UNIVERSITY OF CALIFORNIA, MERCED

The Role of Prejudice in Understanding Epistemically Unwarranted Beliefs

A Dissertation submitted in partial satisfaction of the requirements
for the degree Doctor of Philosophy

in

Cognitive and Information Sciences

by

Emilio Jon Christopher Lobato

Committee in charge:

Professor Dan Hicks, Co-Chair
Professor Colin Holbrook, Co-Chair
Professor David Noelle

2024

The Dissertation of Emilio J. C. Lobato is approved, and it is acceptable in quality and form for publication on microfilm and electronically.

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Professor Dan Hicks, Co-Chair

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Professor Colin Holbrook, Co-Chair

_____

Professor David Noelle

University of California, Merced

2024

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ACKNOWLEDGEMENTS

On more than one occasion, quite frequently in fact, I have been on the border of throwing in the towel on this whole “being a scientist” thing. Even now, deep down, I’m still not 100% sure this was worth it – only time will tell, I suppose. However, as I am at the cusp of finishing, I have to acknowledging that I would not have been able to get as far as I have without so many wonderful and thoughtful people whose support and validation have given me the strength to continue on through the unnecessarily exploitative and dehumanizing experience that is graduate education in the United States.

I want to thank all of the advisors, mentors, committee members, colleagues, and co-authors I have had over the years. I owe a special debt to the people who helped me code the qualitative data reported on in Chapter 6: Gianna Nuñes, Zach Stillman, & Henry Seeger. Thank you for all of your help!

The people who have most helped me get here were my friends, who kept me in good enough spirits so that I did not actually back down no matter how much I wanted to. There are genuinely too many of you to list. It is my sincerest hope that throughout our friendships, I have been as supportive and uplifting to all of you amazing people as you all have been to me. I owe my success to you more than many of you will ever know, and I wish you all nothing but the best in life. You deserve nothing less.

Last, but by no means least, my family has played a massive role in me getting to this point. To my mother Peggy, my brother Michael, and my sister Jennifer: thank you for believing in me, thank you for thinking I was worth bragging about to your friends, thank you for supporting me, thank you for taking an interest in what I’ve chosen to do, thank you for everything.

Chapter 3, in full, is a reprint of the material as it appears in Religiosity Predicts Evidentiary Standards. Lobato, Emilio J. C.; Tabatabaeian, Shadab; Fleming, Morgan; Sulzmann, Sven; Holbrook, Colin. Sage, 2019. The dissertation author was the primary investigator and author of this paper.

Chapter 4, in full, is a reprint of the material as it appears in Factors Predicting the Willingness to Share COVID-19 Misinformation. Lobato, Emilio J. C.; Powell, Maia; Padilla, Lace; Holbrook, Colin. Lobato, Powell, Padilla, & Holbrook, 2020. The dissertation author was the primary investigator and author of this paper.

Chapter 5, in full, is submitted for publication of the material. Lobato, Emilio J. C.; Holbrook, Colin. The dissertation author was the primary researcher and author of this material.

Curriculum Vita

Emilio J. C. Lobato

Education

University of California – Merced, Merced, CA *PhD, Cognitive and Information Sciences* Dissertation: The Role of Prejudice in Epistemically Unwarranted Beliefs	August 2018 - present
Illinois State University, Normal, IL *Master of Science, Cognitive and Behavioral Sciences* Thesis: Examining Different Reasons Why People Accept or Reject Scientific Claims	August 2014 – May 2017
University of Central Florida, Orlando, FL *Graduate Certificate, Cognitive Science*	August 2010 – May 2011
University of Central Florida, Orlando, FL *Bachelor of Arts, Psychology*	August 2003 – May 2007

Honors & Awards

Illinois State University, Department of Psychology Charter Department Graduate Student Excellence Award	2017
Midwestern Association for Graduate Schools (MAGS) Annual Conference Three Minute Thesis (3MT®) Finalist	2017
Illinois State University Three Minute Thesis (3MT®) First Place Winner	2017
Illinois State University, Department of Psychology Graduate Assistant of the Year	2016

Research

EvoLab, University of California - Merced Lab Supervisor: Colin Holbrook, PhD • Graduate Research Assistant	August 2018-present
Scientific Reasoning Laboratory, Illinois State University Lab Supervisor: Corinne Zimmerman, PhD • Graduate Research Assistant • Graduate Teaching Assistant	August 2014 – May 2017
Institute for Simulation and Training, Cognitive Sciences Laboratory (http://csl.ist.ucf.edu/), University of Central Florida Lab Supervisor: Stephen M. Fiore, PhD • Lab Manager • Website Manager • Research Assistant	May 2012 – July 2014
Applied Cognition and Technology Lab, University of Central Florida (http://acat.cos.ucf.edu) Lab Supervisors: Valerie Sims, PhD; Matthew Chin, PhD • Research Assistant	January 2011 – July 2014

University of Central Florida's "Research and Mentor Program" (http://pegasus.cc.ucf.edu/~ramp/home.html), University of Central Florida — September 2006 – May 2007
Faculty Supervisor: Kenyatta Rivers, PhD
- Undergraduate Research Assistant

Grants

Scholarship of Teaching and Learning (SoTL) Small Grant Program — **$4,500**
"An Examination of Psychology Students' Beliefs about the Nature of Science: The Role of Research Experience"
PIs: Dr. Corinne Zimmerman, Dr. Thomas Critchfield

Publications

Journal Manuscripts

Powell, M., **Lobato, E. J. C.**, & Rutter, E. N. (under review). Comparing network structures across different kinds of viral COVID (mis)information. Submitted to *Computers in Human Behavior Reports*.

Lobato, E. J. C. & Holbrook, C. (under revision). Prejudice is epistemically unwarranted belief. Submitted to *Applied Cognitive Psychology*.

Hicks, D. J., & **Lobato, E. J. C.** (2022) Values disclosures and trust in science: A replication study. *Frontiers in Communication*, 7:1017362. doi: 10.3389/fcomm.2022.1017362

van Mulukom, V., Pummerer, L., Alper, S., Bai, H., Cavojova, V., Farias, J., Kay, C. S., Lazarevic, L. B., **Lobato, E. J. C.**, Marinthe, G., Banai, I. P., Šrol, J., & Žeželj, I. (2022). Antecedents and consequences of COVID-19 conspiracy beliefs: A systematic review. *Social Science & Medicine*, 114912.

Lobato E. J. C., Powell M., Padilla L. M. K., & Holbrook C. (2020) Factors predicting willingness to share COVID-19 misinformation. *Frontiers in Psychology*. 11:566108. doi: 10.3389/fpsyg.2020.566108

Lobato, E. J. C., Tabatabaeian, S., Fleming, M., Sulzman, S., & Holbrook, C. (2020). Religiosity predicts evidentiary standards. *Social Psychological and Personality Science*, *11*(4), 546-551. DOI: 10.1177/1948550619869613

Lobato, E. J. C. & Zimmerman, C. Z., (2019). Examining how people reason about controversial scientific topics. *Thinking & Reasoning*, *25*(2), 231-255. DOI: 10.1080/13546783.2018.1521870

Rivers, K. O., Schutz, L. E., **Lobato, E. J. C.**, & Hahs-Vaughn, D. L. (2015). Prevalence of traumatic brain injury in postsecondary education. *ECHO: Journal of the National Black Association for Speech-Language and Hearing*, *10*(2), 89-95.

Wiltshire, T. J., **Lobato, E. J. C.**, McConnell, D. S., & Fiore, S. M. (2014). Prospects for direct social perception: A multi-theoretical integration to further the science of social cognition. *Frontiers in Human Neuroscience*, *8*, 1007. DOI: 10.3389/fnhum.2014.010007

Lobato, E. J. C., Mendoza, J., Sims, V. K., & Chin, M. G. (2014). Examining the relationship between conspiracy theories, paranormal beliefs, and

pseudoscience acceptance. *Applied Cognitive Psychology, 28*(5), 617-625. DOI: 10.1002/acp.3042

Wiltshire, T. J., **Lobato, E. J. C.**, Jentsch, F. G., & Fiore, S. M. (2013). Will (dis)embodied LIDA agents be socially interactive? *Journal of Artificial General Intelligence, 4*(2), 42-47.

Fiore, S. M., Wiltshire, T. J., **Lobato, E. J.**, Jentsch, F. G., Huang, W. H., & Axelrod, B. (2013). Towards understanding social cues and signals in human-robot interaction: Effects of robot gaze and proxemic behavior. *Frontiers in Cognitive Science, 4,* 859. DOI: 10.3389/fpsyg.2013.00859

Schutz, L. E., Rivers, K. O., Schutz, J. A., **Lobato, E.** & MacNamera, E. A. (2010). Traumatic Brain Injury in K-12 Students: Where Have All the Children Gone? *International Journal of Learning Disabilities, 25(2)*, 55-71.

Conference Proceedings

Wiltshire, T. J., **Lobato, E. J. C.**, Garcia, D. R., Fiore, S. M., Jentsch, F. G., Huang, W. H., & Axelrod, B. (2015). Effects of robotic social cues on interpersonal attributions and assessment of robot interaction behaviors. *Proceedings of the 59th Annual Meeting of the Human Factors and Ergonomics Society* (pp. 801-805). Santa Monica, CA: Human Factors and Ergonomics Society.

Lobato, E. J. C., Warta, S. F., Wiltshire, T. J., & Fiore, S. M. (2015). Varying social cue constellations results in different attributed social signals in a simulated surveillance task. *Proceedings of the 28th International Florida Artificial Intelligence Research Society Conference, FLAIRS '15* (pp. 61-66). Palo Alto, CA: AAAI Press.

Wiltshire, T. J., Snow, S., **Lobato, E. J. C.**, & Fiore, S. M. (2014). Leveraging Social Judgement Theory to Examine the Relationship between Social Cues and Signals in Human-Robot Interactions. *Proceedings of the 58th Annual Meeting of the Human Factors and Ergonomics Society* (pp. 1336-1340). Santa Monica, CA: Human Factors and Ergonomics Society.

