness of the IAT to practice effects. Even practice trials, blocks 3 and 6 of the IAT, can help reduce participants' response times in blocks 4 and 7.[70] The AC parameter derived from the i-Quad in the present study did not succumb to practice effects, suggesting that it may be a more rigorous way of measuring implicit bias than the D-score.

Prosocial Behavior

In this study, we provide initial support for further research into the links between implicit bias, as measured by the i-Quad, and prosocial behavior. While we were unable to confirm our hypothesis regarding the interaction between ACBW and partner name and its effect on donation amounts, the marginal interaction does pique our interest. Our results revealed that donations to Darnell were relatively static as a function of ACBW, while donations to Greg varied more as a function of ACBW. Those with high ACBW gave more to Greg, but did not give less to Darnell. One interpretation of this finding is that it reflects in-group favoritism, which supports the prior work done by Balliet, Wu, and De Dreu,[71] however, more research is needed to see if this finding would replicate in a bigger sample. Though OB did not predict donations in the dictator game, it is a parameter worth future investigation given that the controllable process of overcoming implicit biases and implicit bias reduction, is a topic of much interest in the field of implicit cognition.[72] D and G did not impact on donation amounts, as expected. This supports our assumptions that D and G relate specifically to the task and should have no bearing on the dictator game. The D-score did not significantly predict donation amounts. We attribute this to its inability to differentiate the automatic association activation from the controlled processes.

We found that prosocial individuals are inclined to donate more than individuals with a proself orientation, regardless of their partner's race. Prosociality was stronger in predicting donation amount than implicit bias, which is consistent with Stepanikova and colleagues' results.[73] Though our findings solidify the dictator game as a measure of prosocial behavior, implicit biases can have marginal effects. These small effects are of interest to the field and support the growing body of literature that links implicit biases to behavioral outcomes. In fact, Greenwald, Banaji, and Nosek argue that the small effects captured by the IAT can have significant societal impacts.[74] We also found that higher levels of internal motivation to respond without prejudice (IMS) predicted larger donation amounts regardless of partner race. We suspect that IMS captures general values of equality towards all people which would suggest that, in general, individuals with high IMS are more prosocial. This interpretation is consistent with our findings. On the other hand, external motivation to respond without prejudice (EMS) held little predictive power over donation amount. Since the task was designed to be anonymous, one would expect little to no effect of EMS, which is consistent with our findings. Our analyses also showed that the warmer one felt towards their partner, the more they donated, regardless of race. All participants received

69 Greenwald, "Understanding and using the implicit association test: I. An improved scoring algorithm," 197.

70 Brian Nosek, Anthony Greenwald, and Mahzarin Banaji, "Understanding and using the Implicit Association Test: II. Method variables and construct validity," Personality and Social Psychology Bulletin 31, no. 2 (2005): 166-180.

71 Daniel Balliet, Junhui Wu, and Carsten De Dreu, "Ingroup favoritism in cooperation: A meta-analysis," Psychological bulletin 140, no. 6 (2014): 1556.

72 Anthony Greenwald et al., "Understanding and using the Implicit Association Test: III. Meta-analysis of predictive validity," Journal of personality and social psychology 97, no. 1 (2009): 17.

73 Stepanikova, "Implicit racial bias and prosocial behavior," 1186-1195.

74 Anthony Greenwald, Mahzarin Banaji, and Brian Nosek, "Statistically small effects of the Implicit Association Test can have societally large effects," (2015): 553.

their partner's name with no other supplemental information, so we suspect that variations in warmth are due to individual differences. Considering that donation amount, IMS, and warmth towards partner were significantly correlated, there may be an underlying dimension or confounding variable relating to prosociality that we did not capture with our measures.

Contact

The number and percentage of weekly interactions with Black persons, as well as the number of Black friends one has did not predict donation amounts in our sample. After Allport publicized his intergroup contact hypothesis,[75] establishing four conditions for positive intergroup contact, a vast amount of research on the qualifiers and correlates of intergroup contact has emerged. Though various studies have demonstrated positive correlations between contact and intergroup attitudes,[76] we must also consider the effects of negative intergroup contact in the worsening of attitudes.[77] Our findings do not support the notion that pure intergroup contact can improve outcomes, though we cannot confirm whether or not Allport's four conditions were met by our participants. We did, however, find that friendship quality predicted donation amounts such that those with distant or no relationships with Black individuals gave significantly less to Darnell than to Greg. Intergroup friendship has been highlighted as an important aspect of intergroup contact since it theoretically satisfies all of Allport's conditions.[78] Our findings support the growing body of literature that links intergroup friendship with positive outcomes such as decreased prejudice, greater feelings of closeness, greater positive attitude towards integration in majority groups, decreased feelings of hostility in minority groups, and decreased anxiety during intergroup contact.[79,80,81,82,83]

