2018

Gender Bias in Medical Images Affects Students' Implicit but not Explicit Gender Attitudes

Rhiannon Parker
University of New South Wales, rbp774@uowmail.edu.au

Theresa A. Larkin
University of Wollongong, tlarkin@uow.edu.au

Jonathan P. Cockburn
University of Wollongong, jon@uow.edu.au

Publication Details

Parker, R., Larkin, T. A. & Cockburn, J. P. "Gender Bias in Medical Images Affects Students' Implicit but not Explicit Gender Attitudes." AERA Open 4 .3 (2018): 1-7.

Gender Bias in Medical Images Affects Students' Implicit but not Explicit Gender Attitudes

Abstract

Medical education curricula have the potential to impact the gender attitudes of future healthcare providers. This study investigated whether gender-biased imagery from anatomy textbooks had an effect on the implicit and explicit gender attitudes of students. We used an online experimental design in which students (N = 456; 55% female) studying anatomy were randomly assigned to a visual priming task using either gender-neutral or gender-biased images. The impact of this priming task on implicit attitudes was assessed using the Implicit Association Test (IAT) and the impact on explicit attitudes was measured using the Gender Bias in Medical Education Scale. Viewing biased images was significantly positively associated with implicit gender bias as indicated by higher IAT scores in the treatment compared to the control condition (mean IAT difference = 43 milliseconds; Cohen's d = .33). In contrast, there was no significant effect of gender-biased images on explicit gender attitudes.

Keywords

implicit, but, gender, not, bias, explicit, attitudes, medical, images, affects, students'

Disciplines

Arts and Humanities | Law

Publication Details

Parker, R., Larkin, T. A. & Cockburn, J. P. "Gender Bias in Medical Images Affects Students' Implicit but not Explicit Gender Attitudes." AERA Open 4 .3 (2018): 1-7.

AERA Open
July-September 2018, Vol. 4, No. 3, pp. 1–7
DOI: 10.1177/2332858418798832
Article reuse guidelines: sagepub.com/journals-permissions

Gender Bias in Medical Images Affects Students' Implicit but not Explicit Gender Attitudes

Rhiannon B. Parker
Centre for Social Research in Health, University of New South Wales
Theresa Larkin
Graduate School of Medicine, University of Wollongong
Jon Cockburn
Faculty of Law, Humanities, and the Arts, University of Wollongong

Medical education curricula have the potential to impact the gender attitudes of future healthcare providers. This study investigated whether gender-biased imagery from anatomy textbooks had an effect on the implicit and explicit gender attitudes of students. We used an online experimental design in which students (N = 456; 55% female) studying anatomy were randomly assigned to a visual priming task using either gender-neutral or gender-biased images. The impact of this priming task on implicit attitudes was assessed using the Implicit Association Test (IAT) and the impact on explicit attitudes was measured using the Gender Bias in Medical Education Scale. Viewing biased images was significantly positively associated with implicit gender bias as indicated by higher IAT scores in the treatment compared to the control condition (mean IAT difference = 43 milliseconds; Cohen's d = .33). In contrast, there was no significant effect of gender-biased images on explicit gender attitudes.

Keywords: *gender, implicit attitudes, explicit attitudes, images, priming, anatomy education*

Introduction

Gender bias is prevalent in the medical domain and is associated with healthcare disparities (Chiaramonte et al., 2008; Hamberg, 2008; Verdonk, Benschop, De Haes, & Lagro-Janssen, 2009). For example, the exclusion of females from medical trials likely contributes to women with heart disease remaining underdiagnosed, undermanaged, and undertreated (Mehta et al., 2016). The biases of healthcare practitioners, in particular, play a significant role in contributing to these disparities (Chapman, Kaatz, & Carnes, 2013; White, 2011). The persistent use of gender stereotypes by physicians, for example, has meant that women are more likely than men to have their reports of pain be perceived as emotional (Hoffmann & Tarzian, 2001), and to be incorrectly diagnosed with psychological rather than somatic disorders (Smith, 2011). One of the primary arenas where healthcare providers' gender attitudes can be influenced is during medical education, where curriculum and teaching practices can contribute to the development and maintenance of gender ideologies (Bickel, 2001; Stromquist, Lee, & Brock-Utne, 2013). As such, strategies aimed at preventing gender bias in healthcare need to start at the educational level (Hamberg, 2008; Risberg, Johansson, & Hamberg, 2009; Teal et al., 2010; Verdonk et al., 2009). There is therefore a need to examine the role that a medical education curriculum plays in the formation of gender-biased attitudes.