Lobato, E. J. C., Wiltshire, T. J., Hudak, S., & Fiore, S. M. (2014). No time, no problem: Mental state attributions made quickly or after reflection do not differ. *Proceedings of the 58th Annual Meeting of the Human Factors and Ergonomics Society* (pp. 1341-1345). Santa Monica, CA: Human Factors and Ergonomics Society.

Wiltshire, T. J., **Lobato, E. J. C.**, Velez, J., Jentsch, F. G., & Fiore, S. (2014). An interdisciplinary taxonomy of social cues and signals in the service of engineering robotic social intelligence. In SPIE 9084 Unmanned Systems Technology XVI. 90840F (June 3, 2014). DOI:10.1117/12.2049933

Lobato, E. J. C., Wiltshire, T. J., & Fiore, S. M. (2013). A dual-process approach to understanding HRI. *Proceedings of the 57th Annual Meeting of the Human Factors and Ergonomics Society* (pp. 1263-1267). Santa Monica, CA: Human Factors and Ergonomics Society.

Wiltshire, T., **Lobato, E. J. C.**, Wedell, A., Huang, W., Axelrod, B. & Fiore, S. M. (2013). Effects of Robot Gaze and Proxemic Behavior on Perceived Social Presence during a Hallway Navigation Scenario. *Proceedings of the 57th*

Annual Meeting of the Human Factors and Ergonomics Society (pp. 1273-1277). Santa Monica, CA: Human Factors and Ergonomics Society.

Book Chapters

Lobato, E. J. C. & Zimmerman, C. (2018). The psychology of (pseudo)science: Cognitive, social, and cultural factors. In A. B. Kaufman & J. Kaufman (Eds.). *Pseudoscience: The Conspiracy Against Science* (pp. 21-43). MIT Press.

Wesselmann, E. D., **Lobato, E. J. C.**, & Jordan, J. S. (2017). Balancing the warrior and the peace ambassador. In T. Langely & M. Wood (Eds.) *Wonder Woman Psychology: Lassoing the Truth* (pp. 273-285). Sterling.

Cialdella, V. T., **Lobato, E. J. C.**, & Jordan, J. S. (2017). Wild architecture: Self-sustaining systems and the move toward meaning. In J. Vallverdú, M. Mazzara, M. Talanov, R. Lowe, & S. Distefano (Eds.) *Advanced Research on Biologically Inspired Cognitive Architectures* (pp. 41-62). IGI Global.

Presentations

Poster Presentations

Sharma, R., Tomson, A., **Lobato, E.**, Kallmann, M., & Padilla, L. (2020, May). *Data Driven Multi-Hazard Risk Visualization*. Poster presented at the annual conference EuroVIS.

Lobato, E. J. C., Zimmerman, C., & Croker, S. (2016, May). *Rejection of scientific statements is related to low analytical thinking and conservative political ideology*. Poster presented at the 2016 the annual convention of the Association for Psychological Science.

Wiltshire, T. J., **Lobato, E. J. C.**, Garcia, D., Fiore, S. M., Jentsch, F. G., Huang, W. H., & Axelrod, B. (2015, October). *Effects of robotic social cues on interpersonal attributions and assessments of robot interaction behaviors*. Poster presented at the 59th Annual Meeting of the Human Factors and Ergonomics Society.

Lobato, E. J. C. & Zimmerman, C. (2015, July). *Belief in the unbelievable: Individual differences in tendencies to believe pseudoscience, paranormal, and conspiracy theories*. Poster presented at the 2015 Annual Meeting of the Cognitive Science Society.

Lobato, E. J. C. & Zimmerman, C. (2015, May). *Blogging while female: The effects of a polarizing topic on gender bias*. Poster presented at the 2015 Annual Meeting of the Midwestern Psychological Association.

Lobato, E. J. C. & Zimmerman, C. (2015, April). *Belief in the unbelievable: Individual differences in tendencies to believe pseudoscience, paranormal, and conspiracy theories*. Poster presented at the 2015 Annual Meeting of the Midwestern Psychological Association.

Lobato, E. J. C. & Zimmerman, C. (2015, April). *Belief in the unbelievable: Individual differences in tendencies to believe pseudoscience, paranormal, and conspiracy theories*. Poster presented at the 2015 Illinois State University Research Symposium.

Lobato, E. J. C., Warta, S. F., Wiltshire, T. J., & Fiore, S. M. (2015, May). *Varying social cue constellations results in different attributed social signals*

in a simulated surveillance task. Poster presented at the 28th International FLAIRS Conference.

Lobato E. C. J., Zimmerman, C., & Critchfield, T. S. (2015, January). *Psychology majors' views of science: The role of research experience*. Poster presented at the Center for Teaching, Learning, and Technology 2015 Teaching & Learning Symposium at Illinois State University.

Lobato, E. J. C., Wiltshire, T. J., & Fiore, S. M. (2014, October). *The utility of human's ontological knowledge of social robots for human-robot interaction research*. Poster presented at the 58th Annual Meeting of the Human Factors and Ergonomics Society.

Wiltshire, T. J., Snow, S., **Lobato, E. J. C.**, & Fiore, S. M. (2014, October). *Leveraging Social Judgement Theory to Examine the Relationship between Social Cues and Signals in Human-Robot Interactions*. Poster presented at the 58th Annual Meeting of the Human Factors and Ergonomics Society.

Lobato, E. J. C., Wiltshire, T. J., Hudak, S., & Fiore, S. M. (2014, October). *Mental state attributions made quickly or after reflection do not differ*. Poster presented at the 58th Annual Meeting of the Human Factors and Ergonomics Society.

Velez, J., **Lobato, E. J. C.**, Wiltshire, T. J., & Fiore, S. M. (2014, April). *An interdisciplinary social cues taxonomy for social cognition research*. Poster presented at Undergraduate Psychology Conference Hosted by UCF-Palm Bay Psi Chi chapter.

Lobato, E. J. C., Wiltshire, T. J., & Fiore, S. M. (2013, September). *A dual-process approach to understanding HRI*. Poster presented at the 57th Annual Meeting of the Human Factors and Ergonomics Society.

Wiltshire, T., **Lobato, E. J. C.**, Wedell, A., Huang, W., Axelrod, B. & Fiore, S. M. (2013, September). *Effects of robot gaze and proxemic behavior on perceived social presence during a hallway navigation scenario*. Poster presented at the 57th Annual Meeting of the Human Factors and Ergonomics Society.

Wiltshire, T. J., **Lobato, E. J. C.**, Wedell, A., & Fiore, S. M. (2013, April). *Effects of robot gaze and proxemic behavior on perceived social presence during a hallway navigation scenario*. Poster presented at the University of Central Florida's 2013 Graduate Research Forum.

Mendoza, J., **Lobato, E. J. C.**, Sims, V. K., & Chin, M. G. (2012, July). *Political, Religious and Personality Variables in Belief Acceptance*. Poster presented at the annual convention of the International Society for Political Psychology at Chicago, IL.

Lobato, E. J., Mendoza, J., Sims, V. K., & Chin, M. G. (2012, May). *Individual Differences in Belief Acceptance*. Poster presented at the annual convention of the Association for Psychological Science at Chicago, IL.

Rivers., K. O., Schutz, L. E. & **Lobato, E. J. C.** (2007, November). *Prevalence of Traumatic Brain Injury in Post-Secondary Schools*. Poster session presented at the annual convention of the American Speech-Language-Hearing Association at Boston, MA.

Lobato, E. J. C., Rivers., K. O., & Schutz, L. E. (2007, May). *Prevalence of Traumatic Brain Injury in Post-Secondary Schools*. Poster session presented at the annual convention of the Florida Association of Speech-Language Pathologists and Audiologists at Marco Island, FL.

Lobato, E. J. C., Rivers., K. O., & Schutz, L. E. (2007, April). *Prevalence of Traumatic Brain Injury in Post-Secondary Schools*. Poster session presented at the annual Showcase of Undergraduate Research Excellence at University of Central Florida, FL.

Invited Presentations

Lobato, E. J. C. & Wesselmann, E. D. (2017). *Ostracism, discrimination, and psychological well-being in a non-religious sample*. Presented at the 89th Annual Meeting of the Midwestern Psychological Association, Chicago, IL. 20 April 2017.

Lobato, E. J. C. & Wiltshire, T. J. (2017). *Using human heroism and robot narratives to design heroic robots*. Presented at the 89th Annual Meeting of the Midwestern Psychological Association, Chicago, IL. 20 April 2017.

Lobato, E. J. C., & Wiltshire, T. J. (2016). *Can we create heroic machines? Insights from human heroism and fictional robot narratives*. Presented at the 15th Biennial Meeting of the International Society for the Empirical Study of Literature, Chicago, IL. 7 July 2016.

Lobato, E. J. C. (2013) *Believing the unbelievable: Studies of the relationship between conspiracy theories, paranormal beliefs, and pseudoscience acceptance*. Presented at the Cognitive Sciences' Summer Lecture Series. Institute for Simulation and Training, Orlando, FL. 17 May 2013.

Wiltshire, T. J., **Lobato, E. J. C.**, & Fiore, S. M., (2013). *Understanding social signals in human-robot interaction: Effects of robot gaze and proxemic behavior*. Presented at the Cognitive Sciences Summer Lecture Series. Institute for Simulation and Training, Orlando, FL. 3 May 2013.

