Implicit Bias among Physicians and its Prediction of Thrombolysis Decisions for Black and White Patients

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ABSTRACT

Context: Studies documenting racial/ethnic disparities in health care frequently implicate physicians' nonconscious biases. No study to date has measured physicians' nonconscious racial bias to test whether this predicts physicians' clinical decisions.

Objective: To test whether physicians show racial bias on Implicit Association Tests (IATs) and whether magnitude of such bias predicts differential thrombolysis recommendations for black and white patients with acute coronary syndromes.

Design, Setting, and Participants: Internet-based tool comprising a clinical vignette of a patient presenting to the emergency department with an acute coronary syndrome, followed by a questionnaire and three IATs. Study invitations were e-mailed to all internal medicine and emergency medicine residents at four academic medical centers in Atlanta and Boston; 220 completed the study, met inclusion criteria, and were randomized to either a black or white vignette patient.

Main outcome measures: IAT scores (normal continuous variable) measuring physicians' *implicit* racial preference and perceptions of cooperativeness. Physicians' attribution of symptoms to coronary artery disease for vignette patients with randomly assigned race, and their decisions about thrombolysis. Assessment of physicians' *explicit* racial biases by questionnaire.

Results: IATs revealed *implicit* bias favoring whites (mean IAT score=0.36, P<0.001, one-sample t-test) and *implicit* stereotypes of black persons as less cooperative with medical procedures (mean IAT score 0.22, P<0.001), and less cooperative generally (mean IAT score 0.30, P<0.001). As physicians' pro-white implicit bias increased, so did their likelihood of treating white patients and not treating black patients with thrombolysis (P=0.009). Physicians reported no *explicit* preference for white versus black patients or differences in cooperativeness.

Conclusions: This study represents the first evidence of nonconscious (implicit) racial bias among physicians using a measure of implicit social cognition, and its predictive validity. Results suggest that physicians' nonconscious biases may contribute to racial/ethnic disparities in the use of medical procedures such as thrombolysis for myocardial infarction.

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BACKGROUND

Widely-documented racial/ethnic disparities are particularly striking in the treatment of cardiovascular disease,(1, 2) with whites up to twice as likely as blacks to receive thrombolytic therapy for myocardial infarction.(3-7) Whether health professionals' biases contribute to such disparities in care has been a subject of speculation and study.(1, 8-14) For example, physicians might believe that black patients are less likely to adhere to treatment recommendations than whites, and thus offer treatment less often.(12) Some researchers speculate that "unconscious bias" is more likely to underlie treatment disparities than "overt prejudice."(12, 15-18)

For many years, researchers have measured overt prejudice using self-report instruments, but efforts to measure nonconscious bias are more recent. The computer-based Implicit Association Test (IAT), first introduced in 1998, is now used widely to measure bias that may not be consciously recognized.(19) The IAT measures the time it takes subjects to match representatives of social groups (e.g., age, gender, race) to certain values or attributes (e.g., *good*, *bad, cooperative, stubborn*). The IAT operationalizes nonconscious bias by hypothesizing that subjects will match a group representative to an attribute more quickly if they connect these factors in their minds, regardless of their awareness of this connection. For instance, the more strongly study subjects associate pictures of *white persons* with *good* concepts and pictures of *black persons* with *bad* concepts, the more quickly they will match them, and vice versa. The computerized IAT measures the aggregate time required for matching concepts with attributes under two conditions. A difference in average matching speed for opposite pairings (e.g. *black+bad/white+good* vs. *black+good/white+bad*) determines the IAT score (Figure 1).

Subjects are typically aware that they are making these connections but unable to control them given the rapid response times – thus the IAT score is regarded to be a measure of nonconscious rather than explicit bias. To understand the procedure further, readers can take IATs at implicit.harvard.edu.(20)

Although more than 200 studies have employed IATs(19, 21-25) to understand mental processes involved in cognitive, clinical and social tasks, this approach has not yet been applied to health care professionals and the decisions they make. Given questions about the source of observed disparities in health service use, the IAT might provide useful insight into the contribution of implicit biases among physicians. In this study, we used a race preference IAT to measure implicit biases among emergency medicine and internal medicine residents. We also developed two new race IATs to measure stereotypes about general cooperativeness and cooperation with medical procedures. We hypothesized that these stereotypes could affect physicians' clinical decisions differentially for white and black patients. Using a case vignette with patient race assigned randomly, paired with IATs and a questionnaire, we sought to determine whether implicit or explicit race biases predict physicians' decisions to give thrombolysis for acute myocardial infarction.

METHODS

Participants and Study Procedures

In April and May 2005, we e-mailed a study invitation and three weekly reminders to all 776 internal medicine and emergency medicine residents in four academic medical centers in Boston, MA, and Atlanta, GA. The emails included a link to

the research web site and a login code. Using an honor system administered by the chief residents, we offered participants a $10 gift certificate and entry into a lottery ($200 and $100 prizes for each site) for completing the 20-minute, anonymous, web-based study. Of the 776 residents, 393 (50.6%) participants completed the randomized vignette questionnaire and explicit bias section of the study. We excluded 25 participants who were not residents in an eligible program (n=2) or had previously completed part of the study (n=23). Fifty-seven participants failed to complete the Implicit Association Tests (IATs) or had unusable IAT results, as described elsewhere.(22) Twenty-four participants failed to complete the demographics section. This left 287 participants (37.0% of 776) who completed all aspects of the study. On a post-test question, 67 of these 287 participants reported some awareness of what the study was about through discussions with colleagues who had completed it. Because this awareness may have biased their responses to the case vignette, we omitted these participants from the analyses. All results (unless otherwise specified) are based on the 220 participants (28.4%) who completed the study and were unaware of the nature of the study.