Empirical research has highlighted the importance of attitudes by identifying the way in which they manifest themselves through behavior (Maio & Haddock, 2009; Smith, Mackie, & Claypool, 2015; Vaughan & Hogg, 2008). Studies have shown that the attitudes of healthcare practitioners can have an impact on medical treatment and care (Blair et al., 2013; Phelan et al., 2015; Stepanikova, 2012). For example, physicians who exhibit gender-biased attitudes are less likely to recommend women with the same symptoms as men for cardiovascular testing (Daugherty et al., 2017). Attitudes are understood as existing at both an explicit (conscious) and implicit (unconscious) level (Gawronski & Payne, 2010), and individuals can hold implicit attitudes that conflict with their consciously approved beliefs (Greenwald & Banaji, 1995; Wilson, Lindsey, & Schooler, 2000). It is well established that explicit attitudes can have an influence on behavior (Armitage & Conner, 2001). However, not only do implicit attitudes exert a powerful influence on behavior, they are also more likely to predict discriminatory behavior than explicit reports (Gawronski & Payne, 2010; O'Brien et al., 2008). Research on the attitudes of healthcare practitioners has shown that implicit rather than explicit attitudes are more likely to predict disparities in patient treatment and care (Green et al., 2007; Stepanikova, 2012).

Implicit attitudes have been shown to be contextually sensitive (Barden, Maddux, & Brewer, 2004; Wittenbrink, 2007). According to Relational Frame Theory (RFT), an individual's attitudes are not innate but respond to context and can therefore be subtly influenced by the nuances of an environment (Blackledge, 2003). Evidence has shown that medical education plays a unique role in shaping medical students' implicit racial and sexual biases (Burke et al., 2015; van Ryn et al., 2015). For example, exposure to discriminatory remarks during medical school has been shown to increase students' implicit racial biases (van Ryn et al., 2015). Research has explored the role of implicit bias in the evaluation of medical students (Axelson, Solow, Ferguson, & Cohen, 2010) and how implicit bias can be reduced through interventions for medical faculty (Carnes et al., 2015; Girod et al., 2016), yet there is apparently no research that has explored how medical curricula can influence medical students' implicit gender attitudes. Furthermore, to our knowledge, no studies have examined whether images from medical curricula also influence attitudes. Given the potential impact of a physician's biased implicit attitudes on patient health, it is imperative to consider all the influences that contribute to the development of these attitudes. Textbooks play a central and pervasive role in medical education and, as many of them are highly visual (Gunderman, 2011), so do images. Further, anatomy textbooks may contain gender-biased images (Giacomini, Rozée-Koker, & Pepitone-Arreola-Rockwell, 1986; Lawrence & Bendixen, 1992; Mendelsohn, Nieman, Isaacs, Lee, & Levison, 1994; Parker, Larkin, & Cockburn, 2017) that medical students and anatomists are unaware of (Morgan, Plaisant, Lignier, & Moxham, 2017). This highlights how normalized gender bias is in medical education and is concerning as a lack of awareness of bias means it is more likely to be unconsciously perpetuated (Devine, Forscher, Austin, & Cox, 2012). The impact that textbook images have on both the implicit and explicit attitudes of students studying anatomy should be examined. This study aimed to investigate whether visual representations of gender bias from anatomy textbooks impacted the implicit and explicit attitudes of anatomy students.

Method

Participants

Participants were students from two different strands of study within the School of Medicine at the University of Wollongong, Australia: undergraduate medical and health science students enrolled in a first-year anatomy subject (SHS111) and graduate-entry medical students in the first year of their integrated degree (MEDI601). There were 491 students enrolled in SHS111 and 82 students enrolled in MEDI601, for 573 possible participants.

Study Design and Implementation

The study was conducted during anatomy laboratory classes over two weeks (April–May 2015), after ethics approval was obtained from the University of Wollongong Human Research Ethics Committee (ethics approval number HE14/130). Participation was voluntary, and all data collected was anonymous. To reduce distractions and provide students with a convenient way to complete the study, we set up the online task in a private computer room adjacent to the anatomy laboratory. Groups of up to eight students at a time took part and the task took approximately 10 minutes to complete. A researcher remained in the room during all data collection times so that questions or concerns could be directly addressed.

The study used a randomized control trial (RCT) in the form of an online task that was developed for the current study. The online task consisted of four parts: (a) a short introduction that described and provided instructions for the study; (b) a priming task during which participants were randomly assigned by a random number generator embedded in the task to view either gender-biased images for the treatment group or gender-neutral images for the control group; (c) the Implicit Association Test (IAT); and (d) the Gender Bias in Medical Education Scale (GBMES). As participants were unaware of the condition they were assigned to, and as we used a fully automated assignment and treatment procedure, our research used a double-blind random assignment procedure.