Teaching

Instructor

University of California, Merced

COGS 13 Scientific Thinking	Summer 2023

Lab Instructor

Illinois State University

PSY 231 Research Methods in Psychology	Fall 2016; Spring 2017

Teaching Assistant

University of California, Merced

PHIL 003 Contemporary Moral Problems	Fall 2018
COGS 13 Scientific Thinking	Spring 2019, Spring 2020, Spring 2023
COGS 170 Judgment and Decision Making	Spring 2020
PHIL 001 Introduction to Philosophy	Fall 2022
COGS 101 Mind, Brain, and Computation	Fall 2023
PHIL 005 Introduction to Logic	Spring 2024

Illinois State University

PSY 215 Educational Psychology	Spring 2015; Fall 2015; Spring 2016

	PSY 392 Senior Seminar	Spring 2016
	University of Central Florida	
	EXP 3064C Cognitive Psychology	Summer, 2011; Fall 2011
	PSY 3930H Introduction to Cognitive Science	Spring, 2012

Professional Service

Journal Reviewer for:

- *Applied Cognitive Psychology*
- *Cognition*
- *Journal of Experimental Psychopathology*
- *Personality and Social Psychology Bulletin*
- *Studia Psychologica*
- *Science & Education*

ABSTRACT

The Role of Prejudice in Understanding Epistemically Unwarranted Beliefs
Emilio J. C. Lobato
Doctor of Philosophy in Cognitive and Information Sciences
University of California Merced, 2024
Professor Dan J. Hicks, Co-Chair
Professor Colin Holbrook, Co-Chair

In this dissertation, I argue that researchers interested in examining the development, maintenance, transmission, and co-occurrence of epistemically unwarranted beliefs would benefit by incorporating, in diverse ways, an important dimension that might prove useful in providing explanatory power in understanding how seemingly unrelated unwarranted claims tend to co-occur. That dimension is social prejudice.

To make this argument, I start with a philosophical argument concerning the demarcation problem of separating science from nonscience. Specifically, I argue about separating science from pseudoscience based on the behavior of practitioners rather than the features of ideas or claims. Conceiving of pseudoscience as that which emerges from pseudoscientific behavior has consequences for the treatment of scientific fraud and misconduct in the demarcation literature. This serves as the main focal point of the argument. However, the argument also serves as setting the stage for acknowledging that several major pseudoscientific ideas, including some that are prejudicial in nature, have emerged from within the scientific community and were or even still are considered mainstream scientific theories.

Subsequently, I describe both original and replication research examining several factors associated with the contents of peoples' beliefs. I begin with an experiment examining how people treat positive and negative evidence for a secular and a religious/supernatural claim. This research revealed how people set different evidentiary standards when considering the nature of the claim, the nature of the evidence, and how these considerations intersect with individuals' own identity. Following this, I describe research investigating socio-cognitive profiles associated with a willingness to share various forms of misinformation concerning the then-novel COVID-19 pandemic, finding primarily that the construct of social dominance orientation is positively associated with willingness to share conspiratorial misinformation. In the final two chapters, I describe a multi-stage project exploring (a) the degree to which explicitly prejudicial and nonprejudicial epistemically unwarranted beliefs covary, (b) underlying socio-cognitive profiles associated with the endorsement or rejection of prejudicial and non-prejudicial epistemically unwarranted beliefs, and (c) peoples' explicit reasoning behind their beliefs concerning a subset of epistemically unwarranted claims, including prejudicial claims. Findings from this research show robust association between prejudicial and non-prejudicial unwarranted beliefs, that these associations share underlying socio-cognitive profiles associated with belief endorsement. Finally, peoples' explicit reasoning patterns do not systematically differ when justifying their positions about beliefs that are overtly prejudicial in nature compared to beliefs that are not overtly prejudicial in nature.

I conclude with lessons that this research can tell us about how to improve efforts to combat the endorsement and spread of epistemically unwarranted beliefs.

Chapter 1 Introduction

A little over a decade ago, I appropriated the term *epistemic warrant* from some philosophy of science literature dealing with the demarcation problem (Hansson, 2009) and generalized the concept to be more than just a criterion by which to judge a claim as scientific or pseudoscientific. Conspiracy theories, as the term is popularly conceived of, also lack epistemic warrant. Likewise with paranormal or superstitious beliefs. I started referring to these kinds of beliefs collectively as *epistemically unwarranted beliefs* (Lobato et al., 2014), a term which has since been entrenched in the scientific literature examining why people believe various kinds of claims that lack sufficient evidence.

I had observed that several high-profile pseudoscience proponents were alleging conspiracy theories for why their particular pseudoscience is not considered mainstream science. Creationists, for example, liked to invoke the existence of atheistic conspiracies to explain why creationism is being kept out of science classrooms. Similarly, I had observed conspiracy theorists try to defend their conspiracy theories by appealing to scientific evidence in support of the claim; evidence that turns out either to be ignoring other scientific evidence (thus rendering irrelevant the specific scientific factoid the conspiracy theorists cite) or to be pseudoscientific in itself. For instance, 9/11 Truthers' infamous glib remark that "jet fuel doesn't melt steel beams" used as evidence that the Twin Towers collapsed as a result of internally planted explosives is irrelevant. At the temperatures at which jet fuel does burn – between 800F and 1500F – carbon steel alloys lose 40-60% of its tensile strength. Steel beams, not surprisingly, will buckle and break when heated up to that temperature and are forced to support the weight of several stories worth of skyscraper materials. The "magic bullet" aspect of the conspiracy theory alleging that former U.S. President John F. Kennedy was not actually killed by a lone gunman appeals to an intuitive but ultimately false understanding of the relevant physics of how objects move when a bullet penetrates straight through at high velocity. Additionally, I observed that several paranormal or supernatural beliefs either abuse or deny legitimate science or propose conspiracies behind why the paranormal or supernatural claim is not officially recognized by relevant authorities. It is difficult to dissociate the supernatural extraordinary claims of claims about extraterrestrial visitations from the allegations of government cover-ups, Area 51, men in black, and so on. These observations made me wonder, for example, where does a pseudoscience end and a conspiracy theory begin (Lobato et al., 2014)? Are the same mechanisms and processes that lead people to accept conspiracies the same ones that lead people to accept paranormal claims?

Over the past few years, while continuing to research peoples' beliefs about science or conspiracy theories or superstitions, I realized the existence of another related epistemically unwarranted belief system that overlaps substantially with pseudoscience, conspiracies, and even some paranormal claims that I had not seen remarked much upon in the literature. Prejudicial beliefs are very much akin to pseudoscience, conspiracies, and paranormal beliefs. As with my earlier observation that there is overlap between pseudoscience, conspiracies, and superstitions, I am not claiming to be the first to make these observations in some form. There is, in fact, a long history of scientists, historians, and philosophers calling attention to some intersection between prejudices and conspiracies or pseudoscience, although that research tends to be narrow in scope.

However, while some connections between prejudicial or bigoted attitudes and other epistemically unwarranted beliefs have been acknowledged, what has gone underappreciated in the empirical sciences is an explicit integration of prejudice (and its correlates) as a potentially major component of epistemically unwarranted belief systems. Research efforts into understanding epistemically unwarranted belief formation, maintenance, and transmission broadly have much to gain by incorporating research on the formation, maintenance, and transmission of prejudicial beliefs. I intend to defend an argument that just as pseudoscience, conspiracy theories, and paranormal beliefs all share the feature of lacking epistemic warrant and frequently co-occur, bigoted beliefs likewise lack epistemic warrant and co-occur alongside pseudoscience, conspiracy theories, and paranormal claims. In many cases it is difficult to discern where a prejudicial claim ends and where a pseudoscience or conspiracy begins. Incorporating social prejudices under the umbrella of epistemically unwarranted beliefs would be a novel direction for researchers to advance the understanding of how and why people come to endorse or reject belief in empirically unsubstantiated or already falsified claims, how those beliefs are maintained and transmitted at the individual and social levels, and how beliefs and attitudes can be revised or abandoned.

It is necessary to start off by defining the kinds of beliefs that have been lumped together under the "epistemically unwarranted beliefs" label, as well as features of the arguments used to support those beliefs that necessarily have to be substituted in for evidence. Early research (Lobato et al., 2014) considered pseudoscience, conspiracy theories, and paranormal beliefs together as epistemically unwarranted beliefs. Each of these categories and labels have notoriously been difficult to define precisely, resulting in pragmatic yet loose definitions used to define what is a pseudoscience, what is a conspiracy theory, and what is a paranormal belief in the cognitive and social sciences studying such topics. I will likewise use such definitions in this essay, carrying on the proud tradition of punting on the hard question of precisely operationalizing constructs in service of pragmatic concerns.

Pseudoscience: I will consider pseudoscience to roughly mean any claim that is presented as scientific yet does not adhere to scientific evidentiary procedures and traditions. I have much more to say about this in Chapter 2. For the time being, this definition is largely based on two philosophical positions on demarcating science from pseudoscience: (a) a family resemblance view of what science is, with the phrase "scientific evidentiary procedures and traditions" encompassing an array of constituent elements, including the extent to which the claim provides empirical knowledge and is based on coherent theoretical understanding (Pigliucci, 2013); and (b) an emphasis on the behavior of a claim's proponents rather than features of the ideas themselves (Bhakthavatsalam & Sun, 2021; Derksen, 1993). I consider science denial claims to be a subtype of pseudoscience, as science denial efforts often replace the scientific conclusions being denied with alternative empirical claims that are merely asserted to be scientific in the absence of traditional scientific evidentiary support or while explicitly ignoring contradictory evidence.

Conspiracy theory: I will treat conspiracy theories as unofficial and unwarranted claims that attribute the ultimate cause of an event, including the concealment of an event from the general public, to a clandestine and malevolent organization (Goertzel, 1994; Sutton & Douglas, 2020). The definition here is intended to try to disentangle allegations

of a conspiracy for which there is sufficient evidence to reasonably conclude the conspiracy to have occurred (e.g., the Watergate scandal of the Nixon administration; the tobacco industry's efforts to deliberately and knowingly confuse the public on the health consequences of smoking; the events of September 11, 2001 being carried out by members of Al-Qaeda) from conspiracy allegations that are more fantasy than fact (e.g., the 'Pizzagate' conspiracy that Hillary Clinton was running a child sex trafficking ring out of the non-existent basement of a pizzeria in Washington D.C.; the conspiracy theory that the events of September 11, 2001 were carried out by high-ranking members of the United States government).