Study Design

The computer software randomly assigned participants to see a picture of a black or white patient, while reading a clinical vignette. We created numerous patient images by morphing together photographs of individuals obtained from shareware files using Photo Morpher Software (Morpheus Software, LLC, Santa Barbara, CA). Nineteen independent evaluators reviewed these images, and we chose four (two black and two white) that were most closely matched on age (approximately 50) and attractiveness (7-

point scale). The vignette describes a 50 year-old male presenting to the emergency department with chest pain and an electrocardiogram suggestive of anterior myocardial infarction. It is stated that primary angioplasty is not an option and no absolute contraindications to thrombolysis are evident.

We asked participants to rate the likelihood that the chest pain was due to coronary artery disease (CAD) (5-point scale, "very unlikely" to "very likely") and whether they would give the patient thrombolysis (yes/no). To assess "explicit bias," the software then asked participants several questions about whether they preferred white or black Americans (5-point scale with preference expressed as "somewhat" or "slightly" prefer black or white Americans, and 10 point "thermometer" scale of warm feelings toward each group separately). We also asked about their beliefs about patients' cooperativeness in general and with regard to medical procedures such as thrombolysis (5-point scale – black patients somewhat less cooperative, slightly less cooperative, equally cooperative, white patients slightly less cooperative or somewhat less cooperative). Finally, the online survey included queries about respondent demographics, effectiveness of thrombolysis, and pre- and post-test opinions on nonconscious bias and IATs. The vignettes and survey are available upon request.

Participants also completed three implicit association tests (IATs) corresponding to the explicit bias questions. The "Race Preference IAT" measures implicit association of white and black race with good and bad terms. We created the next two IATs specifically for this study. The “Race Cooperativeness IAT” measures implicit associations between race and general cooperativeness. The “Race Medical Cooperativeness IAT” measures implicit associations between race and cooperativeness

with medical recommendations. All IAT scores are expressed as normally distributed continuous variables. For time efficiency we used a 5-block structure for the IATs, with the specific pairing received first (e.g., black-bad/white-good) counterbalanced across participants.(22) Figure 1 shows the faces representing white or black race and the terms used as stimuli for the concepts of "good/bad" and "cooperativeness/uncooperativeness."

Analysis

We examined differences in demographic characteristics, likelihood of CAD, and decisions to treat with thrombolysis between participants assigned to black versus white patients using chi-square and t-tests as appropriate. We scored IATs according to published guidelines(22) with zero representing no racial bias, positive values representing pro-white bias, and negative scores representing pro-black bias (range typically –0.6 to 1.2). We compared mean IAT scores for various demographic groups using t-tests.

To look for relative disparity by race between diagnosis and treatment, we compared participants' ratings of the likelihood that the chest pain was due to coronary artery disease (the *"diagnosis"* variable, 1-5 scale as above) with the likelihood of treating the patient with thrombolysis (the *"treatment"* variable, yes/no). To do this we put both the *diagnosis* and *treatment* variables on the same scale using z-scores. We then subtracted the treatment variable from the diagnosis variable to create a "*delta*" variable. A *delta* score of zero indicated that treatment was commensurate with diagnosis. A negative score indicated that treatment was more likely than diagnosis, and a positive score indicated that diagnosis was more likely than treatment. We used a one-way

ANOVA to test whether diagnosis-treatment *delta* was different for black versus white patients.

To test whether bias predicted physicians' use of thrombolysis for black and white patients, we used multiple linear regression analysis with thrombolysis decision as the dependent variable, bias (implicit or explicit) as the independent variable, and patient race (black or white) as the moderator, adjusting for analysis-relevant covariates (e.g., physician race, sex, socioeconomic background, explicit race bias, implicit race bias, and belief in the effectiveness of thrombolysis). We then added the 67 physicians who were aware of the nature of the study back into the dataset and used multiple linear regression to examine the effect of awareness of study objectives upon thrombolysis recommendation for black patients as a function of IAT score. We performed all analyses using SPSS statistical software (SPSS Inc., Chicago, IL). The study received approval from the Institutional Review Boards at Beth Israel Deaconess Medical Center, Partners HealthCare System, and Emory University.

RESULTS

Table 1 describes demographic characteristics of the participants stratified by whether they were randomly assigned a black or white patient. Participants assigned black vs. white patients did not differ significantly, except that first and second year residents were more likely to be assigned white patients. Year of residency did not have any significant effect on either likelihood of recommending thrombolysis (Chi-square P=0.98) or on IAT scores however. Table 1 shows mean IAT scores for all three IATs by participants' demographic characteristics. Physician race was the only consistent

demographic predictor of IAT scores. Black physicians had mean scores on all three IATs near zero, while all other groups had scores in the positive, pro-white range. Emergency medicine residents also had somewhat less pro-white IAT sores on the general cooperativeness IAT. There was no difference in the IAT scores of participants randomized to black vs. white patient vignettes.

