

Unveiling Implicit Attitudes Towards the Transgender Community: Exploring the Impact of Level of Religiosity on Bias

Yi Tian*

University of Exeter, Exeter EX4 4SZ, UK

*Corresponding author: Yi Tian, iwantgem@163.com

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Abstract: Prior research showed a potential link between religiosity and negative attitudes toward various marginalized populations, which raises the question of the impact of religiosity on implicit bias toward transgender individuals. The principal purpose of this study was to examine whether there was a significant relationship between religiosity and implicit bias toward transgender individuals. To address this research question, a diverse sample of participants was recruited and data was collected through surveys and assessments. After data collection, the collected data was subjected to rigorous statistical analyses to explore the potential link between religiosity and implicit bias toward transgender individuals. The correlation between religiosity and implicit bias was 16% (95% CI = 15% to 16%). To examine this relationship, a linear regression model was employed, with religiosity levels as the independent variable and implicit bias scores as the dependent variable. Furthermore, the statistical analyses involved controlling for potential confounding variables, such as age and political ideology, to ensure that the observed relationship between religiosity and implicit bias was not influenced by other factors. Key statistical parameters were generated through regression analyses, including beta coefficients, *P-values*, and R-squared values, which provided important information about the strength and significance of the association between religiosity and implicit bias.

Keywords: Implicit bias; IAT; Transgender; Religion

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1. Introduction

Around the world, transgender people may suffer discrimination and violence to different degrees because their bodies differ from the typical definition of female or male. Authentically, transgender and gender diverse (TGD) people make up 0.5–0.6% of U.S. adults ^[1]. However, each person deserves the right to equality and respect. However, there is implicit bias, a form of prejudice and discrimination on a subconscious basis. Implicit bias can subconsciously influence people's behavior and attitudes, even if the individuals themselves are not consciously aware of the bias. After interviewing 515 transgender individuals, Dr. Kristen ^[2] and

others concluded that younger age (< 25 years), depression, history of substance abuse, history of compulsive sexual behavior, gender-based discrimination, and gender-based victimization were independently associated with suicide attempts in multifactorial logistic regression analyses. At the same time, religious beliefs play a significant role in many people's lives, influencing not only people's belief systems and behaviors, but also having a profound impact on individuals' attitudes and values. Therefore, understanding the impact of religious beliefs on individuals' implicit biases contributes to revealing the role of religious beliefs in shaping people's attitudes and beliefs of gender diversity. In a case study, Andrew William Wood ^[3] mentioned that transgender individuals were likely to have negative experiences with religion due to mainstream religions being non-affirming of LGBT. Religious institutions in some countries and regions may oppose the rights of transgender people. For example, some Christian groups in the United States opposed the use of public restrooms by transgender people. Such views can lead to dilemmas and the exclusion of transgender people in religious communities. This dissertation aimed to explore the relationship between religious beliefs and implicit bias, with a specific focus on whether individuals with higher levels of religiosity show higher levels of implicit bias toward the transgender population.

2. Research objective and hypothesis

The primary aim of this study was to investigate the influence of religious beliefs on implicit bias toward transgender individuals. By examining the association between religiosity and implicit bias scores, the study aimed to decide whether individuals with higher religious involvement tend to show greater levels of implicit bias toward the transgender community.

Based on earlier research showing a potential link between religious beliefs and negative attitudes towards marginalized groups, it was hypothesized that individuals with higher levels of religiosity will show higher levels of implicit bias toward the transgender community. Specifically, it was expected that those who report stronger religious beliefs and higher levels of religious involvement will display a greater degree of implicit bias towards transgender individuals compared to those with lower levels of religiosity.

3. Methodology

The method consisted of data, main variables, and analysis methods. The two main variables were selected from the hypotheses and the rest of the non-major variables also played significant roles in the analysis.