Paranormal belief: Paranormal beliefs can be defined as a specific instance of category mistakes in which physical, biological, or psychological phenomena are treated as having core ontological properties exclusive to one another (Lindeman & Aarnio, 2006; 2007). The core ontological properties refer to defining characteristics of entities and events as belonging to distinct categories of being (i.e., ontologies). As such, a paranormal belief is one in which a phenomenon belonging to one core category – Lindeman and Aarnio (2006; 2007) consider the core ontologies to be a physical category, a biological category, and a psychological category – at least partially in terms that are only appropriate for conceptualizing phenomena in another category. For example, the belief that there is a direct effect of a full moon in the change in the psychology or behavior of humans is a paranormal belief under this framework because the purely physical event (i.e., lunar phases) is treated as having psychological consequences (i.e., directly affecting cognition or behavior).

Prejudice: With these definitions in mind, it should not be much of a stretch to see how the categories of pseudoscience, conspiracy theory, and paranormal belief may overlap with prejudicial beliefs as well as with each other. As a concept, prejudice has similarly been difficult to define precisely (Duckitt, 1992). Like the definitions provided above, I will simply use a loose definition here for the purpose of pragmatism. Here, I will use prejudice to refer to attitudes or beliefs about socially constructed groups of people for the purpose of negatively evaluating that group and individuals within that group. As it relates to other epistemically unwarranted beliefs, these preconceived attitudes or beliefs may take the form of claims intended to be scientific but which do not actually live up to the standards of good quality, good faith scientific endeavors, may be category mistakes (such as prejudicial claim that dehumanize or superhumanize marginalized groups), or may be attitudes or beliefs that claim a particular group of people is responsible for some state-of-affair in the world (e.g., the so-called "gay agenda").

In the next chapter I will expand on my views about the nature of pseudoscience and the demarcation problem. I will argue that progress on the demarcation problem can be made by shifting the focus of attention from the epistemic products themselves – the ideas, the claims, the propositions – to the epistemic conduct of those who propose or defend any given empirical claim. Pseudoscience, I argue, emerges from pseudoscientific behavior; that is, behavior that is not scientific but is presented as though it were. Pseudoscientific behavior can be engaged in by anyone, including people who are legitimately credentialed as scientists, and several hallmark pseudoscientific ideas did in fact emerge from within the mainstream scientific community. My elaboration on the

nature of pseudoscience will attend to the emergence of pseudoscience from within science.

In Chapter 3 I reproduce a published study describing an experiment I led investigating how people engage with evidence in the context of believing or disbelieving a secular or a religious claim. The work reported there is a replication and extension of prior work showing that religious people place a lower burden of proof before believing a religious claim (i.e.. about the efficacy of prayer healing) than they place before believing a secular claim (i.e., about the efficacy of an experimental new drug).

In Chapter 4 I reproduce a published study describing an observational study I led at the start of the COVID-19 pandemic. The aim of the research was to investigate some probable factors that may increase the willingness people had to share different kinds of COVID-19 related misinformation.

In Chapter 5 I reproduce a manuscript (currently under review) describing an original study and direct replication aimed at examining the relationship that prejudicial epistemically unwarranted beliefs have with epistemically unwarranted beliefs that are not overtly prejudicial. The research explicitly investigated the degree to which belief in prejudiced pseudoscience claims, conspiracies, and paranormal beliefs covaries with belief in non-prejudiced pseudoscience claims, conspiracies, and paranormal beliefs. Furthermore, the research investigated a small array of theoretically relevant social and cognitive individual difference variables and whether any set of these variables contribute to an underlying socio-cognitive profile associated with any networks of epistemically unwarranted beliefs.

Finally, in Chapter 6 I report and analyze qualitative data on how people reason about their beliefs concerning a subset of epistemically unwarranted beliefs that were examined in the studies reported in Chapter 6. I describe the themes that emerged in peoples' explicit reasons for justifying their beliefs. I then further describe themes that emerged when people were asked to imagine reasons that would challenge their beliefs. I finally examine whether the themes people expressed in their explicit reasoning are associated with any of the individual difference measures reported on in Chapter 5.

In the concluding Chapter, I make speculative inferences about what the research in this dissertation can say about mitigating the endorsement and spread of epistemically unwarranted beliefs.

1.1 References

Bhakthavatsalam, S. & Sun, W. (2021). A Virtue Epistemological Approach to the Demarcation Problem with Implications for Teaching about Feng Shui in Science Education. *Science & Education, 30*(6), 1421-1452.

Derksen, A. A. (1993). The seven sins of pseudo-science. *Journal for General Philosophy of Science/Zeitschrift Für Allgemeine Wissenschaftstheorie*, 17-42.

Duckitt, J. H. (1992). *The Social Psychology of Prejudice*. New York: Praeger.

Goertzel, T. (1994). Belief in conspiracy theories. *Political Psychology, 15*, 731–742.

Hansson, S. O. (2009). Cutting the Gordian knot of demarcation. *International Studies in the Philosophy of Science, 23*(3), 237-243.

Lindeman, M., & Aarnio, K. (2006). Paranormal beliefs: Their dimensionality and correlates. *European Journal of Personality, 20*, 585–602.

Lindeman, M., & Aarnio, K. (2007). Superstitious, magical, and paranormal beliefs: An integrative model. *Journal of Research in Personality, 41*(4), 731-744.

Lobato, E. J. C., Mendoza, J., Sims, V., & Chin, M. (2014). Examining the Relationship between Conspiracy Theories, Paranormal Beliefs, and Pseudoscience Acceptance among a University Population. *Applied Cognitive Psychology, 28*(5): 617–625.

Pigliucci, M. (2013). The Demarcation Problem. A (Belated) Response to Laudan. In Massimo Pigliucci and Maarten Boudry (Eds.), *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem*, pp. 9-28. University of Chicago Press.

Sutton, R. M., & Douglas, K. M. (2020). Conspiracy theories and the conspiracy mindset: Implications for political ideology. *Current Opinion in Behavioral Sciences, 34*, 118-122.

Chapter 2 Scientific Fraud is Pseudoscience

2.1 Introduction

Identifying the criteria of pseudoscience has been an ongoing effort in the philosophy of science for over half a century, as part of the demarcation problem. Throughout this time, several scholars interested in the demarcation problem have proposed criteria to identify pseudoscience in a manner that exempts claims presented as scientific that emerge out of scientific misconduct such as fraud. In doing so, the criteria proposed by these philosophers of science produce a contradiction when arguing why cases like Freudian psychoanalysis or phrenology count as pseudoscience. To resolve this contradiction, I argue that certain bad science practices should be considered pseudoscientific behaviors and that the results of pseudoscientific behaviors are pseudoscience, aligning with attempts to demarcate science from pseudoscience based on the practitioner rather than epistemic content.

My argument is that "pseudoscience" results from putting forward some idea or claim that is not science as though it were science. Certain acts of scientific misconduct (e.g. fabricating data) put forward something that is not science (e.g., because the data is made up) as though it were science. Therefore, these acts of scientific misconduct are pseudoscientific, and the ideas or claims that result from these behaviors are pseudoscience. Further, pseudoscience is produced by pseudoscientists, and therefore people who engage in certain acts of scientific misconduct, such as data falsification, are pseudoscientists.

Throughout this paper, I will focus specifically on the deliberate fabrication of data or results within a scientific context. While the argument I have outlined above is broad enough to encompass other bad science practices—plagiarism (Lesk, 2014), p-hacking (Head et al., 2015)—not all bad science practices are equal in terms of the pretentions of science they put forward. I am using "bad science practices" here to denote behaviors or practices that violate standards and practices of a scientific community in ways that call into question the value of work put forward as science. Bad science practices can occur intentionally (such as via fraud) or unintentionally (such as via carelessness or poor training), and insofar as they can occur unintentionally, they may not rise to the level of scientific misconduct. Falsification of data is the most straightforward kind of scientific misconduct, as it is a behavior that cannot be attributed to poor training or honest mistake. It is one of the most egregious acts of scientific misconduct. If I cannot adequately defend my position on what pseudoscience is as it concerns falsifying data or results, then there is no reason to consider how my argument might apply to practices that could arise not just because of misconduct but because of insufficient scientific training or an honest mistake. Only if my argument can stand up to scrutiny regarding fabricated data or results would it be worth considering how adequately my argument could generalize to other bad science practices. However, for the moment, I will focus exclusively on falsifying data or results.

To clarify my position, I do not mean to imply that only the fabrication of data or results should be considered pseudoscience, nor do I wish to imply that anyone who fabricates data or results should only be considered a pseudoscientist. There are other ways to misrepresent nonscience as science, and pseudoscientists are capable of being accurately described with multiple different labels, including as scientists. I am also not

making an argument that what constitutes pseudoscience concerns any presumed or even demonstrable mental states of any person attempting to present an idea, a claim, or a study as science. My argument is that identifying what counts as pseudoscience benefits by attending to behavior, and to illustrate this I am starting with the behavior of fabricating data, independent of the attitudes or mental states of a person who chooses to fabricate data. My intentions with this argument are threefold. After reviewing the history of the demarcation problem in Sect. 2, I will call attention to an apparent contradiction in the demarcation literature about the nature of pseudoscience and the treatment of scientific fraud in Sect. 3. In Sect. 4 I will offer a resolution to that contradiction by extending a practitioner-centered demarcation approach to scientific fraud. I will also compare and contrast the approach I am advocating with other practitioner-centered demarcation approaches. Finally, assuming my attempt at resolving this contradiction is worth the paper this is printed on (or the server space the digital version of this is stored on), in Sect. 5 I advocate for more epistemic humility on the part of scientists and philosophers concerning the treatment of science and pseudoscience and move past a treatment of pseudoscience that is merely a manifestation of an in-group/out-group bias. Increased epistemic humility may increase the acceptance of proposals aiming to improve the standards and practices of the scientific community in ways that can help combat pseudoscience generally and science fraud in particular.