Limitations

In interpreting these results, we must consider the limitations of this study. The current college student sample may not represent the views and responses of the population as a whole. As a result, findings may not generalize to other populations. UC Berkeley's student population is only 3% Black which could lead to low levels of intergroup salience in regards to Black persons.[84] Previous research shows that intergroup salience can cause more conservative political attitudes and greater prejudicial attitudes toward minority groups.[85,86] However, given that intergroup exposure at UC Berkeley is low, effects of salience may be minimal when compared to a more diverse sample. Another consideration is the proportion of non-U.S. native students in the sample. Twenty-five participants (26%) indicated that they have lived in the U.S. for less than 10 years. Their cultural knowledge of the Black-weapon stereotype may be limited. This would most likely have a negative impact on the strength of

75 Gordon Allport, Kenneth Clark, and Thomas Pettigrew, "The nature of prejudice," (1954).

76 Thomas Pettigrew and Linda Tropp, "A meta-analytic test of intergroup contact theory," Journal of personality and social psychology 90, no. 5 (2006): 751.

77 Stefania Paolini, Jake Harwood, and Mark Rubin, "Negative intergroup contact makes group memberships salient: Explaining why intergroup conflict endures," Personality and Social Psychology Bulletin 36, no. 12 (2010): 1723-1738.

78 Thomas Pettigrew, "Intergroup contact theory," Annual review of psychology 49, no. 1 (1998): 65-85.

79 Pettigrew, "A meta-analytic test of intergroup contact theory," 751.

80 Linda Tropp, "Perceived discrimination and interracial contact: Predicting interracial closeness among Black and White Americans," Social Psychology Quarterly 70, no. 1 (2007): 70-81.

81 Lee Sigelman and Susan Welch, "The contact hypothesis revisited: Black-white interaction and positive racial attitudes," Social forces 71, no. 3 (1993): 781-795.

82 Shana Levin, Colette Van Laar, and Jim Sidanius, "The effects of ingroup and outgroup friendships on ethnic attitudes in college: A longitudinal study," Group Processes & Intergroup Relations 6, no. 1 (2003): 76-92.

83 Elizabeth Page-Gould, Rodolfo Mendoza-Denton, and Linda Tropp, "With a little help from my cross-group friend: Reducing anxiety in intergroup contexts through cross-group friendship," Journal of personality and social psychology 95, no. 5 (2008): 1080.

84 UC Berkeley Office of Planning and Analysis, "UC Berkeley Fall Enrollment Data," berkeley.edu.

85 Maureen Craig and Jennifer Richeson, "On the precipice of a "majority-minority" America: Perceived status threat from the racial demographic shift affects White Americans' political ideology," Psychological Science 25, no. 6 (2014): 1189-1197.

86 Paolini, "Negative intergroup contact makes group memberships salient: Explaining why intergroup conflict endures," 1723-1738.

ACBW. Just like a native US citizen may not understand the associations that Basque children attach to Spanish people,[87] a student from Hong Kong may not have knowledge of the association of Black persons with weapons. This would predict low levels of ACBW. Sample size should also be taken into consideration as a larger number of participants can increase statistical power for exploratory analyses. Many of our marginal results, such as the interaction between ACBW and partner name, could be elucidated with a larger sample size.

Relating specifically to the methods of the design, the dictator game may have had different outcomes had we used real cash in the game instead of coins. Real cash could have encouraged responses that more closely resemble real life outcomes thus increasing the ecological validity of the study. The dictator game may have also been susceptible to order effects having occurred after the IATs. It is reasonable to consider that the IAT alerted or primed participants that the study was intended to measure bias, especially if they were already familiar with the IAT. This could have led to an overcompensation in the dictator game and could explain the unexpected difference between donation amounts to Darnell and Greg. Order effects could also explain the significant differences in warmth towards partner. The warmth towards partner probe was assessed subsequent to the explicit attitudes towards Black people probe. Since both measures assessed explicit attitudes with a "feeling thermometer," participants paired with Darnell may have felt pressured to respond consistently to both measures due to cognitive dissonance. This would have created a response bias artificially increasing responses of warmth towards Darnell but would not have had an effect on responses toward Greg. There is room to improve on the design by recruiting a larger sample size so that tasks can be counterbalanced and any order effects can be confirmed. In general, order effects in this study could produce social desirability bias. This is especially reasonable in this sample since participants on average ranked high on internal motivation to respond without prejudice.