Physicians' *explicit* and *implicit* racial biases

On the measures of *explicit* bias, participants expressed equal preference for black and white Americans on the 5-point scale of race preference (mean difference = 0.03, P=0.36) and on the 10-point thermometer scale measuring warmth toward black and white Americans separately (mean difference = 0.04, P=0.61). They reported black and white patients to be equally cooperative on a 5-point scale of cooperativeness with medical procedures (mean difference = 0.01, P=1.00) and on a 10-point thermometer scale measuring cooperativeness separately for black and white patients (mean difference = 0.08, P=0.49).

On the measures of *implicit* bias, all three IATs showed statistically significant effects (P<0.001), with stronger associations of negative attributes (e.g., "bad," "uncooperative") to blacks than to whites. Figure 2 displays a graph of the magnitude of physicians' bias on the four explicit measures (top half) and three implicit measures (bottom half). Because measures of explicit bias (5 and 10-point scales) and implicit bias (reaction time scores ranging from -1.01 to +1.35) were on different scales, the magnitude of physicians' bias across the seven measures could only be directly compared by converting them all to the same metric - Cohen's effect size *d*. Cohen's *d* is

conceptually defined as the magnitude of an effect independent of sample size (see conversion formula at the bottom of Figure 2) and is widely used in empirical research and meta-analysis in the behavioral sciences. Cohen's *d* values range in size from small (0.20), to medium (0.50), and large (0.80).(26) As shown in Figure 2, none of the explicit effects approached the cut-off for a small effect. In contrast, all of the implicit effects were medium or large in magnitude.

Aggregate scores on the three separate IATs were all somewhat correlated (average pairwise correlation r=0.32, P=0.001). We found some correlation between implicit bias (IAT score) and explicit bias (composite 5-point scale and 10-point feeling thermometer) for general racial preference (r=0.28, P=0.001) and no correlation for cooperativeness with medical procedures (r=0.05, P=0.50).

Diagnosis of coronary artery disease (CAD) and treatment with thrombolysis

On a scale from 1 (less than 20% likely) to 5 (more than 80% likely), physicians were more likely to diagnose black patients (M = 4.08) than white patients (M = 3.71) with CAD as a cause of their chest pain (P=0.02). However, participants were *equally* likely to give thrombolysis for black (52%) and white (48%) patients (Chi-square P=0.68). Further analyses adjusting for covariates demonstrated a weaker relationship between diagnosis of CAD and recommendation of thrombolysis among blacks versus whites. For blacks, *delta* was 0.11 (see definition above), indicating lower likelihood of thrombolysis in the face of perceived acute myocardial infarction. For whites, *delta* was –0.14, indicating higher likelihood of thrombolysis in the face of perceived acute myocardial infarction (P=0.06).

Implicit (but not explicit) bias predicts differences in physicians' thrombolysis decisions

Physicians' *explicit* (self-reported) attitudes toward patients by race did not influence their decision to give thrombolysis for black versus white patients. A multiple linear regression analysis showed no evidence of an interaction between self-reported attitude and patient race on thrombolysis recommendation (P=0.82). This result remained non-significant after controlling for physicians' implicit bias, race, sex, SES, and belief in thrombolysis effectiveness (P=0.64).

Physicians' *implicit* biases, however, showed strong associations with their decisions to give thrombolysis. Figure 3 illustrates how each of the three IAT results and the combined IAT composite predicted thrombolysis decisions for black and white patients. Panel A shows that, as the degree of anti-black bias on the race preference IAT increased, recommendations for thrombolysis for black patients decreased. The interaction between implicit anti-black bias and patient race on treatment recommendation was significant (P=0.009). After controlling for physicians' explicit race bias, race, sex, SES, and belief in thrombolysis effectiveness, the interaction effect of patient race and thrombolysis remained significant. A composite IAT measure combining all three IATs (race, attitude, and stereotypes) showed the same pattern (panel D) and was statistically significant both with and without the covariates included in the model (P=0.04). The same general pattern also held for the "General Cooperativeness" and "Medical Cooperativeness" IATs (panels B and C); however, the interactions were not statistically significant (P=0.44 and 0.21).

Participants who were aware of the study's purpose

Results presented above excluded the 67 participants who reported some awareness of the nature of the study. Additional analyses including these 67 "aware" physicians demonstrated a two-way interaction between awareness and IAT score on thrombolysis recommendation (P=0.001) (figure 4). As "unaware" physicians' bias on the composite IAT variable increased, their likelihood of recommending thrombolysis to black patients decreased, as described above. In contrast, increase in bias among "aware" physicians was associated with more thrombolysis for black patients. All P-values remained significant after adjusting for covariates and the same general pattern held for all three IATs.