2.2 A history of the demarcation problem

It is perhaps impossible to wax philosophical on the demarcation problem without acknowledging Karl Popper's notion of falsifiability, if for no other reason than because as far as many non-philosophers are concerned, falsification is the alpha and omega of demarcating science from pseudoscience. If many of the science courses I have taken throughout my education are any indication, I suspect quite a few scientists are unaware that other philosophers of science even exist. As such, I might as well start a literature review on the demarcation problem with Popper. For Popper (1962), what made a claim scientific was that it resulted in making risky predictions; that is, predictions about the nature of observations that could be gathered and, therefore, refute the claim. There are, of course, problems with falsification as a sufficient condition to demarcate science from pseudoscience. Notably, any claim which has been falsified is necessarily falsifiable, but it would seem peculiar to consider a claim of a geocentric solar system to be scientific by today's standards of knowledge. Additionally, it is trivially easy to frame any nonsensical claim in a way that gives the appearance of falsifiability. An example, used by Bhakthavatsalam and Sun (2021), is that creationists do this with claims that the earth is 6,000 to 10,000 years old. That is, in theory, a falsifiable claim, yet no amount of evidence to the contrary seems to sway the minds of creationists. Thus, while falsifiability may be a feature of some good scientific claims, it is not alone sufficient to judge a claim as scientific.

Philosophers have thus made many additional contributions to our understanding of the nature of both science and pseudoscience beyond falsification. For example, Thomas Kuhn (1970/2012) argued that the level of analysis to attend to—for understanding science as distinguished from pseudoscience—is how science operates at the level of a community, rather than at the level of the claim. Communities of scientists work under dominant paradigms attempting to understand and explain curious aspects of

nature, and in the process of doing so, anomalies crop up that fail to be neatly explained under a given discipline's dominant paradigm. Over time, there is an accumulation of anomalies that create a schism in that scientific community and the potential for paradigm shifts to occur. Later still, Imre Lakatos (1978) suggested demarcating science from pseudoscience based on whether or not the research program is progressive. A research program, according to Lakatos, contains a hard core and a set of auxiliary hypotheses. Whereas the hard core is directly untestable, it is the auxiliary hypotheses that "bear the brunt of tests and get adjusted and re-adjusted, or even completely replaced, to defend the thus-hardened core" (p. 48). Progressivism, for Lakatos, meant that science is a process of generating new theories over time that do not just explain our observations, including anomalous observations, but also generate new predictions that lead to new facts.

Although there was interest in the demarcation problem over the span of decades, there was very little agreement among philosophers as to the features of either science or pseudoscience in helping understand why, for example, Einstein's theories were scientific while Freud's were pseudoscientific. This led to Larry Laudan (1983) declaring the demise of the demarcation problem in a paper aptly titled "The Demise of the Demarcation Problem." His argument, which echoed criticisms of other philosophers, draws attention to science being quite pluralistic, encompassing a wide variety of both contents and methods. This pluralism, according to Laudan, makes the task of finding jointly necessary and sufficient conditions to demarcate science from nonscience impossible. He additionally noted that philosophers of science had thus far failed to agree on anything demarcating science from pseudoscience, which he took as evidence that the concept of pseudoscience was a "hollow phrase" doing "emotive work" (p. 125) rather than scholarly work.

Despite Laudan calling for the demise of the demarcation problem, philosophers did not actually stop caring about the demarcation problem. Philosophers are feisty like that. Around the mid- to late-2000s, there was a particular resurgence of interest by philosophers in the demarcation problem. This is perhaps due to events in the late 90s and early 2000s that demonstrated how little the general population knew about science at all—not just science facts but what science *is*.

For example, there was a rise in anti-vaccine sentiments after the then-physician Andrew Wakefield managed to get fraudulent data published in The Lancet in 1998 that served as the basis for an alleged causal link between pediatric vaccines and the development of autism spectrum disorders (Dubé, Vivion, & MacDonald, 2015). There was also the increasingly politicized nature of conversations around global warming, driven by conservative and libertarian thinktanks attempting to discredit climate science findings and by a media landscape in the 90s that gave equal airtime to global warming deniers as it did to climate scientists in the name of "balanced" reporting (Oreskes & Conway, 2010). Additionally, there were conservative efforts throughout the early 2000s to legally force the teaching of creationism in U.S. public schools, either in addition to or instead of evolutionary theory, through the introduction of what were called "academic freedom" bills (Binns, 2013).

Some philosophers observing the discussions surrounding these issues figured they have a responsibility to try and help people figure out how to tell science from pseudoscience. This appears to be what motivated the philosopher Massimo Pigliucci

(2010) to wade into these issues: "Given the power and influence that science increasingly has in our daily lives, it is important that we as citizens of an open and democratic society learn to separate good science from bunk" (p. 4). This renewed interest in the demarcation problem brought forward new attempts to demarcate science from pseudoscience.

Several philosophers, including Pigliucci, have taken up the strategy of proposing Wittgensteinian family resemblance demarcations of science and pseudoscience. This approach involves putting forward a set of characteristics that connect various instantiations of a concept, such as "pseudoscience", with different characteristics having greater or lesser relevance for a given instantiation of the concept. Pigliucci (2013) starts his family resemblance framework noting that two features we can look at to determine how scientific an idea is are the amount of theoretical coherence—the internal coherence or logic of the idea—and the richness of relevant empirical data for the idea or domain or discipline. Pigliucci also stated that this contribution was intended to start a conversation rather than to end one. He acknowledged that the two dimensions he proposed could be deconstructed into even more fine-grained dimensions and that other dimensions may be added to the list.

Other contributions to the demarcation problem have attended to different aspects of pseudoscience. Sven Hansson (2009, 2013) focused on the role of the epistemic warrant in demarcating science from pseudoscience. The idea here is that a claim has epistemic warrant, and is therefore scientific, if the sum of relevant evidence at a given point in time supports the claim. This allows for legitimate scientific controversy in cases where, for instance, the totality of relevant evidence is ambiguous or inconclusive. This also opens the door for ideas to change in how scientific they are, as the corpus of evidence changes over time.

Maarten Boudry (2022) has put forward the suggestion that the pseudoscience concept needs to be regarded as the simulacra of science, where the doctrines are not epistemically supported but proponents work to create the pretense that they are. Angelo Fasce (2019) has likewise put forward that "mimicry of science is a necessary requirement to be pseudoscience, given that this is its distinctive feature as a subclass of non-science" (p. 166). By characterizing pseudoscience as simulacra and mimicry, we can start to foreground the idea that different pseudoscience claims are differentially successful at coming across as science.

After all, mimics would likely not exist at all if mimicry never worked. Despite efforts to superficially appear scientific, some pseudoscience claims such as homeopathy and creationism will not be considered science by the scientifically-literate. Proponents of such ideas do a poor job of mimicking science to anyone familiar with how science tends to work, despite having success in convincing people with poorer scientific literacy that the claims are in fact scientific. However, some pseudoscience claims, such as race science, are taken as legitimate areas of scientific inquiry in several corners of various scholarly communities. The race scientists' pretentions of science are more convincing, even to some people who have a high degree of scientific literacy (Panofsky, 2014; Saini, 2019; Winton, 2020). Further, the claim by Andrew Wakefield of a link between childhood vaccines and later developing health disorders was taken very seriously by the medical community, until multiple independent investigations failed to substantiate Wakefield's claims. Only years later was it discovered that Andrew Wakefield falsified

the data he reported. Indeed, it took 12 years before his fraud was finally fully retracted from The Lancet in 2010. His simulacrum of science was quite successful, by any standard, as it did divert a lot of professional attention and resources to investigating his false claim.

2.3 A Contradiction: Fraud versus Freud

Regardless of the specifics of what the above-reviewed philosophers have proposed about demarcating science from pseudoscience, there is the question of how to address the issue of scientific fraud and hoaxes. A common treatment by philosophers of science is to exempt scientific fraud from being included as pseudoscience. James Ladyman (2013) exempts fraud by saying that

> "in science fraud, it is not the avowed methodology, the nature of the subject, and the kinds of theories that in question… the fakery of pseudoscience is more profound than the mere faking of results; it is the nature of the enterprise and its methods that are falsely pretended to be scientific." (p. 48)

Ladyman goes on to say that science fraud is certainly unscientific, but he removes it from consideration as pseudoscientific, despite fraud being quite literally pretentious. For him, "pseudoscience is largely characterized not by a desire to mislead about how things are (as with science fraud) but by failing to say anything much at all about how things are" (p. 57). Hansson (2013) likewise exempts fraud by stating that pseudoscience needs to be part of a deviant doctrine rather than a scientific doctrine. Boudry (2022) agrees, saying that fraud does not count as pseudoscience because fraud emerges within the safe confines of an established scientific theory.

This, to me, creates a contradiction, as there are clear examples of mainstream scientific communities developing and promoting ideas despite those ideas being unscientific, even by the standards of the era they arose in. Freudian psychoanalysis is a frequent example of a pseudoscience within the philosophy of science literature (e.g., Popper, 1960; Derksen, 1993; Boudry, 2022). However, Freudian psychoanalysis did not merely emerge within the safe confines of an established scientific theory, but *was itself* considered an established scientific theory taken seriously by mainstream academics and scholars for decades, even while still being subjected to justified critique from within the scientific community (Frosh, 2006; Jenness, 2017). It took some time before Freud's theories were relegated to the status of pseudoscience.