Another consideration of our design is the puzzle task. The puzzles may have been difficult for some and may have increased cognitive load or distraction during the second IAT, especially since participants were informed after IAT 1 that they would be continuing the task later in the study. Studies have shown that increased cognitive load reduces ability to perform well on the IAT.[88] Conrey suggests that increased cognitive load as well as distraction and motivation, can affect the Discriminability parameter.[89] Since we found estimates of D to significantly decrease from IAT 1 to IAT 2, this limitation should be addressed in future studies by either utilizing a simpler filler task, or by entirely removing the puzzle after the first round without informing participants about continuing it later on, and then reissuing the puzzle at the designated time. It is possible that the D parameter is reliable across time when cognitive load remains stable. It is also of interest to determine what differentiate the D and OB parameter on this front since Conrey and colleagues indicated that both D and OB are affected by cognitive load and motivation.[90] Since we found OB to be reliable but not D, they may be differentially susceptible to these variables.

Future Directions

The i-Quad

There is more work to be done in testing and validating the i-Quad. In the current study, we were faced with the methodological issue of splitting the OB parameter, similarly to the split of AC between ACBW and ACWH. The OB parameter, like all other parameters, is specific to the stimulus for that trial. Activation of a Black-weapons bias and a White-harmless objects bias are distinct and the ability to overcome them may differ. In the Weapon IAT, we would expect participants to have a more difficult time overcoming the association of Black and weapons in incompatible trials since it is a stereotype reinforced by popular culture. We would not expect the same effect with the association between White and harmless objects. In order to test this hypothesis, OB would need to be split between association to achieve separate estimates for each bias tested in the IAT. We

87 Luixa Reizábal, Jose Valencia, and Martyn Barrett, "National identifications and attitudes to national ingroups and outgroups amongst children living in the Basque Country," Infant and Child Development: an International Journal of Research and Practice 13, no. 1 (2004): 1-20.

88 Schmitz, "When scoring algorithms matter: Effects of working memory load on different IAT scores," 103-121.

89 Conrey, "Separating multiple processes in implicit social cognition: the quad model of implicit task performance," 469.

90 Ibid, 469.

attempted to split OB in the current study, but found that there were not enough trials to converge the maximum likelihood estimation model for all participants. In order to resolve this issue, we had to remove several of our participants which greatly impacted our sample size and statistical power. Therefore, we did not find this solution to be reasonable in the current study. As a result, the OB parameter in the current study reflects the overall ability to overcome bias. With more trials, OB can be split and we can test the effect of overcoming bias on behavioral outcomes more rigorously.

It may be valuable to consider different quantitative methods with which to analyze data produced by the i-Quad. Across our sample, parameter estimates tended to be heavily skewed. We recommend further investigation into data transformations that may improve modeling and data interpretation. We also acknowledge the possibility that non-parametric statistics may be applicable to i-Quad data. Though these types of analyses are beyond the scope of this study, discovering effective methods could greatly improve the predictive utility of the i-Quad model parameters.

Measures and Design

In the current study, we recognized that individual differences in prosociality, aside from bias, may account for donation amounts. However, there may be confounding variables we did not capture with our measures such as a personality trait. The literature regarding dictator games and personality traits produces varied results. In the realm of the Big Five traits, research suggests personality traits can differentially predict dictator game outcomes as a function of expected payout.[91] Research also suggests a non-linear relationship between the Big Five traits and donation amounts for non-kin partners.[92] Exploring beyond the Big Five, Hilbig et al. investigated the relationship between the HEXACO personality inventory and the dictator game.[93] Their findings suggest that the Honesty-Humility attribute may map more closely to altruism than even the Big Five's agreeableness. Though we did not collect a personality inventory, further research is needed on whether personality traits can affect donation.

We hope to thoroughly evaluate the impact of order effects in this study by varying task sequence. It is also of interest to test the differences in predictive utility of the Weapon IAT versus the Race IAT. Since our findings suggest ingroup favoritism may play a role in dictator game outcomes, the association of White and good in the Race IAT may also produce similar effects to ACBW. This research can also expand onto other tasks beyond the dictator game such as hiring decision paradigms, school scholarship application vignettes, juror decisions, and more.