Specifically, the regression model is represented by the following equation:

$$D_biep.Cisgender_Good_all = \beta_0 + \beta_{religionid} \cdot religionid + \beta_{age} \cdot age + \beta_{politicalid_7} \cdot politicalid_7 + \epsilon$$

Where $D_biep.Cisgender_Good_all$ denotes a measure of implicit attitudes toward transgender populations, $religionid$ denotes the level of belief in religion, age represents age, and $politicalid_7$ denotes level of political opinion. β_0 is the intercept, $\beta_{religionid}$, β_{age} , and $\beta_{politicalid_7}$ denote the regression coefficients corresponding to the independent variables, respectively. Error term ϵ signifies the random effects of factors that are not captured in the model. By fitting this linear regression model, the relationship between different independent variables and implicit attitudes was quantified, further deepening the understanding of the impact between religiosity levels and implicit attitudes in the transgender population.

In the random forest model, the following equation was used for prediction:

$$D_biep.Cisgender_Good_all = f(religionid, age, politicalid_7)$$

In this equation, $D_biep.Cisgender_Good_all$ is the total implicit bias score, $religionid$ is the level of religious affiliation, age shows the age of the participants, and $politicalid_7$ denotes the level of political opinion. The function f is the learning process of the random forest model, which combines the predictions of 500 decision trees and arrives at the final prediction by weighted averaging the predictions of each tree. By integrating predictions from multiple decision trees, the random forest model can capture complex variable relationships and improve the predictive power of the model.

4. Data

This study used a dataset named “Transgender IAT Data” which was collected between 2020 and 2021 and included information on implicit bias scores and religiosity levels among participants. The Implicit Association Test (IAT) is a psychological test that is designed to measure individuals’ implicit biases and attitudes toward various social groups or concepts. The dataset, which was cleaned comprises eight columns, including birth year, order of combined tasks, implicit bias score, religiosity level, ethnicity, political orientation, and education level. It had a wealth of information, including participants’ demographic characteristics, religiosity levels, implicit bias scores obtained through the IAT, and other relevant variables.

The Implicit Bias Score ranged from negative values (showing a preference for cisgender individuals) to positive values (showing a preference for transgender individuals).

$$\begin{aligned} &\geq 0.65 \text{ (strong bias)} \\ 0.65 > x \geq 0.35 &\text{ (moderate bias)} \\ 0.35 > x \geq 0.15 &\text{ (slight bias)} \\ 0.15 > x \geq 0 &\text{ (no bias)} \end{aligned}$$

5. Data analysis and results

5.1. Data cleaning and pre-processing

In this study, the dataset used held a sample of approximately 800,000 observations. After filtering and screening out irrelevant variables, a sample of approximately 200,000 observations was ultimately retained. By seeing and statistically analyzing the distribution of each variable, possible outliers were found. Outliers that were clearly outside the normal range were treated as data entry errors and corrected. Extreme or outlier values were dealt with appropriately, such as adjusting them using truncation or transformation methods to within a reasonable range.

5.2. Descriptive statistical analysis

Table 1. Descriptive statistics table of the level of religious belief

Religiosity	Frequency	Percentage
Not at all religious	90435	44.76%
Slightly religious	58182	28.80%
Moderately religious	38339	18.98%
Strongly religious	15082	7.46%

As shown in **Table 1**, the descriptive statistics of the total implicit bias score column show the minimum, first quartile, median, mean, third quartile, and maximum values of the column. According to the results, the total implicit bias score column ranged from -1.81655 to 1.79861. The median was 0.11253 and the mean was 0.09841, which showed that the overall IAT D score was close to zero and a non-bias attitude.

The descriptive statistics of religiosity levels are visualized in **Figure 1**. This makes it easier to perceive the number of people with different scores for each level of religiosity varies and compare their numbers.