As a second example, consider phrenology, the pseudoscience alleging that a person's cognitive abilities and personality traits could be ascertained by measuring the size and shape of that person's skull. Despite being subjected to intense and justified scrutiny by scholars, physicians, and scientists in the 19th century after it was first introduced (originally called "organology"), phrenology was considered acceptably mainstream science for decades and later inspired aspects of subsequent pseudoscientific ideas such as eugenics (Hilts, 1982). Even throughout the first quarter of 21st century, there are still scientists employed at reputable institutions of higher education in psychology, anthropology, or neuroscience departments who publish manuscripts supportive of phrenological assumptions and conclusions in mainstream scientific journals, often in service of advancing race science (see, e.g., Miller & Penke, 2007; Rushton & Rushton, 2003).

Pseudoscience, therefore, does appear to occasionally arise from within and are maintained by mainstream scientific communities as scientific doctrines and theories, contrary to the position adopted by philosophers like Hansson (2013) or Boudry (2022). Indeed, several ideas and even disciplines within science today are critiqued as pseudoscience, such as the Integrated Information Theory of consciousness (IIT-Concerned, 2023) or the entire discipline of evolutionary psychology (Smith, 2020).

To resolve this seeming contradiction, either Freudian psychoanalysis and phrenology should no longer be considered pseudoscience, or calling something pseudoscience should not require the claim to have emerged outside of the scientific community. I am not of the mind to try and argue that Freudian psychoanalysis or phrenology are not pseudoscience. They are. I am therefore left to argue that pseudoscience can, but does not necessarily have to, emerge from within the confines of mainstream science. If this is the case, then I feel it necessary to revisit the status of scientific fraud vis-à-vis pseudoscience. The fabrication of data or results cannot be scientific because science is generally considered an approach to understanding the natural world. Fabricated data or results are, by definition, not representative of the natural world. As such, scientists who seek to have falsified data or fabricated images or the like be taken as representing some aspect of the natural world are pushing pseudoscience.

Before continuing, I want to make two minor clarifying points. First, all of the above-quoted authors who exempt science fraud from the category of pseudoscience consider science fraud problematic. I can find no evidence in any of the work by those authors that I have read that they diminish the severity of science fraud as a problem. Second, it is worth noting that the quotes above represent what I observe to be a common view among contemporary philosophers of science in their treatment of science fraud. However, it is not universally accepted, and other philosophers have expressed views about demarcating science and pseudoscience that allow for pseudoscience to emerge from mainstream science in ways that align with the argument I am putting forward. Martin Mahner (2007), for example, acknowledges that pockets of pseudoscience can emerge from mainstream science as a means by which genuine scientific endeavor can produce unreliable knowledge. Victor Moberger (2020), in arguing that pseudoscience is one manifestation of bullshit, also argued against the idea that pseudoscience arises from a deviant doctrine:

> "The fact that pseudoscientific claims often or usually conflict with scientific claims is a *symptom* of their pseudoscientificness—more precisely a symptom of epistemic unconscientiousnesss—not what *makes* them pseudoscientific." (p. 607, italics original).

Thus, my contribution to the demarcation literature is not about whether pseudoscience arises from within science. That point has been raised by philosophers already and I agree with them. Rather, I elaborate on this point because I am responding to the treatment of scientific fraud in the context of defining pseudoscience to argue that scientific fraud is one kind of pseudoscience.

Returning to the larger argument, assuming I have identified a legitimate contradiction in the demarcation literature, it is worth considering how such a contradiction originated. I suspect this seeming contradiction may stem from the

perceived ease in identifying what constitutes pseudoscience, even in the absence of agreed-upon criteria for how to do so, which several scholars have articulated.

Letrud (2022) recently examined how philosophers use "pseudoscience" when referring to certain alleged cases of pseudoscience. Reviewing specifically philosophy papers about pseudoscience from 1958 to 2020, and excluding examples produced by the same authors multiple times over multiple papers, Letrud tabulated the frequency with which certain ideas were referenced by the authors and whether the authors treated the idea as a pseudoscience claim, a science claim, something else such as being nonscientific, protosocience, or some other category. What Letrud found was that across philosophy dealing with pseudoscience, authors referenced 511 different topics in their discussions, with 319 of those cases labeled as pseudoscientific. Of those cases labeled pseudoscience, about 60% of them—193 cases—were only referenced one time across the whole corpora. Outside of only a few exemplars like astrology, creationism, or homeopathy, there does not appear to be any real consistency for what gets referenced as a case of pseudoscience. Freudian psychoanalysis was the 11th most commonly used example of a pseudoscience, used by over a dozen philosophers over this period of time. Phrenology was 39th, used as an example of pseudoscience by only six philosophers. Letrud suggests that this lack of consistency or consensus on what claims get referenced as pseudoscience may contribute to the problems of the demarcation project.

Further, Letrud's own literature review documents instances of scholars positing that identifying pseudoscience is, for scholars, an easy task. From Pigliucci and Boudry (2013), "Philosophers and scientists readily recognize a pseudoscience when they see one." (p. 2). From Alan Sokal (2008), "one can distinguish (in most cases quite readily) between genuine science and pseudoscience." (p. 267). From Mahner (2013),

> "Despite the lack of generally accepted demarcation criteria, we find remarkable agreement among virtually all philosophers and scientists that fields like astrology, creationism, homeopathy, dowsing, psychokinesis, faith healing, clairvoyance, or ufology are either pseudosciences or at least lack the epistemic warrant to be taken seriously. As Hansson (2008, 2009) observes, we are thus faced with the paradoxical situation that most of us seem to recognize a pseudoscience when we encounter one…" (p. 30-31)

And from Angelo Fasce (2019),

> "There is a tacit consensus about what is scientific and what is pseudoscientific so people with the adequate motivational state can normally differentiate between both ... Accordingly, the demarcation problem can be defined as the project to justify and optimise this already existing consensus. Hence, it should not necessarily be a fuzzy task: a demarcation criterion could be restricted to discriminating between classes that are known in advance, thus offering philosophical justification to decisions that have already been made." (p. 165)

I think these quotes can clue us in to why fraud gets exempt from the concept of pseudoscience: The demarcating itself has already been done and the project is about justifying the demarcation. I find this unsatisfying because, beyond Letrud's data suggesting inconsistency in what gets referenced as pseudoscience outside of a handful of cases, such a project leaves scholars vulnerable to new pseudoscientific claims, by new simulacra of science, or to more sophisticated pseudoscience that is not readily

recognizable or as such. I unpack this in more detail in Sect. 5 in the context of epistemic humility.

2.4 Resolving the Contradiction: The Practitioner-Centered Approach

There is a perspective in the demarcation literature that I think can help us resolve the apparent contradiction. This view shifts the focus of demarcation away from the ideas themselves to focus instead on how the proponents of those ideas treat those ideas, how they work to defend them, how they respond to critique, and so on. Elements of a practitioner-centered approach to demarcation can be found as far back as Kuhn (1970/2012), who, as reviewed earlier, called attention to the behaviors of scientists as a community as key for distinguishing science from various kinds of nonscience. Derksen (1993) explicitly stated that "I place the emphasis on the pseudo-scientist, because it is a person, and not a theory or a field, who can have scientific pretensions, and who can be blamed for not making good these pretensions" (p. 21). "The seven sins of pseudo-science" that Derksen put forward draw attention to behaviors and practices rather than features of ideas. For example, Derksen wrote about the sin of a dearth of decent evidence, explaining that the pseudoscientist—in contrast to, he argued, the religious zealot—attends to the importance of evidence, but problematically does things like cherry pick data. Other sins of pseudoscience that Derksen proposed relate to the strategic ambiguity of how a pseudoscientific theory is described, where the theory can be molded in such a way as to immunize it from criticism or expanded to be an all-encompassing theory, *a la* the motte and bailey fallacy. Derksen does not seem to include anywhere in his paper that fraud is a sin. It may be read between the lines because he spends the paper talking about the many ways in which the pseudoscientist holds scientific pretentions—for example, the pretentiousness of assuming a greater reliability of their ideas than the data really warrant—but fraud is not stated outright anywhere.

More recently, an interesting suggestion has been proposed by Bhakthavatsalam and Sun (2021) expanding on the idea of focusing on the practitioner. In their paper, the authors argued that progress on the demarcation problem can be made by focusing on epistemic conduct rather epistemic products, as they claim epistemic products are the primary or sole focus found in approaches like Popper's or Pigliucci's. Bhakthavatsalam and Sun argued that identifying the intellectual virtues and vices of a cognitive agent helps distinguish between genuine science and pseudoscience. They define pseudoscience as

> "a discipline or set of ideas claiming scientific status or claiming to be (one of) the most authoritative on the subject matter at hand when the subject matter falls within the purview of science – and all or most of whose proponents exhibit in a sustained and usually organized manner, relevant intellectual vices – or fail to exhibit relevant intellectual virtues – instantiated in failings in reliably carrying out canonical scientific practices." (p. 1432-1433)

For example, Bhakthavatsalam and Sun identify the intellectual vice of obtuseness, which they associated with the vicious practice of ignoring contrary evidence. Likewise, they associated the vice of intellectual cowardice with the vicious practice of failing to test claims. These philosophers argued that an advantage of their approach is that the focus of demarcation is not restricted to fields or disciplines, but

allows for identifying individuals as pseudoscientists even if they have found their way into being accepted as a member of a scientific community. They state very clearly "If a member of a respected scientific field… is epistemically vicious in a consistent and sustained manner, we see no reason why we should not call them a pseudoscientist even though they belong… to legitimate scientific field" (p. 1434). Though these authors, similarly to Derksen, do not explicitly discuss data fabrication *per se* as a pseudoscience practice (however they do explicitly say the fraudster Andrew Wakefield qualifies as a pseudoscientist), I argue that falsifying data or results is an epistemically vicious practice that can emerge as a result of the intellectual vices Bhakthavatsalam and Sun identified and, therefore, produces pseudoscience. Most relevantly to my argument, Bhakthavatsalam and Sun identified the intellectual vices of underhandedness and dishonesty, which they associated with the respective practices of cherry-picking data and "confidently sharing with, and justifying to, others untested claims" (p. 1431). When the practice of data falsification involves a researcher selectively altering only a subset of data in a dataset, that is a variation of cherry-picking, in that the researcher selects only some specific subset the real data for inclusion while other real data is selected for alteration. Hypotheses made in a scientific paper containing wholly fabricated data are hypotheses untested by the authors despite being given the pretense of justification to the scientific community.