Materials

Priming Task. For the priming task, gender-biased images for the treatment condition and gender-neutral images for the control condition were selected from existing anatomy textbooks. Specifically, the treatment condition included images of males in traditionally masculine sports roles (e.g., men playing soccer) and females in traditionally feminine reproductive roles (e.g., a mother breastfeeding). The control condition consisted of images of internal anatomy in which the sex or gender could not be determined, including isolated organs such as the lung, heart, and brain, and musculoskeletal structures such as the vertebral column and muscles. Twenty-four images were displayed on the screen in automatic succession for four seconds each, running for 96 seconds. To increase participants' engagement with the priming task, the question "What anatomy chapter would this image appear in?" appeared below each image.

Implicit Measures. Following the visual priming task, participants completed an IAT, adapted from https://github.com/winteram/IAT (Mason, Allon, & Ozturk, 2018). The

IAT measured the categorization speed at which participants associated stereotypically similar (i.e., reproductive health terms with female pronouns and sports health terms with male pronouns) and dissimilar (i.e., reproductive health terms with male pronouns and sports health terms with female pronouns) terms (see online supplemental material 1 for more details). The categories of reproductive and sports health were chosen as these represent stereotypical female and male roles respectively (Collins, 2011; Haines, Deaux, & Lofaro, 2016; Hardin & Greer, 2009). Terms were vetted for relevance by the second author (an anatomy lecturer) to ensure that they were of approximately equal relevance to men and women despite being stereotypically related to one gender. Thus, while issues like fertility/infertility may be stereotypically related to women they are relevant to men also. Indeed, infertility rates in the population are similar among men and women (see Chandra, Copen, & Stephen, 2013).

After instructions, participants completed the IAT. We used a standard IAT design (Mason et al., 2018). A screenshot of each round and an explanation of what participants were required to do is presented in online supplemental material 2. Test terms were presented in the center of the computer screen. Categories were presented on the top left and top right of the screen (see Figure 1). When the test term in the center of the screen matched a category on the left participants were asked to press the "E" button on their keyboard as quickly as possible. When the test term matched a category on the right participants were asked to press the "I" button as quickly as possible. The standard procedure consisted of seven rounds broken into two main sections, each with familiarization, practice, and recorded rounds. The first section (rounds one to four) aimed to gain a baseline estimate of participants' speed in co-categorizing stereotypically similar gender and medical terms (i.e., female pronouns and reproductive health terms were presented as categories on the left; male pronouns and sports health terms were presented on the right). Round one asked participants to assign gender terms only (female on the left; male on the right). Round two asked participants to assign health terms only (reproductive health on the left; sports health on the right). Round three, presented in Figure 1a, was a practice round with participants assigning intermixed gender and health terms to categories on the left (female pronouns and reproductive health terms) or the right (male pronouns and sports health terms). Round four was identical to round three but participants' average response times were recorded in milliseconds.

The second section (rounds five to seven) aimed to gain a comparison estimate of participants' speed in co-categorizing stereotypically dissimilar gender and medical terms (i.e., male pronouns and reproductive health terms were presented as categories on the left; female pronouns and sports health terms were presented on the right). Round five was a familiarization round for gender terms only, as these categories had now switched sides (male on the left; female on the right). Round six, presented in Figure 1b, was a practice round with participants assigning intermixed gender and health terms to categories on the left (male pronouns and reproductive health terms) or the right (female pronouns and sports health terms). Round seven was identical to round six, but here participants' average response times were recorded in milliseconds. The IAT score, which was used as the primary outcome in this research, was taken by subtracting participants' average response times in round seven from those in round four. The participant average response time difference in milliseconds and the participant average response time difference in milliseconds corrected by the standard deviation were measured. The latter resulted in a slightly bigger effect size for the treatment group. However, the average categorizing speed in milliseconds was retained as the primary scaling of the dependent variable to provide a more straightforward interpretation of results. Responses less than 300 or greater than 3000 milliseconds long were excluded as invalid responses.