Prior to completing the IAT section of the study, 60.5% of physicians agreed or strongly agreed with the statement: "Subconscious biases about patients based on their race may affect the way I make decisions about their care without my realizing it." When shown the same statement after taking the IATs, 71.6% of physicians agreed or strongly agreed with this statement (difference in mean 5-point score = 0.33, $P < 0.001$ by paired t-test). 74.8% felt that taking IATs is a worthwhile experience for physicians, and 76.1% felt that learning more about subconscious biases could improve their care of patients.

COMMENT

The Implicit Association Test (IAT) is a new methodology for studying health care provider bias as a potential root cause of racial/ethnic disparities in health care. This is the first study to use a cognitive measure of bias among physicians, and to correlate this with treatment decisions according to patient race. It also represents the first time that

the IAT – first published in 1998(19) – has been modified to measure an implicit bias/stereotype specific to medical care (i.e. that black patients are less willing to undergo medical procedures).

Not surprisingly, most physicians did not admit to any racial biases *explicitly*. However, on the *implicit* measures of bias (IATs), most non-black physicians demonstrated some degree of bias favoring whites over blacks. Participants' scores on the race preference IAT showed a range of *implicit* race bias similar to previous social psychology studies among non-physicians.(22, 27) The new "cooperativeness IATs" were normally distributed and somewhat correlated with the well-studied race preference IAT, suggesting that they measure different but related racial bias constructs. Future research should seek to validate their use among physicians.

Findings of implicit bias and its effects on clinical decisions may surprise physicians who tend to view their work as both altruistic and evidence-based.(28) Implicit race biases are prevalent in the U.S. in general,(27) so it should not be surprising that they are prevalent among physicians as well. Implicit biases are thought to reflect societal, cultural, and media messages that have accumulated below conscious recognition over time – essentially, our environment's "thumbprint" on our minds. Implicit biases are primarily nonconscious and do not imply overt racism. This is supported by the fairly low correlation between explicit and implicit race preference in our study. However, they may affect behavior even among individuals with good intentions, as demonstrated in numerous studies in the psychology literature(25) and suggested by several medical studies.(12, 13, 15) IAT methodology has not previously

been used in medical research, so meaning and significance implicit biases in health care deserves further investigation.

We found no difference in the crude rate of thrombolysis between study participants assigned a black patient versus those assigned a white patient. However, participants were more likely to assign a diagnosis of coronary artery disease to black patients than to white patients. In the face of equal rates of thrombolysis among the two groups, this constitutes a disparity. However, our results did not depend on demonstrating disparities in treatment. Rather, our study was designed to determine whether physicians' implicit biases (IAT scores) predicted different patterns of thrombolysis recommendation for black and white patients.

We found that implicit bias against blacks (as measured by the race preference IAT) was negatively correlated with likelihood of recommending thrombolysis for black patients and positively correlated with likelihood of recommending thrombolysis for white patients. This finding suggests that nonconscious race biases among physicians may influence their decisions about important interventions such as thrombolysis for suspected myocardial infarction. While several studies have pointed to nonconscious biases as one potential root cause for racial and ethnic disparities in health care,(9-14) this is the first evidence directly supporting this link. We were encouraged to find most resident physicians open to the idea that subconscious biases could affect their clinical decisions, and that learning more about these biases could improve their care of patients. After completing the IATs, residents acknowledged greater vulnerability to subconscious bias than they did at the start, suggesting that the experience heightened their awareness. Also, those physicians who were aware that the study had to do with racial bias, and who

had higher levels of implicit pro-white bias, were more likely to recommend thrombolysis to black patients than physicians with low bias – the opposite of the study's main effect. This suggests that implicit bias can be recognized and modulated to counteract its effect on treatment decisions. Together, these finding support the IAT's value as an educational tool.

Our study has several limitations. Our sample size was fairly small, which made it difficult to detect small effects and inappropriate to generalize to physicians more broadly. Resident physicians, particularly those at large academic health centers in Boston and Atlanta, may be very different from physicians who typically make thrombolysis decisions. Also, our participation rate was relatively low, which raises concern for non-response bias. We have no information about whether responders were different from non-responders. However, our primary findings are based on the part of the study where participants are randomized to a black or white patient vignette – an experimental design – not a survey where validity depends upon a high response rate. Another limitation is that nonconscious bias elicited by a computerized vignette may be different from that elicited by an in-person encounter. Moreover, physicians' self-report may not accurately reflect their true thoughts and actions. Both of these last limitations would likely lead to underestimation rather than overestimation of disparities in thrombolysis use.

Future IAT studies should examine both actual patient-physician interactions and more realistic simulations, introducing such issues as communication, rapport, and culture. It may in fact be the subtleties of interracial interactions that lay the foundation for differential treatment to occur.(29) IATs should measure clinically relevant

stereotypes that are hypothesized to affect specific medical decisions, in addition to the standard race preference IAT. Studies should also account for participants' awareness of the purpose of the study, since this had a clear impact on treatment decisions in our study.