Fraud can happen in the context of any idea, any theory, any claim. Detecting fraud is not actually easy. It is not exactly the most difficult thing in the scientific world to do—after all, convincing Reviewer 2 to endorse a manuscript for publication when their entire review boils down to "you should have done a different study entirely" is a perennial challenge—but detecting fraud requires a particularly restrictive set of conditions that very few people ever satisfy. At the very minimum, three conditions must be met. First, a degree of relevant subject-matter expertise is required to be able to detect an error in the published scientific literature. I, for example, have a background in the disciplines of psychology and cognitive science and therefore could never reasonably be able to ferret out fraud in unrelated fields, like physics. Second, a manuscript reader has to be paying sufficient attention to detail to detect that something being presented by the author(s) of the manuscript does not add up—for example, an impossible statistic or a duplicated image. Finally, the reader then has to follow up on the noticed anomaly in the manuscript and investigate whether it is the result of their own error in reading the manuscript, an innocent human error on the part of one or more of the authors that can be corrected, or a deliberate act of misconduct. The amount of effort required to deal with authors who (justifiably, in some cases) may be defensive about inquiries into some minutiae of their research, or with editors or university staff who have additional pressure to protect the reputations of their institutions as only outputting stellar quality work can be prohibitively high. This high cost is especially true when considering that most science manuscript readers are under professional pressures to attend to other aspects of their job, such as publishing their own research, teaching their classes, mentoring their graduate students, organizing workshops or symposia, or attending the myriad wonderful and productive meetings that definitely could have been emails that the average scholar has to attend during any given week. Time spent chasing down the source of published anomalies that got through peer review is time not spent doing the things that get positively reinforced in the careers of many professional scholars.

Fraud also happens a lot. Fanelli (2009) published a meta-analysis of surveys assessing rates of questionable research practices in science, and concludes with an estimate that approximately 2% of scientists are willing to admit having falsified research at least once and approximately 14% of scientists report having observed a colleague falsify research. That is a large number of practitioners of science who commit fraud. That is a larger amount of fraud than one would suspect based just on examining papers retracted due to fabricated data or results. The Retraction Watch Database (http://retractiondatabase.org/)—a database kept by the creators of Retraction Watch, a blog owned by the Center for Scientific Inquiry, the aim of which is to increase transparency surrounding article retractions and related phenomena in academic publishing (e.g. corrections)—contains, as of this writing, over 44,000 total entries, with only around 2,000 entries detailing retraction notices due to the fabrication or falsification of data, images, or results. For context, over 3 million peer-reviewed English-language academic articles are published each year (Johnson, Watkinson, & Mabe, 2018).

Fraud can happen in any legitimate scientific area, there is evidence to suggest that fraud happens a lot, and fraud is hard to detect. I can understand the impulse to not want to consider fraud while grappling with the demarcation problem, but it is inconsistent to consider psychoanalysis or vaccine denialism or phrenology to be pseudosciences while presuming that pseudoscience cannot emerge from the confines and doctrines of mainstream science. If we accept that some ideas that are or were at some time considered scientific by the scientific mainstream are in fact pseudosciences—and should have been considered as such even by the scientific standards of the day—then we have to consider data fabrication as a surprisingly successful avenue for the promotion of some pseudoscientific ideas.

The behavior-focused practitioner-centered approach I am arguing for can be compared and contrasted with other practitioner-centered approaches to demarcation that focus more on the attitudes or mental states of practitioners. Lee McIntyre (2019), for example, has argued that rather than examine the products or methods of science as a way to differentiate science from nonscience, what is special about science is that scientists are committed to a scientific attitude, which he described as an attitude centered on principles of caring about empirical evidence and revising theories in response to new evidence. McIntyre's proposal for understanding what is distinctive about science is to sidestep the demarcation problem: "One need not prove that anything *with* the scientific attitude *is* science; one need only show that anything *without* the scientific attitude is *not*." (p. 65, italics original). McIntyre explicitly calls out committing fraud as a direct challenge to one's stated commitment to the scientific attitude, while still recognizing that there are many motivations one has to commit fraud – ranging from ego or monetary gain to an entitled view permitting fraud as a shortcut to what a fraudster is convinced will eventually be borne out as true anyway. However, while McIntyre argues that both fraud and pseudoscience run counter to the scientific attitude, he still treats them as distinct. Fraud, to McIntyre, is a result of accepting scientific standards and then deliberately violating them, whereas pseudoscience in McIntyre's view results from either misunderstanding or indifference to scientific standards.

Here is where an attitude-based approach such as McIntyre's differs from the behavior-based view I am advocating. While humans typically have immensely powerful

theory of mind capabilities, allowing us to ascertain or estimate, with reasonable accuracy, the mental states of other cognitive agents on the basis of social cues, social signals, experience, and memory (Frith & Frith, 2012), humans are not actually capable of reading minds, to my knowledge. As such, an attitude-based approach to demarcating science from different forms of non-science seems to require arguing about what lie in the hearts of men. This is not an impossible task, but I do not think it is necessary for understanding how pseudoscience is demarcated from science. In a behavior-based view, one only needs to demonstrate that the observable behavior runs afoul of contemporary standards of practice within science in service of presenting some idea as though it were scientific. If one wants to, and there may be good reasons for doing so, one could then subsequently attempt to relate the behavior to preceding mental states, which is what Bhakthavatsalam and Sun (2021) attempt to do by embedding their demarcation approach in a virtue epistemological framework, linking vicious behavior to intellectual vices. Whether one chooses to do that or not, though, there are no mainstream scientific communities that have standards of practice that either advocate or permit fabricating data. An individual who fakes just a little data just to get $p < .05$ from an analysis that originally gave $p = .051$ is still someone who faked data, regardless of why.

I also need to contrast the behavior-based approach I am advocating with a similar behavior-based understanding of pseudoscience put forward by Moberger (2020). While we both consider pseudoscience to be the result of pseudoscientific behavior, Moberger nonetheless distinguishes pseudoscience from scientific fraud. He does this because his argument is that pseudoscience is one manifestation of bullshit, a concept described by Frankfurt (2005). Bullshit, according to Frankfurt, results from an indifference towards truth and so the bullshitter may end up saying things that are true, whereas a liar is concerned with and is responding to the truth so as to steer people away from it. Moberger expands on this to argue that beyond indifference to truth, bullshit is produced as a consequence of being epistemically unconscientious with the truth. As with Frankfurt's distinction between the liar and the bullshitter, for Moberger the scientific fraudster believes their fabricated data to be false whereas pseudoscientists can sometimes take their claims to be true. I agree that bullshitting, as a behavior, can result in pseudoscience when the bullshitting is done to advocate some idea as being scientifically supported. I depart from Moberger because he is carving out of consideration from the category of pseudoscience a behavior that can be nothing but a scientific pretention by appealing to underlying mental states of the pretentions' proponents. More importantly, a fraudster can believe the data they fabricated is false while still believing the claim they are trying to support with their fraudulent data is true. While, again, it may be useful to interrogate and understand the underlying mental states that motivated a pseudoscientist to promote their scientific pretention of choice, it does not appear necessary to do so in order to judge that pretention as pseudoscience.

2.5 Who is a pseudoscientist? Why does it matter?

A consequence of acknowledging that pseudoscience can emerge from within the scientific community by individuals who violate good scientific practices through actions like falsifying data is that we must reconsider who counts as a pseudoscientist. Following in the practitioner-centered approaches of philosophers like Derksen (1993), McIntyre (2019), Moberger (2020), or Bhakthavatsalam and Sun (2021), we can conclude that

some percentage of people currently credentialed and employed as professional scientists are also pseudoscientists, whatever else we consider them.

Here, I think we get to another psychological barrier that makes people hesitant to accept that scientific fraud counts as pseudoscience. Under the view I have sketched in this manuscript, there are quite a few scientists we would conclude have engaged in pseudoscientific behavior, thus making them pseudoscientists. Some examples are of people who were very prolific in their data forgeries, such as Diederik Stapel who has over 50 articles retracted on the basis of fabricated data. Others are people who have few or only one known instance of data fabrication but have persistently maintained the legitimacy of the claim they fabricated data to support, such as Andrew Wakefield who has only been discovered to have fabricated data on the 1998 Lancet article. Stapel and Wakefield are examples of people who have since been excommunicated from the scientific community, but not everyone who has been caught fabricating data has endured such a consequence. Quite a few data fakers are still employed as professional scientists at legitimate research institutions, both public and private. They are colleagues, collaborators, perhaps even friends.

While Laudan (1983) may have been wrong to declare the death of the demarcation problem, he was correct to assert that the pseudoscience concept does emotive work for us. It is pejorative, even when used accurately. By all appearances, "pseudoscientist" is comfortably deployed to describe people outside of mainstream scientific circles putting forward and defending scientific pretentions. It would likely be perceived as rude and unprofessional to start using that term for members of the scholarly in-group, even if the target of the accusation has indeed been shown to put forward nonscience as science in one the most pretentious ways possible, i.e., by fabricating data.