Explicit Measures. Explicit attitudes were measured using the GBMES, a three-factor measure of participants' explicit attitudes toward gender bias in medical education (Parker, Parker, Larkin, & Cockburn, 2016). The GBMES consists of 10 items using a six-point Likert scale, ranging from 0 (strongly disagree) to 5 (strongly agree) (see online supplemental material 3). It measures three factors related to gender bias: (a) awareness, for example, "In anatomy textbooks, reproductive chapters have more images of females than males"; (b) beliefs, for example, "I believe educators should raise awareness of the risks of gender bias in medicine"; and (c) experiences, for example, "I have seen evidence of gender bias in anatomy class activities." We used the scale scores (i.e., the average item score for a given factor) in this analysis. Thus, average agreement for a GBMES factor was represented by a score of 2.5. The coefficient of reliability for the three scale scores of the GBMES ranged from .72 to .91.

Analysis

Group differences between the control and treatment conditions on the implicit and three explicit attitude dependent variables were assessed using *t*-tests in *R* (R Core Development Team, 2014). Results are given in the original metric and in the form of Cohen's *d*, indicating differences between groups in standard deviation units. A sensitivity analysis using ANCOVA was undertaken, in which we tested the difference between the treatment condition and the control condition on the outcomes, controlling for key covariates (i.e., age, gender, and program of study). This is referred to as a doubly robust design in which both random assignment and statistical adjustment are used to mitigate potential biasing

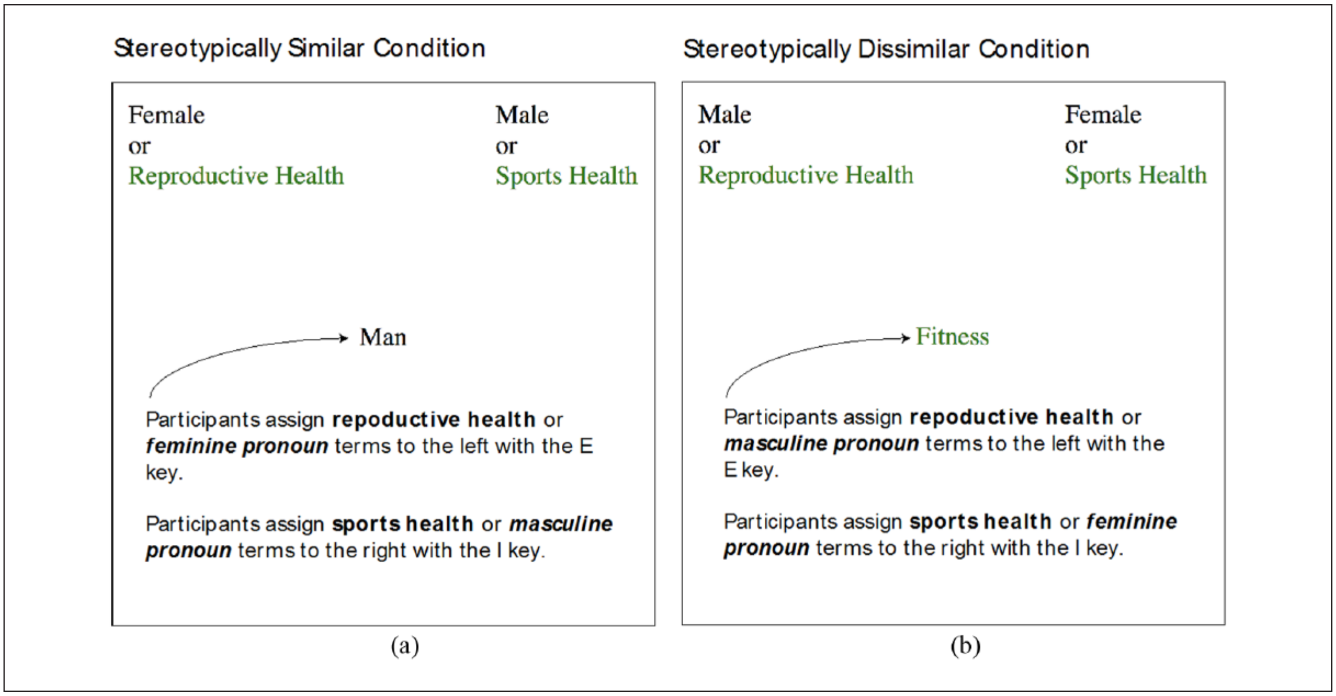

FIGURE 1. *Main rounds in the Implicit Association Test. Panel (a) represents the stereotypically similar condition. Panel (b) represents the stereotypically dissimilar condition.*
Screenshots from the actual experiment.

selection effects and thus construct robust counterfactuals for causal inference (Morgan & Winship, 2015).