Conclusions

We have supported the i-Quad as a meaningful measure due to its ability to dissociate the multiple processes within the IAT. We have also shown support for the i-Quad as a reliable measure across time that is robust against practice effects. These estimates of reliability were achieved with smaller sample sizes, as opposed to the hundreds of aggregated trials used by the Quad model. This is an important contribution since it shows the accessibility of the i-Quad. Further investigation can elaborate on the ability of the parameters to hold predictive power of behavioral and real-world outcomes.

The i-Quad has great potential and, with further exploration, can be a powerful tool for analyzing IAT data. The i-Quad provides more angles from which to interpret the IAT and its links to behavior. It analyzes IAT data using error rates as opposed to response latency (D-score). Though we have supported the i-Quad as a robust and meaningful measure, we must acknowledge and respect the large body of work supporting the D-score's functionality and strength as a measure. Both tools can unlock unique information through the IAT and should be used in conjunction to further understand implicit bias. We encourage others to continue the validation of the

91 Avner Ben-Ner, Amit Kramer, and Ori Levy, "Economic and hypothetical dictator game experiments: Incentive effects at the individual level," The Journal of Socio-Economics 37, no. 5 (2008): 1775-1784.

92 Avner Ben-Ner and Amit Kramer, "Personality and altruism in the dictator game: Relationship to giving to kin, collaborators, competitors, and neutrals," Personality and Individual Differences 51, no. 3 (2011): 216-221.

93 Benjamin Hilbig et al., "From personality to altruistic behavior (and back): Evidence from a double-blind dictator game," Journal of Research in Personality 55 (2015): 46-50.

i-Quad since we believe it can produce deeper insight into the working of implicit bias as well as the ways it can impact interactions between individuals.

Appendix A

Fitting the i-Quad

The i-Quad model produces 4 × 2 × 2 = 16 formulas each predicting the outcome for each stimulus/trial type pair. We then calculate the proportion of correct and incorrect answers for each trial type. These proportions will be used in the maximum likelihood estimation (MLE) function in addition to the Quad model formulas to estimate the lowest possible for each of the i-Quad model parameters (ACWH, ACBW, D, OB, and G). The formulas are derived from the multinomial processing tree. Each formula represents the probability that a correct or incorrect answer is achieved for that trial type. The 16 formulas are as follows:

$p(\text{correct} \mid \text{Black, compatible}) = AC_{B/W} + ((1\text{-}AC_{B/W}) \times D) + ((1\text{-}AC_{B/W}) \times (1\text{-}D) \times G)$

$p(\text{correct} \mid \text{Black, incompatible}) = (AC_{B/W} \times D \times OB) + ((1\text{-}AC_{B/W}) \times D) + ((1\text{-}AC_{B/W}) \times (1\text{-}D) \times (1\text{-}G))$

$p(\text{incorrect} \mid \text{Black, compatible}) = (1\text{-}AC_{B/W}) \times (1\text{-}D) \times (1\text{-}G)$

$p(\text{incorrect} \mid \text{Black, incompatible}) = (AC_{B/W} \times D \times (1\text{-}OB)) + (AC_{B/W} \times (1\text{-}D)) + ((1\text{-}AC_{B/W}) \times (1\text{-}D) \times (1\text{-}G))$

$p(\text{correct} \mid \text{weapon, compatible}) = (AC_{B/W}) + ((1\text{-}AC_{B/W}) \times D) + ((1\text{-}AC_{B/W}) \times (1\text{-}D) \times G)$

$p(\text{correct} \mid \text{weapon, incompatible}) = (AC_{B/W} \times D \times OB) + ((1\text{-}AC_{B/W}) \times D) + ((1\text{-}AC_{B/W}) \times (1\text{-}D) \times G)$

$p(\text{incorrect} \mid \text{weapon, compatible}) = (1\text{-}AC_{B/W}) \times (1\text{-}D) \times G$

$p(\text{incorrect} \mid \text{weapon, incompatible}) = (AC_{B/W} \times D \times (1\text{-}OB)) + (AC_{B/W} \times (1\text{-}D)) + ((1\text{-}AC_{B/W}) \times (1\text{-}D) \times G)$