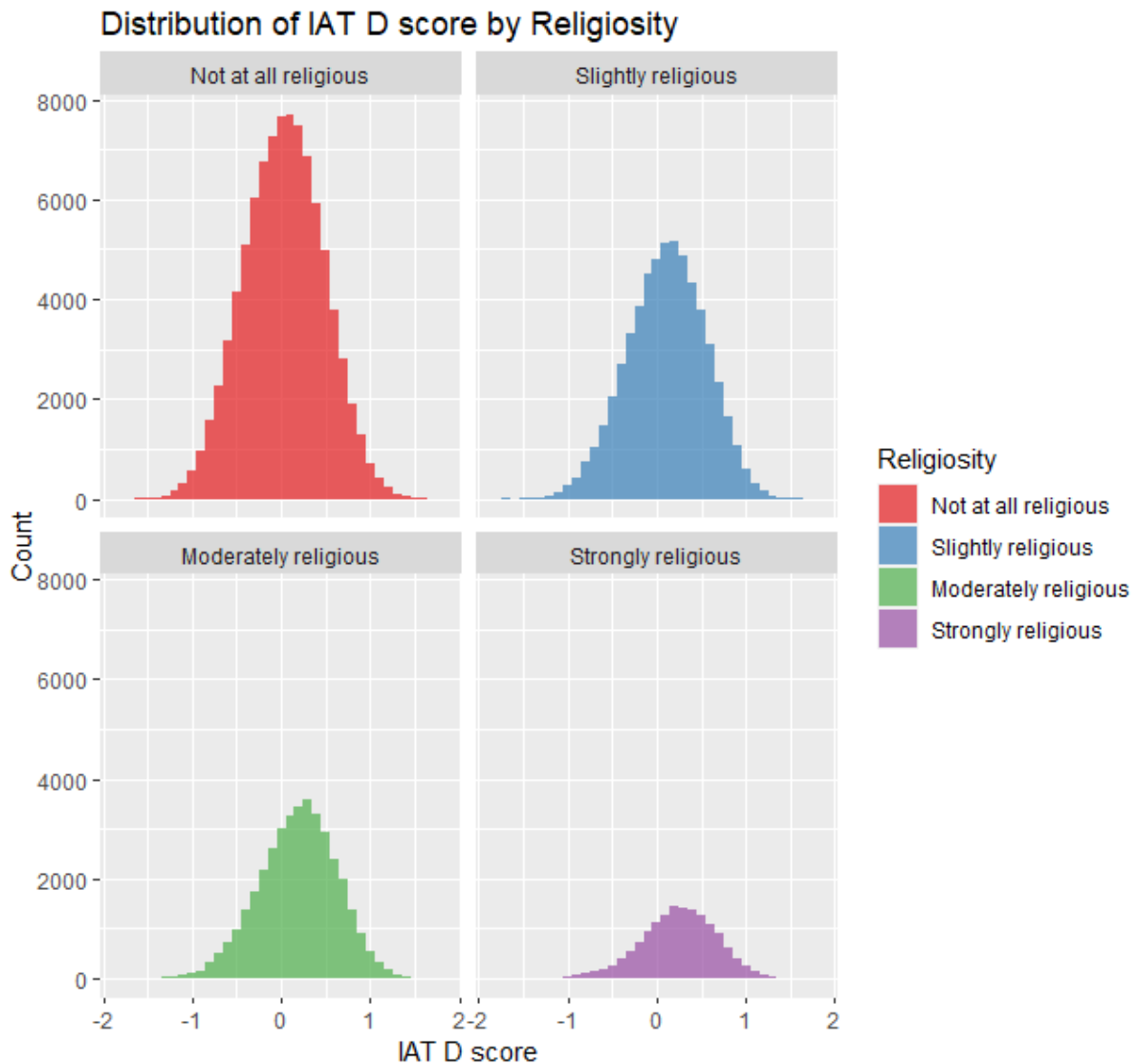


Figure 1. Histograms of descriptive statistics of religiosity levels

5.3. Correlation analysis

The correlation between the level of religiosity and the total implicit bias score was 0.1585 ($P = 0.1585$), indicating a feeble positive correlation. The significance test yielded a t -value of 72.177, degree of freedom (df) of 202,036, and a P -value of $< 2.2e-16$. With a significance level of 0.05, the null hypothesis was rejected, showing a statistically significant correlation between religiosity level and implicit bias score. The 95% confidence interval was 0.1543–0.1628, which supports a confident estimation of the true correlation. In conclusion, the results of the analysis indicate a feeble positive and statistically significant correlation between religiosity level and the total implicit bias score.