Results

Demographics

Out of the 573 students invited to participate, 456 voluntarily participated in this study (response rate 80%). This included 252 females (55%) and 190 males (42%), with a mean age of 20.7 ± 4.5 years (median = 19 years). From the undergraduate cohort, 384 out of 491 participants took part (76% female), with a mean age of 19.9 ± 4.1 years (median = 18 years), and 91% were in their first year of university. Among the graduate-entry medical students, 72 out of 82 participants took part (37% female), with a mean age of 24.9 ± 4.1 years (median = 23 years). Random assignment of participants to the image groups for the priming task resulted in 248 in the treatment (56% female) and 208 in the control (54% female) condition.

In the methods section we assumed that participants would find it harder to assign stereotypically dissimilar terms (e.g., male pronouns and reproductive terms) to a common target than stereotypically similar terms (e.g., male pronouns and sports injury terms). This was indeed the case, with participants taking 168 milliseconds longer to assign terms in the stereotypically dissimilar condition (paired t-test: t [455] = 27.149, $p < .001$).

Randomized Control Trial Results

Results indicated that the difference in categorization speed for the IAT between the treatment and control conditions was significant (Table 1), with those in the treatment condition being on average 36 milliseconds slower in the categorization tasks for stereotypically dissimilar than similar groups compared to those in the control condition. This effect size was small ($d = .28$) according to standard metrics in psychology (Cohen, 1992). Controlling for key covariates—gender, age, and program of study—via ANCOVA altered the effect size little, with those in the treatment condition being 43 milliseconds slower than those in the control condition ($d = .33$). For the explicit measures from the GBMES there was no significant difference in attitudes between those in the treatment and control conditions (Table 1). These effects were also not significant when controlling for key covariates (see online supplemental material 4). We also considered whether the effect of the priming task on either explicit or implicit attitudes was moderated by gender, age, program of study, and their combination. In no case was a significant effect observed.

Discussion

This experimental study investigated whether gender-biased imagery influenced the implicit and explicit gender attitudes of students studying anatomy. The results showed

TABLE 1
Main Effects of Treatment Condition on Implicit and Explicit Attitudes

	Total sample		Treatment		Control		Group difference[a]	
Dependent measures	Mean	SD	Mean	SD	Mean	SD	Diff.	Cohen's *d*
IAT	167	132	184	134	148	127	36**	.28**
Gender bias awareness	2.60	0.91	2.67	0.83	2.52	0.99	.15^	.16^
Gender bias beliefs	3.24	1.03	3.25	1.04	3.23	1.02	.02	.02
Gender bias experience	1.53	1.14	1.50	1.10	1.57	1.19	.07	.10

IAT responses are given in milliseconds. All other variables were measured on a six-point Likert scale from strongly disagree (0) to strongly agree (5).
[a]Estimates taken from a regression model.
IAT = Implicit Association Test, SD = Standard deviation, Diff = Difference, ^p <.10, ** p < .01.

that viewing gender-biased images had a significant effect of moderate size on implicit gender attitudes. This is consistent with research showing that implicit attitudes are contextually sensitive and can be influenced by environmental factors (Barden et al., 2004; Wittenbrink, 2007). These results are significant given that implicit bias has been linked with issues such as poorer patient care (Blair et al., 2013; Cooper et al., 2012) and treatment decisions (Stepanikova, 2012). Thus, the visual representation of bias in educational content may have the potential to impact healthcare outcomes.

That exposure to gender-biased images had a statistically significant effect on implicit bias is important given that the treatment was short (96 seconds). Research has shown that medical textbooks, a core part of medical education, are replete with visual gender bias (Giacomini et al., 1986; Lawrence & Bendixen, 1992; Mendelsohn et al., 1994; Parker et al., 2017). Thus, the results of this paper give rise to questions about the implications of long-term exposure to gender bias in visual images in medical curricula. It seems possible that exposure to biased images throughout students' medical education career may cumulatively influence implicit attitudes. Indeed, some research has suggested that long-term exposure to news stereotypes not only has a significant impact on implicit attitudes but that this, in turn, modifies explicit attitudes (Arendt & Northup, 2015). Future research could explore the duration of the effects of a priming task and the effects of long-term exposure to gender-biased imagery in medicine.

In contrast to the significant effect of viewing gender-biased images on implicit attitudes, there was no observed effect of the treatment condition on participants' explicit reports of bias in the GBMES. This is noteworthy as research has shown that implicit attitudes are more likely to predict disparities in medical treatment and care than explicit attitudes (Green et al., 2007; Stepanikova, 2012). Such a result is in line with existing theories that individuals can simultaneously hold disparate implicit and explicit attitudes (Wilson et al., 2000). However, this disparity could also be explained by that fact that explicit attitudes can be much easier to disguise than implicit attitudes ((Blair, Steiner, & Havranek, 2011; Dovidio, Kawakami, & Beach, 2001).