In conclusion, our findings suggest that physicians, like others in the U.S., may harbor nonconscious racial biases, and that these biases may influence clinical decisions. Further study is needed to confirm our findings, and to determine whether nonconscious racial biases contribute to healthcare disparities. If this is the case, new approaches to addressing disparities might include confidential feedback mechanisms to make providers aware of disparities in their own cohort of patients, use of IATs to increase providers' awareness of nonconscious bias, and targeted training to decrease bias or mitigate its effects on clinical decision-making. We do not suggest that bias among health care providers is the largest or most important factor leading to health care disparities. These disparities are complex and their causes are multifactorial. However, efforts to eliminate them should consider any potential contributing factor, even if it lies within us.

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LEGENDS FOR FIGURES

Figure 1. Implicit Association Test (IAT) sample screens and stimuli

This figure displays sample screens and stimuli from the “race preference" (Black-White / Good-Bad) IAT. Sample screens “A” and “B” represent one of the two types of pairing tasks that participants rapidly complete (called combined tasks), and screens “C” and “D” represent the other type of combined task. In screens “A” and “B,” the category “Black” is paired with the evaluative attribute “Bad” in the upper left corner, and “White” is paired with “Good” in the upper right corner. Participants classify pictures and words that are “Black” or “Bad” by pressing the “e” key on their computer keyboard, and those words and pictures that are “White” or “Good” by pressing the “i” key (all picture and word stimuli are shown with arrows below the screens). Screen “A” shows a *picture* trial, and screen “B” shows a *word* trial. Trials containing pictures and words alternate. The second type of combined task (screens “C” and “D”) uses the same picture and word stimuli, only the category and attribute pairings in the upper corners are switched. Here “White” is paired with “Bad” and “Black” is paired with “Good.” Participants continue to use the “e” and “i” keys to classify picture and word stimuli into the category-attribute pairs in the upper left and right corners. Participants with strong implicit anti-black bias are faster when classifying pictures and words when “Black” is paired with “Bad” (screens “A” and “B”) than when “Black” is paired with “Good” (screens “C” and “D”). The order in which the two combined tasks are presented is counterbalanced across participants.

Two additional IATs, the “Cooperativeness” and “Medical Cooperativeness” use the same social categories (race: black or white) and associated picture stimuli, but different evaluative attributes and associated word stimuli. Both use the evaluative attribute “Difficult Patient” and “Cooperative Patient.” The Cooperativeness IAT uses synonyms associated with difficult and cooperative: Stubborn, Disagreeable, Rejecting, Unwilling, Agreeable, Accepting, Accommodating, Willing. The Medical Cooperativeness IAT uses words specific to rejecting or accepting medical treatment: Refuses TPA, Refuses Thrombolysis, Declines Treatment, Opposes Catheterization, Accepts TPA, Accepts Thrombolysis, Takes Treatment,
Welcomes Catheterization.

Figure 2. Magnitude of physicians' explicit (self-reported) and implicit (IAT) race bias

Figure 3. Relationship between physician race preference IAT score and thrombolysis decisions by patient race

* $P<0.05$.
+ $P=0.05$ - 0.11
B-values are standardized regression coefficients that describe the magnitude of each relationship that the regression lines represent.
IAT bias is a continuous variable represented on the polar ends of the x-axis as “low anti-black IAT” and “high anti-black IAT.” Treatment recommendation of thrombolysis is represented on the y-axis and is a dichotomous variable for which “0” = “would not give

thrombolysis," "1" = "would give thrombolysis." Panels A – D represent "race preference" "general cooperativeness," "medical cooperativeness," and the composite IAT measures respectively.

Figure 4. Relation between physicians' awareness of the study's purpose and IAT bias on recommendation for thrombolysis (black patients only)

B-values are standardized regression coefficients that describe the magnitude of each relationship that the regression lines represent (P=0.001). IAT bias is a continuous variable represented on the polar ends of the X-axis as "Low Anti-Black IAT" and "High Anti-Black IAT." Treatment recommendation of thrombolysis is represented on the Y-axis and is a dichotomous variable for which "1" means "No Recommendation" was given and "2" means a "Recommendation" was given.

Table. Baseline characteristics and Implicit Association Test (IAT) scores of physician participants

	Assigned vignette picture*		Mean IAT score‡		
Characteristics	Black	White	Attitude (good/bad)	General cooperativeness	Cooperativeness with procedures
Overall	n=108	n=112	0.36† (SD=0.40)	0.30† (SD=0.39)	0.22† (SD=0.40)
Age, mean (SD), years (p=0.40)*	29.2 (2.4)	28.9 (3.2)	NS	NS	NS
Sex (p=0.58)*			p=0.17	p=0.12	p=0.20
% Female	41.9	38.2	0.32	0.25	0.18
% Male	58.1	61.8	0.39	0.34	0.25
Race/ethnicity (p=0.57)*					
% European-American/White	67.9	60.4	0.40	0.31	0.22
% African-American/Black	2.8	6.3	-0.04 (p=0.01)§	-0.02 (p=0.04)§	-0.07 (p<0.02)§
% Hispanic/Latino	0.9	3.6	0.36	0.13	0.42
% Asian/Pacific Islander	22.6	24.3	0.38	0.40	0.27
% Other	5.7	5.4	0.22	0.23	0.09
Socioeconomic background (p=0.63)*			p=0.11	p=0.71	p=0.15
% Lower / lower middle	11.3	9.8	0.16	0.22	0.06
% Middle	28.3	30.4	0.38	0.30	0.23
% Upper middle	50.0	53.6	0.39	0.31	0.26
% Upper	10.4	6.3	0.30	0.36	0.15
Specialty (p=0.36)*			p=0.56	p=0.02	p=0.10
% Internal Medicine	80.2	83.0	0.36	0.33	0.24
% Emergency Medicine	19.8	17.0	0.32	0.17	0.12

Table. Baseline characteristics and Implicit Association Test (IAT) scores of physician participants (cont).