$p(\text{correct} \mid \text{White, compatible}) = AC_{W/H} + ((1\text{-}AC_{W/H}) \times D) + (1\text{-}AC_{W/H}) \times (1\text{-}D) \times (1\text{-}G)$

$p(\text{correct} \mid \text{White, incompatible}) = (AC_{W/H} \times D \times OB) + ((1\text{-}AC_{W/H}) \times D) + ((1\text{-}AC_{W/H}) \times (1\text{-}D) \times G)$

$p(\text{incorrect} \mid \text{White, compatible}) = (1\text{-}AC_{W/H}) \times (1\text{-}D) \times (1\text{-}G)$

$p(\text{incorrect} \mid \text{White, incompatible}) = (AC_{W/H} \times D \times (1\text{-}OB)) + (AC_{W/H} \times (1\text{-}D)) + ((1\text{-}AC_{W/H}) \times (1\text{-}D) \times G)$

$p(\text{correct} \mid \text{harmless object, compatible}) = AC_{W/H} + ((1\text{-}AC_{W/H}) \times D) + ((1\text{-}AC_{W/H}) \times (1\text{-}D) \times (1\text{-}G))$

$p(\text{correct} \mid \text{harmless object, incompatible}) = (AC_{W/H} \times D \times OB) + ((1\text{-}AC_{W/H}) \times D) + ((1\text{-}AC_{W/H}) \text{ x } (1\text{-}D) \text{ x } (1\text{-}G))$

$p(\text{incorrect} \mid \text{harmless object, compatible}) = (1\text{-}AC_{W/H}) \times (1\text{-}D) \times (1\text{-}G)$

$p(\text{incorrect} \mid \text{harmless object, incompatible}) = (AC_{W/H} \times D \times (1\text{-}OB)) + (AC_{W/H} \times (1\text{-}D)) + ((1\text{-}AC_{W/H}) \times (1\text{-}D) \times (1\text{-}G))$

Each formula is passed through a maximum likelihood estimation model for each participant and returns the minimum value possible, based on the observed data, for each parameter. Overall model fit is assessed through a chi-square distribution. We found the model did not fit the overall data well for IAT 1 (X^2 (3, N = 96) = 464.83, $p < 0.01$) and IAT 2 (X^2 (3, N = 96) = 521.69, $p < 0.01$). I attribute this to our few outliers in the dataset. Model fit for individual participants in this sample is 67%. Excluding the participants whose data did not fit the model well would significantly decrease our sample size and statistical power so we decided it was not a reasonable solution for the current study. Increasing trial numbers may help improve model fit and increasing model fit may help in data modeling and interpretation.

Appendix B

Dictator Game Instructions

--- Screen 1 ---
Instructions:
In this task you will have the role of the 'Giver.' You will be paired with a partner who will have the role of the 'Receiver'. As the 'Giver' you must decide how many coins, if any, to give to your partner. This partner is someone you do not know and that you will not knowingly meet in the future.
For this task, each coin is equivalent to $1 for a total of $10.
You will be eligible for a cash bonus at the end of the study.
Please press 'Next' to be paired with a partner."
--- Screen 2 ---
*At this time, they were paired with either "Darnell" or "Greg"
--- Screen 3 ---
"You have been randomly paired with a partner. Although you know the name of your partner, your identity will remain anonymous and your partner will not know who you are. Unlike the task you completed earlier, only you will be making the allocation decision and your partner will simply receive the coins he/she is given. Remember, the more coins you keep, the better for you, and the more coins you give, the better for your partner. You will be eligible for a cash bonus at the end of the study. Think about your decision for a moment before you proceed."
--- Screen 4 ---
Your partner is: Darnell/or/Greg
Each coin is equivalent to $1.
Please place the coins you intend to keep for yourself inside the envelope labeled 'Self'. Place the coins for your partner inside the envelope labeled 'Partner.' Once this task is complete, the experimenter will bring a box in which you will drop your envelopes. This is so that your allocation remains anonymous.
--- Screen 5 ---
Please record how many coins you will keep for yourself and how many, if any, you will give to your partner:
$ I will keep for myself: ___
$ I will give to my partner: ___

Appendix C

Social Value Orientation Inventory

In this task we ask you to imagine that you have been randomly paired with another person, whom we will refer to simply as the "other." This other person is someone you do not know and that you will not knowingly meet in the future. Both you and the "Other" person will be making choices by circling either the letter A, B, or C. Your own choices will produce points for both yourself and the "Other" person. Likewise, the other's choice will produce points for him/her and for you. Every point has value: The more points you receive, the better for you, and the more points the "other" received, the better for him/her.