Limitations

Readers should be aware of some limitations to the generalization of the findings. The participants were all from a single university and their attitudes and experiences may differ from other subsets of the population. Although this study provides evidence of the influence of gender-biased images on implicit attitudes, it remains unclear how long these effects last. This study also focused solely on the effects of images as a source of gender bias; it would be beneficial to explore how other curricula's content and educational experiences may contribute to or counteract gender-biased attitudes. We used a gold standard double-blind random assignment procedure to assign participants to conditions. With 491 participants, we also had adequate power to not only detect a significant effect but also to ensure balance across key covariates. Indeed, the sensitivity analysis in which we conditioned on key covariates resulted in little change to the estimated treatment effect. While these design features and sensitivity results suggested we did indeed have an unbiased treatment effect, we cannot guarantee that there were not pre-existing differences between the treatment and control group in underlying bias prior to assignment. While there are concerns about practice effects, future research should consider collecting pre-treatment data on implicit and explicit bias. Despite these limitations, the results of this study have significant implications for the presence of visual gender bias within medical curricula.

Conclusion

The current study demonstrated that viewing gender-biased images can have a significant impact on the implicit gender attitudes of students studying anatomy. This shows that implicit attitudes are affected by context and can be influenced via interventions such as visual priming tasks. A medical curriculum design that avoids both visual and textual gender bias and which aims to provide bias-reduction interventions may ultimately improve healthcare outcomes. Studies such as this are therefore important for providing medical educators with information on why and how to reduce implicit gender bias during medical education.

Availability of Data

The dataset supporting the conclusions of this article is available in the figshare repository: https://figshare.com/articles/Study3_Data/3798228

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

Arendt, F., & Northup, T. (2015). Effects of long-term exposure to news stereotypes on implicit and explicit attitudes. *International Journal of Communication*, *9*, 2370–2390.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour. *British Journal of Social Psychology*, *40*(4), 471–499.

Axelson, R. D., Solow, C. M., Ferguson, K. J., & Cohen, M. B. (2010). Assessing implicit gender bias in medical student performance evaluations. *Evaluation & the Health Professions*, *33*(3), 365–385.

Barden, J., Maddux, W. W., Petty, R. E., & Brewer, M. B. (2004). Contextual moderation of racial bias: The impact of social roles on controlled and automatically activated attitudes. *Journal of Personality and Social Psychology*, *87*(1), 5–22.

Bickel, J. (2001). Gender equity in undergraduate medical education: A status report. *Journal of Women's Health & Gender-Based Medicine*, *10*(3), 261–270.

Blackledge, J. T. (2003). An introduction to Relational Frame Theory: Basics and applications. *Behavior Analyst Today*, *3*(4), 421–434.

Blair, I. V., Steiner, J. F., Fairclough, D. L., Hanratty, R., Price, D. W., Hirsh, H. K., …Havranek, E. P. (2013). Clinicians' implicit ethnic/racial bias and perceptions of care among Black and Latino patients. *The Annals of Family Medicine*, *11*(1), 43–52.

Blair, I. V., Steiner, J. F., & Havranek, E. P. (2011). Unconscious (implicit) bias and health disparities: where do we go from here? *The Permanente Journal, 15*(2), 71–78.

Burke, S., Dovidio, J., Przedworski, J., Hardeman, R., Perry, S., Phelan, S., … van Ryn, M. (2015). Do contact and empathy mitigate bias against gay and lesbian people among heterosexual first-year medical students? A report from the medical student change study. *Academic Medicine*, *90*(5), 645–651.

Carnes, M., Devine, P. G., Manwell, L. B., Byars-Winston, A., Fine, E., Ford, C. E., … Palta, M. (2015). Effect of an intervention to break the gender bias habit for faculty at one institution: A cluster randomized, controlled trial. *Academic Medicine*, *90*(2), 221–230.

Chandra, A., Copen, C. E., & Stephen, E. H. (2013). *Infertility and impaired fecundity in the United States, 1982–2010: Data from the National Survey of Family Growth*. Hyattsville, MD: National Center for Health Statistics.

Chapman, E., Kaatz, A., & Carnes, M. (2013). Physicians and implicit bias: How doctors may unwittingly perpetuate health care disparities. *Journal of General Internal Medicine*, *28*(11), 1504–1510.

Chiaramonte, G., Friend, R., Jaffe, A., Lansky, A., Weitzman, G., Trilling, J., & Evans, S. (2008). Gender bias in the diagnosis, treatment, and interpretation of CHD symptoms: Two experimental studies with internists and family physicians. *American Journal of Cardiology*, *102*(8A), 213I.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159.