City (p=0.38)*			p=0.77	p=0.79	p=0.54
% Boston, MA	81.1	78.6	0.35	0.31	0.23
% Atlanta, GA	18.9	21.4	0.37	0.29	0.19
Year of training (p=0.05)*			p=0.80	p=0.81	p=0.93
% First	34.3	45.5	0.38	0.32	0.23
% Second	23.8	30.4	0.37	0.28	0.22
% Third and higher	41.9	24.1	0.33	0.30	0.20
% Black patients seen (p=0.57)*			p=0.75	p=0.08	p=0.28
<=20%	34.0	32.2	0.37	0.37	0.26
>20%	66.0	67.8	0.35	0.27	0.20
Mean IAT score			--	--	--
Attitude (good/bad) (p=0.88)	0.35	0.36			
General cooperativeness (p=0.44)	0.32	0.28			
Medical cooperativeness (p=0.28)	0.19	0.25			

Note: Reanalysis excluding data from the 10 black physician participants in the sample did not notably or significantly change any of the results reported here, therefore all physicians' data (regardless of race) are displayed.

* No statistically significant differences between participants assigned black or white vignette pictures (except by year of training) using chi-squared (categorical variables) or Student's t-test (continuous variables).

† Values are statistically significantly different from zero by Student's t-test at $p < 0.001$

‡ Implicit Association Test (IAT) scores – positive value represents pro-white bias, negative value represents pro-black bias

§ Statistically significant difference from the other groups combined, by Student's t-test

NS = No significant difference in mean IAT score for participants above vs. below mean age

Figure 1.