Here's an example:

	A	B	C
You Get	500	500	550
Other Gets	100	500	300

In this example, if you chose A you would receive 500 points and the other would receive 100 points; if you chose B, you would receive 500 points and the other 500; and if you chose C you would receive 550 points and the other 300. So, you see that your choice influences both the number of points you receive and the number of points the other receives.

Before you begin making choices, please keep in mind that there are no right or wrong answers--choose the option that you, for whatever reason, prefer most. Also, remember that the points have value: The more of them you accumulate, the better for you. Likewise, from the "other's" point of view, the more points s/he accumulates, the better for him/her. For each of the nine choice situations, circle A, B, or C, depending on which column you prefer most:

1)	A	B	C
You Get	480	540	480
Other Gets	80	280	480
2)	A	B	C
You Get	560	500	500
Other Gets	300	500	100

3)	A	B	C
You Get	520	520	580
Other Gets	520	120	320
4)	A	B	C
You Get	500	560	490
Other Gets	100	300	490

5)	A	B	C
You Get	560	500	490
Other Gets	300	500	90
6)	A	B	C
You Get	500	500	570
Other Gets	500	100	300
7)	A	B	C
You Get	510	560	510
Other Gets	510	300	110
8)	A	B	C
You Get	550	500	500

Other Gets	300	100	500
9)	A	B	C
You Get	480	490	540
Other Gets	100	490	300

Note: Participants are classified when they make 6 or more consistent choices.
Prosocial Choices: 1C, 2B, 3A, 4C, 5B, 6A, 7A, 8C, 9B
Individualistic Choices: 1B, 2A, 3C, 4B, 5A, 6C, 7B, 8A, 9C
Competitive Choices: 1A, 2C, 3B, 4A, 5C, 6B, 7C, 8B, 9A.
(Van Lange, Otten, De Bruin, & Joireman, 1997)

Appendix D

Analyses Without the Excluded Participants

Mean levels of Donation by partner name. Darnell (M = $4.71, SD = $2.52), Greg (M = $4.09, SD = $1.64), small but significant effect, t(82) = 1.4, p = 0.149, d = 0.294.
Interaction of AC-Black Bad and partner name in predicting donation. AC Black-weapon (b = 1.46, p = 0.27), partner name (b = 0.49, p = 0.057), interaction of AC Black-weapon and partner name (b =-1.98, p = 0.14); R^2 = 0.017, F(3, 89) = 1.538 , p = 0.210.
SVO predicting donation. R^2 = 0.02, F(2, 85) = 1.958, p = 0.147.
Controlling for SVO in the interaction of AC Black-weapon and partner name on donation. Prosocial participants (b = 1.40, p < 0.05), R^2 = 0.047, F(5, 78) = 1.833, p = 0.116. Interaction of SVO and partner name in predicting donation. Prosocial SVO (b = 1.39, p < 0.05), R2 = 0.016, F(5, 82) = 1.295, p = 0.274.
Interaction of IMS and partner name predicting donation. IMS (b = 0.528, p < 0.05), interaction of IMS and partner name (b = 0.183, p = 0.443); R^2 = 0.059, F(3, 92) = 2.001, p = 0.034.
Interaction of EMS and partner name in predicting donation. R^2 = -0.006, F(3, 92) = 0.388 p = 0.534.
Interaction of explicit bias and partner name in predicting donation. R^2 = 0.059, F(3, 92) = 2.001, p = 0.034.
Interaction of number of weekly interactions with Black persons and partner name in predicting donation. (R^2 = 0.026, F(3, 92), p = 0.475)
Interaction of percentage of weekly interactions with Black persons and partner name in predicting donation. (R^2 = 0.008, F(3, 92), p = 0.849).
Interaction of number of Black friends and partner name in predicting donation. R^2 = 0.000, F(3,93) = 1.010, p = 0.317.
Interaction of quality of closest friendship with a Black person and partner name in predicting donation, three new levels. “Distant” (b = -1.25, p < 0.05), R^2 = 0.032, F(5, 90) = 1.647, p = 0.155).
Age predicting donation. R^2 = 0.013, F(1, 94) = 2.333, p =0.13.
Gender predicting donation. R^2 = 0.002, F(1, 93) = 0.270, p = 0.604.
Income predicting donation. R^2 = 0.030, F(3, 92) = 0.976, p = 0.407.
Race predicting donation. R^2 = 0.062, F(6, 89) = 0.987, p =0.43.
Perceived anonymity predicting donation. R^2 = 0.009, F(1, 94) = 0.875, p = 0.351.
Believability predicting donation. R^2 = 0.006, F(1, 94) = 0.581, p = 0.447.
Warmth towards partner predicting donation. Warmth (b = 0.704, p < 0.01, R^2 = 0.121, F(1, 94) =14.12, p < 0.01.
Interaction of D-Score and partner name in predicting donation. R^2 = 0.025, F(3, 92) = 0.794, p = 0.500.