Collins, R. (2011). Content analysis of gender roles in media: Where are we now and where should we go? *Sex Roles*, *64*(3/4), 290–298.

Cooper, L. A., Roter, D. L., Carson, K. A., Beach, M. C., Sabin, J. A., Greenwald, A. G., & Inui, T. S. (2012). The associations of clinicians' implicit attitudes about race with medical visit communication and patient ratings of interpersonal care. *American Journal of Public Health*, *102*(5), 979–987.

Daugherty, S., Blair, I., Havranek, E., Furniss, A., Dickinson, L., Karimkhani, E., … Masoudi, F. (2017). Implicit gender bias and the use of cardiovascular tests among cardiologists. *Journal of the American Heart Association*, *6*(12), 1–11.

Devine, P., Forscher, P., Austin, A., & Cox, W. (2012). Long-term reduction in implicit race bias: A prejudice habit-breaking intervention. *Journal of Experimental Social Psychology*, *48*(6), 1267–1278.

Dovidio, J. F., Kawakami, K., & Beach, K. R. (2001). Implicit and explicit attitudes: Examination of the relationship between measures of inter-group bias. In R. Brown, & S. L. Gaertner (Eds.), *Blackwell handbook of social psychology: Intergroup processes* (pp. 175–197). Malden, MA: Blackwell.

Gawronski, B., & Payne, B. K. (2010). *Handbook of implicit social cognition: Measurement, theory and application*. New York, NY: Guilford Press.

Giacomini, M., Rozée-Koker, P., & Pepitone-Arreola-Rockwell, F. (1986). Gender bias in human anatomy textbook illustrations. *Psychology of Women Quarterly*, *10*(4), 413–420.

Girod, S., Fassiotto, M., Grewal, D., Ku, M. C., Sriram, N., Nosek, B. A., & Valantine, H. (2016). Reducing implicit gender leadership bias in academic medicine with an educational intervention. *Academic Medicine*, *91*(8), 1143–1150.

Green, A. R., Carney, D. R., Pallin, D. J., Ngo, L. H., Raymond, K. L., Iezzoni, L. I., & Banaji, M. R. (2007). Implicit bias among physicians and its prediction of thrombolysis decisions for black and white patients. *General Internal Medicine*, *22*(9), 1231–1238.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychology Review*, *102*(1), 4–27.

Gunderman, R. B. (2011). *Achieving excellence in medical education*. 2nd ed. London, UK: Springer.

Haines, E. L., Deaux, K., & Lofaro, N. (2016). The times they are a-changing … or are they not? A comparison of gender stereotypes, 1983–2014. *Psychology of Women Quarterly*, *40*(3), 353–363.

Hamberg, K. (2008). Gender bias in medicine. *Women's Health*, *4*(3), 237–243.

Hardin, M., & Greer, J. D. (2009). The influence of gender-role socialization, media use and sports participation on perceptions of gender-appropriate sports. *Journal of Sports Behavior*, *32*(2), 207–226.

Hoffmann, D., & Tarzian, A. (2001). The girl who cried pain: A bias against women in the treatment of pain. *Journal of Law and Medical Ethics*, *29*(1), 13–27.

Lawrence, S. C., & Bendixen, K. (1992). His and hers: Male and female anatomy in anatomy texts for U.S. medical students, 1890–1989. *Social Science and Medicine*, *35*(7), 925–935.

Maio, G., & Haddock, G. (2009). *The psychology of attitudes and attitude change*. London, UK: Sage.

Mason, W., Allon, S., & Ozturk, P. (2018). Open Source, Web-based IAT. *Github Repository*. Retrieved from https://github.com/winteram/IAT

Mehta, L. S., Beckie, T. M., DeVon, H. A., Grines, C. L., Krumholz, H. N., Johnson, M. J., …Wenger, N. (2016). Acute myocardial infarction in Women: A scientific statement from the American Heart Association. *Circulation*, *133*(9), 916–947.

Mendelsohn, K., Nieman, L., Isaacs, K., Lee, S., & Levison, S. (1994). Sex and gender bias in anatomy and physical diagnosis text illustrations. *JAMA*, *272*(16), 1267–1270.

Morgan, S., Plaisant, O., Lignier, B., & Moxham, B. (2017). Medical students and professional anatomists do not perceive gender bias within imagery featuring anatomy. *Clinical Anatomy*, *30*(6), 711–732.