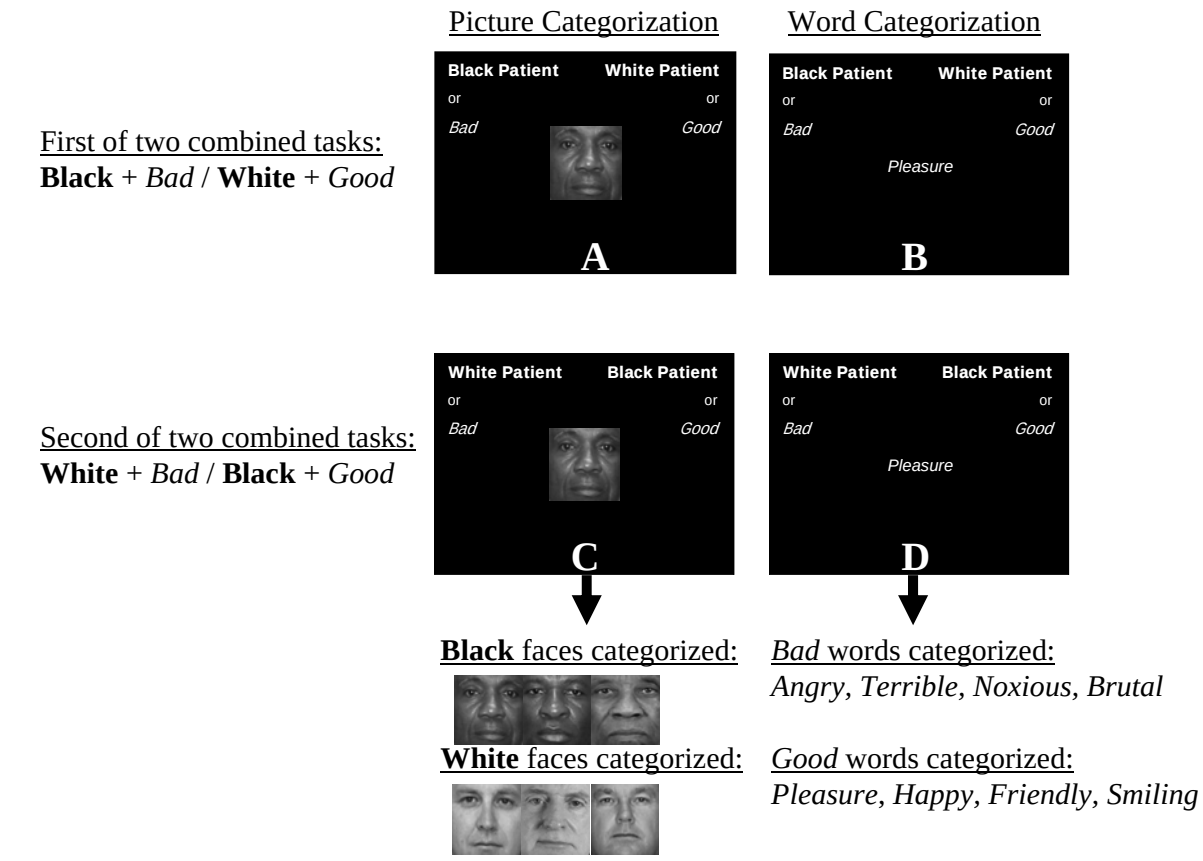

Picture Categorization
Word Categorization
First of two combined tasks:
Black + *Bad* / **White** + *Good*
Black Patient
or
Bad
White Patient
or
Good
Pleasure
A
B
Second of two combined tasks:
White + *Bad* / **Black** + *Good*
White Patient
or
Bad
Black Patient
or
Good
Pleasure
C
D
Black faces categorized:
Bad words categorized:
Angry, Terrible, Noxious, Brutal
White faces categorized:
Good words categorized:
Pleasure, Happy, Friendly, Smiling

Figure 2.

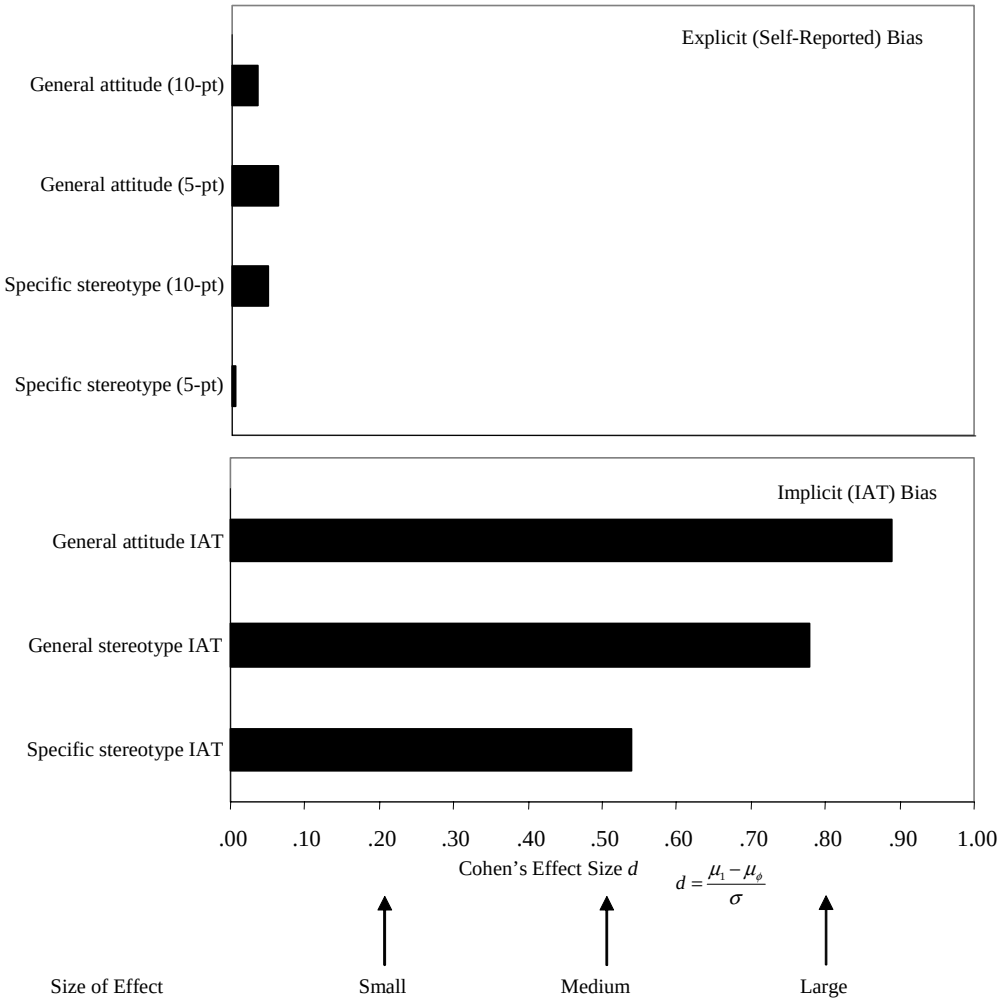

Explicit (Self-Reported) Bias
General attitude (10-pt)
General attitude (5-pt)
Specific stereotype (10-pt)
Specific stereotype (5-pt)
Implicit (IAT) Bias
General attitude IAT
General stereotype IAT
Specific stereotype IAT
.00 .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00
Cohen's Effect Size d
$d = \frac{\mu_1 - \mu_\phi}{\sigma}$
Size of Effect
Small
Medium
Large

Figure 3.