5.4. Linear regression analysis

Table 2. Summary of results from multiple linear regression modeling

	Estimate	Std. error	t-value	Pr(> t)
(Intercept)	1.263e+01	1.402e-01	90.08	< 2e-16 ***
<i>religionid</i>	2.022e-02	1.069e-03	18.93	< 2e-16 ***
<i>age</i>	-6.150e-03	7.039e-05	87.38	< 2e-16 ***
<i>politicalid_7</i>	-6.644e-02	6.145e-04	-108.12	< 2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
 Residual standard error: 0.4228 on 202,034 df
 Multiple R-squared: 0.1104
 Adjusted R-squared: 0.1104
 F-statistic: 8355 on 3 and 202,034 df, P-value < 2.2e-16

As shown in **Table 2**, the implicit bias was used as the dependent variable, level of religiosity was used as the independent variable, and age and political views were used as controlled variables.

Generally, according to this multiple linear regression model, religiosity level, age, and political views were found to be significantly associated with implicit bias. By controlling the two potential influences of age and political opinion, the independent effect of religiosity level on implicit bias was more accurately analyzed.

5.5. Analysis of random forest models

A forest regression model was applied to explore the effects of the level of religiosity, age, and political views on implicit bias toward the transgender population. Random forest modeling is a generalization of the decision tree method ^[4] that allows samples to be drawn from the original dataset with put back to generate multiple training sets to improve the robustness and accuracy of the model ^[5]. After training the decision tree 500 times using the three independent variables in the dataset, it was observed that the model had relatively small prediction errors and demonstrated some fitting ability. In the variable importance score, the level of religiosity was ranked first, indicating its presence in affecting implicit bias. However, its importance was found to be not significant, positioned at just over 500. Age occupied the second rank, displaying a more substantial impact on implicit bias, with an importance score of around 1300. Lastly, political opinion secured the third position, signifying a relatively significant effect on implicit bias, with an importance score of approximately 2400.

In general, the results of the study showed that the level of religiosity had a relatively insignificant role in implicit bias towards the transgender group, while age and political views had a more significant effect on the total implicit bias score. Specifically, political views emerged as a significant influencer of implicit bias. Andrew R. Flores ^[6] agrees with Arceneaux's ^[7] mention that cognitive biases may influence how individuals evaluate political arguments and are therefore persuaded. Additionally, Dyck & Pearson-Merkowitz ^[8] noted that partisanship conditions the effectiveness of prejudice reduction through interpersonal contact with lesbians and gay men, with no discernible effect among lesbians and gay men themselves. He concluded that partisanship in the context of transgender people may be a tendency to enhance or inhibit the effects of mere exposure. These findings supply new insights into the relationship between religiosity, age, political views, and transgender groups. Nevertheless, the focus of this study was to examine whether higher levels of religiosity would have a higher total implicit bias score for the transgender population, thus age and political views, which were the control variables, were not examined extensively.

Table 3. Resampling results across tuning parameters

Mtry	RMSE	R-squared	MAE
2	0.4210927	0.1175568	0.3359402
3	0.4223478	0.1129220	0.3368965

Cross-validation showed that the model performed slightly better in terms of root-mean-square error and mean absolute error when the adjustment parameter $Mtry = 2$ rather than when $Mtry = 3$. Nonetheless, the model did not fit well with a low R-squared value, showing that the model only explained about 11.76% of the variance of the target variable (Table 3).