Contributors' Notes

The authors' research experience began in the lab of Drew Jacoby-Senghor in Haas School of Business, University of California Berkeley. While conducting various literature reviews in the Jacoby-Senghor lab, they gained valuable insights into common research methods and frameworks regarding implicit bias. After a year of assisting in the lab, they took on an independent research project under the mentorship of Rodolfo Mendoza-Denton and PhD candidate Amanda Perez in the Department of Psychology, University of California Berkeley. This research produced the following manuscript, which was granted the Swan Research Award, and was a culmination of a full year of literature reviews, running participants, and drafting papers.

The authors graduated in the spring of 2019 with a Bachelor's degree in Psychology with Honors. Their research interests include biases within social networks and leadership within teams. Their coursework spanned the fields of Psychology, Media Studies, and Business and their aspirations include a higher degree in organizational behavior.

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Tables and Figures

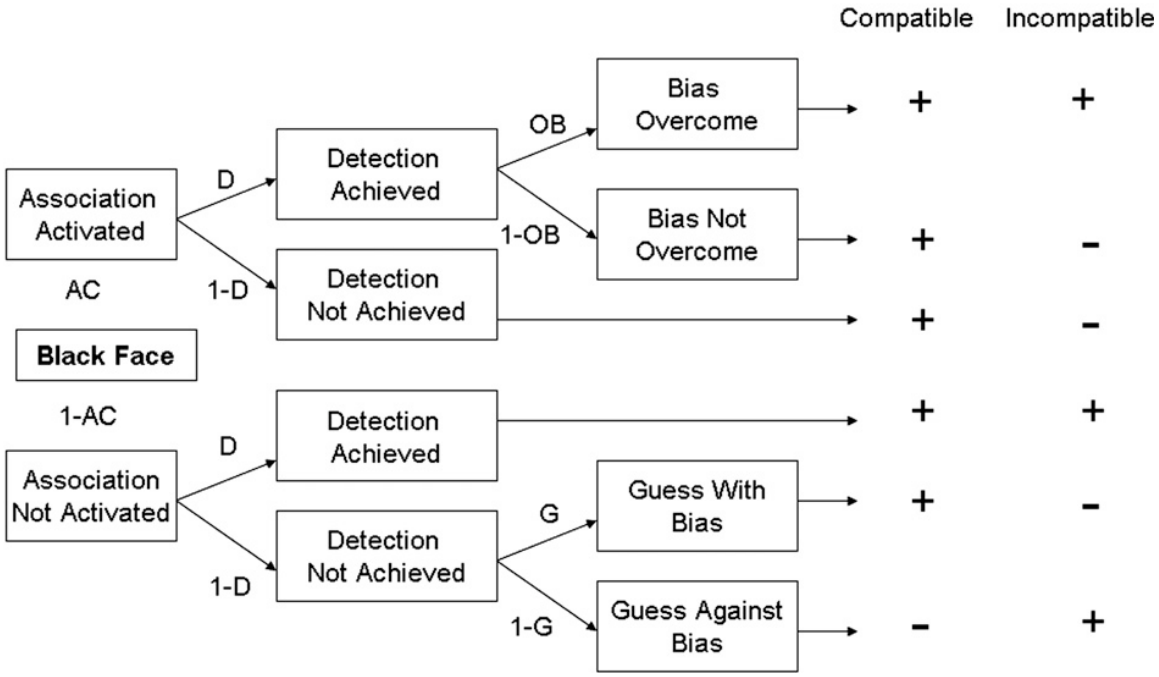

Figure 1. The quadruple process model (quad model). Each path represents a likelihood. Parameters with lines leading to them are conditional upon all preceding parameters. The table on the left panel of the figure depicts correct (√) and incorrect (×) responses in the Implicit Association Test as a function of process pattern and block type.