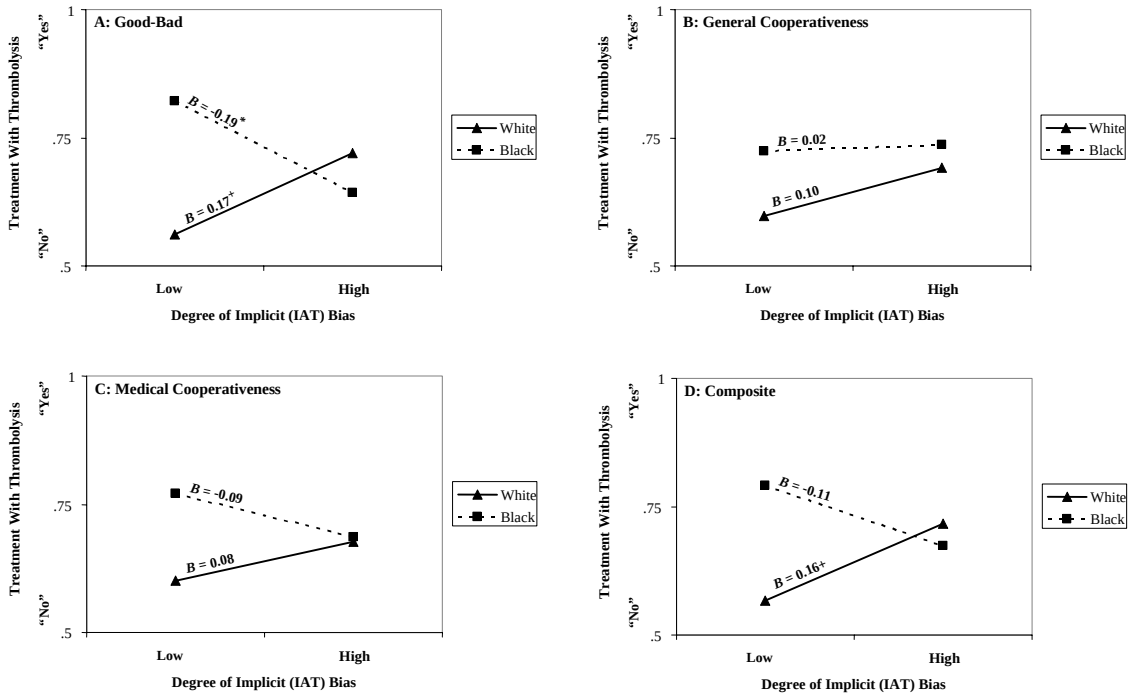
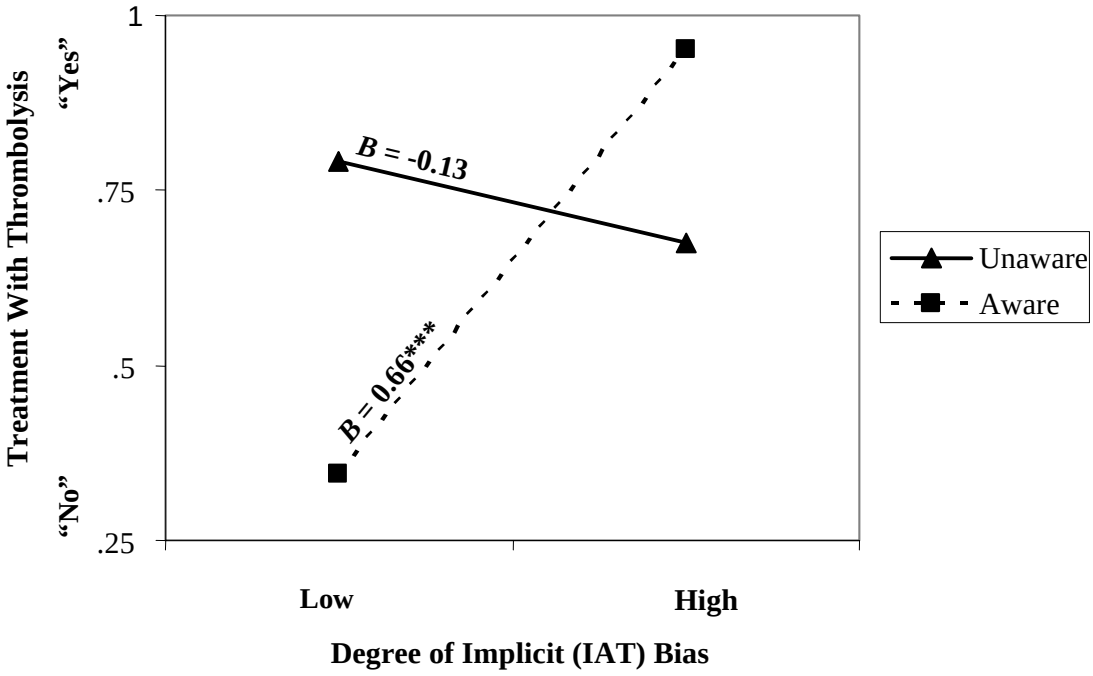

A: Good-Bad
B = -0.19*
B = 0.17*
B: General Cooperativeness
B = 0.02
B = 0.10
C: Medical Cooperativeness
B = -0.09
B = 0.08
D: Composite
B = -0.11
B = 0.16*
Treatment With Thrombolysis
"Yes"
"No"
1
.75
.5
Low
High
Degree of Implicit (IAT) Bias
White
Black

Figure 4.


Treatment With Thrombolysis
"Yes"
"No"
1
.75
.5
.25
B = -0.13
B = 0.66***
Unaware
Aware
Low
High
Degree of Implicit (IAT) Bias