5.6. Differences in bias between various levels

Table 4. Summary of variance (ANOVA)

	df	Sum Sq	Mean Sq	F-value	Pr(> F)
r\Religiosity level	3	1014	341.3	1743	< 2e-16 ***
Residuals	202034	39569	0.2		

Signif. codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '.' 0.1 ' ' 1

Based on the results of the ANOVA, table 4 can be concluded that the level of religiosity has a significant effect on implicit bias, and that there is a significant difference in implicit bias between groups with various levels of religiosity. (Table 4)

Table 5. Summary of Tukey HSD

The religiosity level groups	diff	lwr	upr	P_{adj}
2-1	0.074	0.068	0.080 7137	0
3-1	0.155	0.148	0.162 9549	0
4-1	0.212	0.202	0.222 616	0
3-2	0.081	0.074	0.089 1644	0
4-2	0.137	0.127	0.148 2131	0
4-3	0.056	0.045	0.067 2310	0

The results of Table 5 were consistent with the research hypothesis that there is a significant association between the level of religiosity and implicit bias. There were differences in implicit bias toward transgender people across levels of religiosity and this implies that individuals who identify as having strong religious beliefs may be more susceptible to implicit biases towards transgender individuals.

Collectively, the ANOVA provides an effective way to compare differences in implicit bias between groups with distinct levels of religiosity and to contribute to a better understanding of the relationship between religiosity and implicit bias.

6. Discussion

6.1. Limitations

A researcher argued that one of the obvious weaknesses of the linear model was that it assumed that the effect of the covariates on the intensity function was constant and did not account for changes over time^[8]. This could lead to model inappropriateness and bias. It is also crucial to recognize the limitations of this study.

6.2. Cross-sectional design

One of the primary limitations of this study was the use of a cross-sectional design, which only captured data at a single point in time. In this design, data was collected from participants being distinct groups or populations at a single moment, supplying a snapshot of their characteristics, attitudes, behaviors, or other variables of interest.

Participants were not followed over time, nor were variables manipulated as would occur in longitudinal or experimental designs. Instead, data were gathered from participants of various ages, backgrounds, or conditions all at once, allowing for the examination of relationships, differences, or associations between variables at a specific moment.

6.3. IAT

The IAT measures implicit biases indirectly by assessing participants' response times to different stimulus pairings. While this indirect approach supplies valuable insights into unconscious biases, it may not fully capture the complexity and subtlety of an individual's attitudes and beliefs. An article written in 2013^[10] argues that response times can be influenced by several factors, including familiarity with the test format, cognitive processing speed, and individual differences in motor skills. Most importantly, the IAT's results can be influenced by the specific context in which the test is administered. Factors such as the order of test blocks, the wording of instructions, and the selection of stimuli can affect participants' responses.

6.4. Mediating factors

In addition, the study focused on the relationship between religious beliefs and implicit bias towards transgender individuals; however, there may be other mediating factors influencing this relationship that were not accounted for in this analysis. Factors such as exposure to media, individual experiences, or social interactions could also play a role in shaping individuals' implicit biases.

6.5. Implicit bias assessment

Eventually, while this research focuses on implicit bias, it is essential to acknowledge that implicit bias measures may not fully capture individuals' conscious attitudes and behaviors. The assessment of religious beliefs in this study is limited to a single measure, which may not capture the complexity and nuances of an individual's religious orientation fully.

6.6. Recommendations for future research

Longitudinal research designs would allow researchers to track changes in implicit bias and religious belief over time, helping to prove the directionality of the relationship. Moreover, incorporating experimental interventions could shed light on the causal mechanisms underlying the observed associations. For instance, conducting randomized controlled trials to examine the effects of interventions aimed at reducing implicit bias among individuals with varying religious beliefs could supply valuable insights into potential avenues for bias reduction. According to the systematic review conducted by Millet^[11], a total of 25 studies were included in

their analysis, forming 17 cross-sectional studies and 8 longitudinal studies. Their findings revealed higher prevalence of anxiety symptoms in the transgender group compared to the cisgender population in the cross-sectional studies. The prevalence of anxiety disorders ranged from 17% to 68%, with specific phobias, social phobias, panic disorders, and obsessive-compulsive disorders being the most common. Such longitudinal studies would allow for the tracking of changes in anxiety symptoms and disorders over time within transgender populations. By following participants over an extended period, researchers can investigate how anxiety symptoms and disorders evolve and how they may be influenced by factors such as social support, gender transition, and access to healthcare.