Morgan, S. L., & Winship, C. (2015). *Counterfactuals and causal inference: Methods and principles for social research (analytical methods for social research)*. New York, NY: Cambridge University Press.

O'Brien, K., Latner, J., Halberstadt, J., Hunter, J., Anderson, J., & Caputi, P. (2008). Do antifat attitudes predict antifat behaviors? *Obesity*, *16*(Suppl.2), S87–S92.

Parker, R. B., Larkin, T., & Cockburn, J. (2017). A visual analysis of gender bias in contemporary anatomy textbooks. *Social Science and Medicine*, *180*, 106–113.

Parker, R. B., Parker, P. D., Larkin, T., & Cockburn, J. (2016). A psychometric evaluation of the Gender Bias in Medical Education Scale. *BMC Medical Education*, *16*(1), 251–259.

Phelan, S. M., Puhl, R. M., Burke, S. E., Hardeman, R., Dovidio, J. F., Nelson, D. B., …Ryn, M. (2015). The mixed impact of medical school on medical students' implicit and explicit weight bias. *Medical Education*, *49*(10), 983–992.

R Core Team (2014). R: A language and environment for statistical computing. Vienna: R Foundation for Statistical Computing; 2014 (cited July 30, 2016). Retrieved from www.R-project.org/

Risberg, G., Johansson, E., & Hamberg, K. (2009). A theoretical model for analysing gender bias in medicine. *International Journal for Equity in Health*, *8*(28), 1–8.

Smith, E. C. (2011). *Gender-biased diagnosing, the consequences of psychosomatic misdiagnosis and 'doing credibility'*. Los Angeles, CA: Occidental College.

Smith, E. R., Mackie, D. M., & Claypool, H. M. (2015). *Social psychology, 4th ed*. New York, NY: Psychology Press.

Stepanikova, I. (2012). Racial-ethnic biases, time pressure, and medical decisions. *Journal of Health & Social Behavior*, *53*(3), 329–343.

Stromquist, N. P., Lee, M., & Brock-Utne, M. B. (2013). The explicit and the hidden school curriculum. In N. Stromquist, & K. Monkman (Eds.), *Women in the third world: An Encyclopedia of contemporary issues* (pp. 397–407). New York, NY: Routledge.

Teal, C. R., Shada, R. E., Gill, A. C., Thompson, B. M., Frugé, E., Villarreal, G. B., & Haidet, P. (2010). When best intentions aren't enough: Helping medical students develop strategies for managing bias about patients. *Journal of General Internal Medicine*, *25*(5 Suppl.2), S115–118.

van Ryn, M., Hardeman, R., Phelan, S. M., Burgess, D. J., Dovidio, J. F., Herrin, J., … Przedworski, J. M. (2015). Medical school experiences associated with change in implicit racial bias among 3547 students: A medical student CHANGES study report. *Journal of General Internal Medicine*, *30*(12), 1748–1756.

Vaughan, G., & Hogg, M. (2008). *Introduction to social psychology. 7th ed*. Frenchs Forest, NSW: Pearson Education Australia.

Verdonk, P., Benschop, Y., De Haes, H., & Lagro-Janssen, T. (2009). From gender bias to gender awareness in medical education. *Advances in Health Sciences Education*, *14*(1), 135–152.

White, A. A., III. (2011). *Seeing patients: Unconscious bias in health care*. Cambridge, MA: Harvard University Press.

Wilson, T. D., Lindsey, S., & Schooler, T. Y. (2000). A model of dual attitudes. *Psychological Review*, *107*(1), 101–126.

Wittenbrink, B. (2007). Measuring attitudes through priming. In: B. Wittenbrink, & N. Schwarz (Eds.), *Implicit measures of attitudes* (pp. 17–58). New York, NY: Guilford Press.

Authors

RHIANNON B. PARKER is a postdoctoral research fellow at the Practical Justice Initiative, Centre for Social Research in Health, University of New South Wales. She specializes in the sociology of health and illness, exploring the social dynamics of cancer and palliative care and investigating the role that medical education plays in constructing knowledge about gender and the body.

THERESA LARKIN is a senior lecturer in medical sciences at the Graduate School of Medicine, University of Wollongong. Her research focuses on the roles of oxytocin and cortisol in health and disease, gender differences in anatomy and physiology, and applying the cognitive theory of learning in medical and anatomical education.

JON COCKBURN is a design theory lecturer, research degree supervisor, and course coordinator in the Creative Industries Group in the Faculty of Law, Humanities and the Arts at the University of Wollongong, Australia. His research focuses on fashion, media, and visual communications theory using humanities models of scholarship.