Conrey, Frederica R., Jeffrey W. Sherman, Bertram Gawronski, Kurt Hugenberg, and Carla J. Groom. "Separating multiple processes in implicit social cognition: the quad model of implicit task performance." Journal of personality and social psychology 89, no. 4 (2005): 469.

Table 1
Overview of the IAT Employed in the Present Study

Block	Trial	Stimuli assigned to left Response Key "E"	Stimuli assigned to right Response Key "I"
1	20	African-American	Caucasian
2	20	Weapon	Harmless Object
3	40	African-American + Weapon	Caucasian + Harmless Object
4	40	African-American + Weapon	Caucasian + Harmless Object
5	20	Caucasian	African-American
6	40	Caucasian + Weapon	African-American + Harmless Object
7	40	Caucasian +Weapon	African-American + Harmless Object

Note. For half the participants, the presentation of blocks will be counterbalanced such that Blocks 1, 3, and 4 will be switched with Blocks 5, 6, and 7 respectively.

Figure 2. The visual stimuli utilized in the Weapon IAT for the categories of "Weapons" and "Harmless Objects."

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Table 2
Reliability of i-Quad Parameters by Paired-Sample t-Test

Parameter	IAT 1		IAT 2		t (df)	*p*	Cohen's d
	Mean	SD	Mean	SD			
$AC_{Black\text{-}weapon}$	0.12	0.24	0.10	0.18	0.65 (91)	0.51	0.08
$AC_{White\text{-}harmless\ object}$	0.18	0.29	0.14	0.24	0.97 (91)	0.33	0.13
D	0.85	0.12	0.82	0.14	3.29 (91)	0.00*	0.21
OB	0.62	0.45	0.62	0.44	-0.12 (91)	0.89	-0.01
G	0.50	0.26	0.54	0.21	-1.16 (91)	0.24	-0.17

** $p < 0.001$*

Table 3
Linear Regression Results Testing H2

	β	*SE*	*t*	*p*
$Partner\ Name_{Darnell}$	0.757	0.315	2.400	0.191*
$AC_{Black\text{-}weapon}$	1.210	1.457	0.831	0.409
$AC_{White\text{-}harmless\ object}$	-1.280	1.178	-1.086	0.281
D	1.292	1.811	0.713	0.478
OB	0.898	0.630	1.424	0.159
G	-0.378	1.334	-0.283	0.777
D-score	0.508	0.836	0.608	0.545
$Partner\ Name_{Darnell} \times AC_{Black\text{-}weapon}$	-2.869	1.489	-1.926	0.058 □

Notes. $R^2 = 0.015$, $F(8,68)$, $p = 0.340$. □$p < 0.1$. *$p < 0.05$.

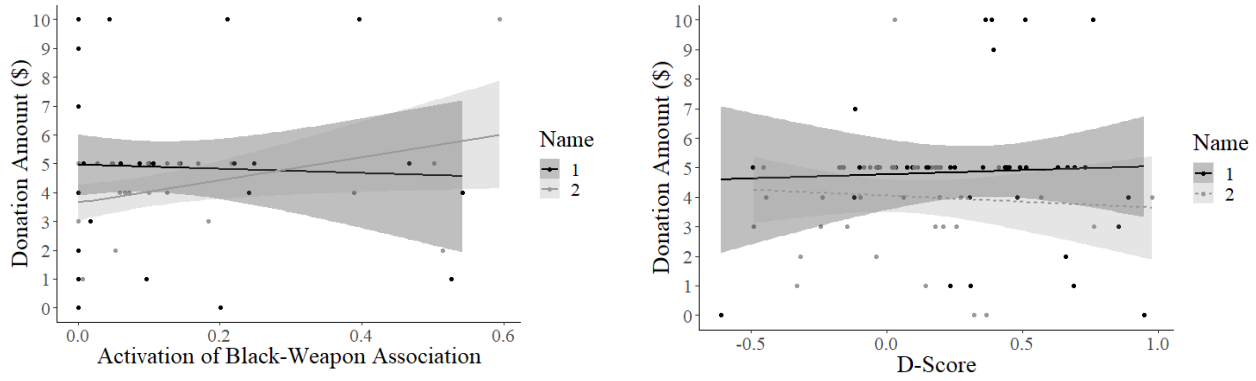

Figure 3. Results from linear regression using ACBW and D-score to predict donation amount where Name 1 refers to Darnell and Name 2 refers to Greg.