Furthermore, exploring the influence of contextual factors on the relationship between religious belief and implicit bias could be an exciting avenue for future research. For instance, investigating the impact of religious teachings, social norms, and cultural factors on the development and maintenance of implicit bias could offer a more nuanced understanding of this relationship across diverse populations.

Additionally, future research may receive help from incorporating a broader range of measures to assess implicit bias. DeCoster and Semin^[12] highlighted the advantages of using implicit measures over overt questioning in psychology. However, the interpretation of implicit measures is not as straightforward as explicit measures because they tap into different memory systems. While the IAT used in this study is widely recognized, incorporating other implicit measures and combining them with explicit measures of bias may supply a more comprehensive assessment of individuals' attitudes and beliefs toward transgender individuals.

Lastly, given the complexities and diversity of religious beliefs across diverse cultures and societies, cross-cultural research is essential in understanding how religious belief and implicit bias may vary across different regions of the world. Examining how cultural and religious contexts interact to influence attitudes towards marginalized groups, such as transgender individuals, can supply valuable insights into the universality or cultural specificity of the observed relationships. Dunham and Barner^[13] addressed the gap in research on the development of implicit intergroup attitudes, which is exploring social categories prominent in Indian culture, namely caste and religion. The researchers proposed that religion may prevent children from internalizing stigma. This finding suggests that religious belief can influence the development of intergroup attitudes in a unique manner, potentially leading to different patterns of implicit bias across regions of the world. In another example, research was done in 2023 on how people of color viewed Jesus' race and the influence of culture on that view, and it was concluded that participants would show implicit bias. Implicit bias could be predicted through beliefs about Jesus' race, racial colorblindness, ethnic identity, and inherent model minority stereotypes^[14].

6.7. Implications

The implications of these findings are relevant for fostering understanding and empathy towards the transgender community. By finding the role of religious beliefs in shaping implicit biases, this study highlights the importance of promoting dialogue and awareness within religious communities to foster greater acceptance and support for gender diversity. Policy and intervention efforts aimed at reducing implicit biases and promoting diversity and inclusivity should consider the influence of religious beliefs in shaping attitudes toward marginalized groups. Truthfully, transgender people in the United States experience widespread prejudice, discrimination, violence, and other forms of stigma^[15]. By addressing potential biases related to religious beliefs, interventions can be tailored to target specific areas for promoting positive intergroup attitudes and shedding light on the relationship between religious belief and implicit bias, which contributes to a deeper understanding of the complexities involved in forming intergroup attitudes.

7. Conclusion

The results of this investigation supported the hypothesis that people with higher levels of religiosity tend to show higher levels of implicit bias toward transgender people. Specifically, the findings showed that stronger religiosity and higher levels of religious involvement may lead to higher levels of implicit bias toward the transgender community. These results have significant implications for understanding the factors that shape attitudes toward marginalized groups, such as the transgender community. It highlights the need for further exploration and consideration of religious beliefs and their potential influence on attitudes and biases. Nevertheless, the fit of the model was relatively low, with the level of religiosity explaining only a minor part of the variance in implicit bias. This suggests that religiosity is merely one of the multiple factors influencing implicit bias, and that many other personal and social factors may have an impact on implicit bias. Therefore, further in-depth studies are needed to explore more factors influencing implicit bias and to deepen the understanding of this complex phenomenon.

Disclosure statement

The author declares no conflict of interest.

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