As a recent illustration of what I mean, albeit one that involves no accusation of fraud or data fabrication on the part of anyone involved, the Integrated Information Theory of consciousness (IIT) was described as pseudoscience in a letter signed by 124 scientists and philosophers who study consciousness (IIT-Concerned, 2023). Responses to this accusation by other philosophers and scientists included no small degree of outrage. David Chalmers posted an initial response on the website formally known as Twitter, stating "IIT has many problems. [B]ut 'pseudoscience' is like dropping a nuclear bomb over a regional dispute. [I]t's disproportionate, unsupported by good reasoning, and does vast collateral damage to the field far beyond IIT. [A]s in [V]ietnam: 'we had to destroy the field in order to save it.'" (Chalmers, 2023). In a news article published in *Nature* about the controversy, Anil Seth is quoted as saying "I think it's inflammatory to describe IIT as pseudoscience" (Lenharo, 2023). Descriptions such as "like dropping a nuclear bomb" or "inflammatory" suggest that among at least some prominent scholars, an accusation of "pseudoscience" goes far beyond an accusation of being "wrong" or even "bullshit" in a way that is just not done in polite company.

Under the view I have outlined in this manuscript, pseudoscience is not merely a problem of people outside of scholarly communities working to persuade the general public to accept some unwarranted (Hansson, 2009) or bullshit (Frankfurt, 2005) claim, thus harming the legitimacy of science. If the argument I have presented holds up to scrutiny—a big "if", I recognize—then the problem of pseudoscience is expanded to also reflect systemic failings within scientific communities that allow fraud and fabrication to successfully navigate institutionalized integrity checks (e.g., problems in peer review;

problems in reporting and investigating observed or suspected misconduct). Pseudoscience, then, joins the list of systemic problems within science alongside the replication crisis or persistent underrepresentation of marginalized communities, emerging in part or in whole because of some combination of (a) a large number of scholars unable (or unwilling) to double-check whether or not they have been duped by some of their more unscrupulous colleagues as per the conditions to detect fraud I outlined in Sect. 4; (b) a perceived incentive structure in professional science that prioritizes publishing above other responsibilities (Sigl, Felt, & Fochler, 2020); and (c) a small population of, let's face it, mostly men (Fang, Bennett, & Casadevall, 2013) who lie about how big their *Cohen's d* is.

One of the aims of my argument is to argue for increasing our own epistemic humility. Identifying pseudoscience is sometimes easy because of exemplar cases like creationism or astrology that have been the subject of a lot of attention. New attempts to smuggle in creationist rhetoric in the published scientific body of record are more likely to be caught and gatekept out of science (though the imperfect nature of peer review means that sometimes, creationist talking points still sneak through, as happened recently with a paper advocating Assembly Theory, see Sharma et al., 2023, and commentary by Bateman, 2023). However, identifying pseudoscience can also be quite difficult in other instances, sometimes because the issue receives less attention, sometimes because the issue is so new (e.g. various pseudoscientific claims about the origins of SARS-CoV-2 virus), sometimes for other reasons. I do not think that accepting the results of scientific fraud as pseudoscience will directly make the effort to combat pseudoscience easier. Nor do I think it will directly make preventing or catching fraud easier. Maybe the worry over being considered a pseudoscientist might give some tempted researchers pause before fabricating data, but that is highly speculative. Still, if work on the demarcation problem stays focused primarily on elucidating more reasons that members of the scholarly outgroup deserve to be members of the outgroup, then a fair number of non-scientific ideas that are presented as and argued to be science are going to be missed.

Rather, perhaps expanding the "pseudoscience" label to include some of the products of the scientific community may increase the receptivity to suggestions put forward to improve the quality of science, such as suggestions found in the Open Science movement for openly available data and analysis code (Vicente-Saez & Martinez-Fuentes, 2018). In recent years, several fraudsters have been detected by an examination of the raw data files (see, e.g., Simonsohn, Simmons, & Nelson, 2021; 2023). Some examples of fraud that went undetected for many years are the result of comically lazy behavior. For example, in one of multiple instances of data fabrication carried out spider behavior researcher Jonathan Pruitt, he used a second sheet in the Excel file he was keeping legitimate data in to fabricate swaths of data to get the outcomes he wanted and kept the evidence of his data fabrication in the data files he shared with his colleagues. Even then, the fraud went undetected until nearly a decade later when one of his colleagues was prompted to check on the work her colleague has done (see Laskowski, 2020). To be sure, open data and open code are only part of the equation for investigating allegations of scientific fraud so as to be eventually excised from the body of scientific record, but they are still part of the equation. The culture of science benefits by granting the resources required by scientists to properly scrutinize published work, work submitted for publication, and work conducted by our colleagues. It serves not only to aid in

detecting fraud but also to aid people in defending themselves against spurious allegations of fraud or misconduct. Falsifying data is among the most severe acts of scientific pretentiousness, and there exists a convenient category with which to label such scientific pretentions. We should use it.

While a reading of my argument could be interpreted as advocating for a single-criterion view of demarcation—it looks like science but is not—that is not what I am arguing. The nature of what is considered the acceptable standards and practices of any scientific discipline is constantly changing: new technologies for observing nature in novel ways are regularly invented, advances in computational power over time allow for analytic techniques that would have been impossible or at least unreasonable to expect scientists to adhere to decades or even years ago to be performed nigh instantaneously, and new methodologies for collecting and analyzing data are proposed, debated over, and some are eventually adopted. As a result of these changes in the behavior of scientists, the practices of science, what is considered mainstream science at one time may become nonscience at a later time (and vice versa), and the criteria by which this assessment is made will likewise differ from one time to the next. This has been recognized by other philosophers in their own writing about pseudoscience. Moberger (2020) stated that whether a claim is pseudoscientific is dependent on time-bound contextual factors. Demarcation by primarily considering epistemic products, while undervaluing or ignoring what constitutes acceptable or obligatory epistemic conduct, misses the historical contexts from which both scientific and pseudoscientific epistemic products emerge.

It is incumbent on us as scholars to be upfront about our own blind spots and weaknesses, so as to avoid the pitfall of continuing to treat the demarcation problem as an in-group/out-group dynamic. We also stand to benefit by being more assertive in protecting the integrity of science by calling out those who coopt the mantle of science from within. To paraphrase the 1974 horror movie *Black Christmas*, "the pseudoscience is coming from inside the house!" We make little progress in understanding, and therefore combatting, pseudoscientific misinformation if we cannot showcase the epistemic humility necessary to consider that some pseudoscience is remarkably successful at being treated as science *by scholars*. Any effort to exempt some scientific pretentions as not pseudoscience is doing other work than making progress on the demarcation problem, ironically making the demarcation problem more difficult. Fabricated data are harder to identify than creationist or homeopathic bullshit is, but fabricated data is no less an offense to science for much the same reason creationism and homeopathy are offensive: They all pretend to be scientific when they simply cannot be. That is the heart of what pseudoscience is.

2.6 References

Bateman, B. (November 9, 2023). A new theory linking evolution and physics has scientists baffled – but is it solving a problem that doesn't exist? The Conversation.

Binns, I. C. (2013). Academic freedom legislation: The latest effort to undermine the integrity of science and science education. *Journal of Science Teacher Education, 24*(4), 589-595.

Bhakthavatsalam, S., & Sun, W. (2021). A Virtue Epistemological Approach to the Demarcation Problem: Implications for Teaching About Feng Shui in Science Education. *Science & Education, 30*, 1421-1452.

Boudry, M. (2022). Diagnosing pseudoscience–by getting rid of the demarcation problem. *Journal for General Philosophy of Science, 53*(2), 83-101.

Chalmers, D. [@davidchalmers42]. (2023, September 18). *IIT has many problems. but "pseudoscience" is like dropping a nuclear bomb over a regional dispute. it's disproportionate, unsupported by…* [Tweet]. X. https://twitter.com/davidchalmers42/status/1703782006507589781

Derksen, A. A. (1993). The seven sins of pseudo-science. *Journal for General Philosophy of Science/Zeitschrift Für Allgemeine Wissenschaftstheorie*, 17-42.

Dubé, E., Vivion, M., & MacDonald, N. E. (2015). Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: influence, impact and implications. *Expert Review of Vaccines,* 14(1), 99-117.

Fasce, A. (2019). Are pseudosciences like seagulls? A discriminant metacriterion facilitates the solution of the demarcation problem. *International Studies in the Philosophy of Science, 32*(3-4), 155-175.

Fanelli, D. (2009). How many scientists fabricate and falsify research? A systematic review and meta-analysis of survey data. *PloS One, 4*(5), e5738.

Fang, F. C., Bennett, J. W., & Casadevall, A. (2013). Males are overrepresented among life science researchers committing scientific misconduct. *MBio, 4*(1), e00640-12.

Frankfurt, H. G. (2005). *On Bullshit*. Princeton University Press.

Frith, C. D., & Frith, U. (2012). Mechanisms of social cognition. *Annual Review of Psychology, 63*, 287-313.

Frosh, S. (2006). *For and Against Psychoanalysis*. Routledge.

Hansson, S. O. (2009). Cutting the Gordian knot of demarcation. *International Studies in the Philosophy of Science, 23*(3), 237-243.

Hansson, S. O. (2013). *Defining pseudoscience and science*. In M. Pigliucci and M. Boudry (eds), Philosophy of Pseudoscience: Reconsidering the Demarcation Problem, pp. 61-77. Chicago, IL: University of Chicago Press.

Head, M. L., Holman, L., Lanfear, R., Kahn, A. T., & Jennions, M. D. (2015). The extent and consequences of p-hacking in science. *PLoS Biology, 13*(3), e1002106.

Hilts, V. L. (1982). Obeying the laws of hereditary descent: phrenological views on inheritance and eugenics. *Journal of the History of the Behavioral Sciences, 18*(1), 62-77.

IIT-Concerned (Fleming, S. M., Frith, C., Goodale, M., Lau, H., LeDoux, J., Lee, A. L. F., Michel, M., Owen, A. M, Peters, M. A. K., Slagter, H. A., Arnold, D., Azzopardi, P., Baars, B. J., Barry, T. J., Baxter, M. G., Bekinschtein, T. A., Bengio, Y., Bisley, J., Brown, S., Buonomano, D., et al.) (2023) The integrated information theory of consciousness as pseudoscience. PsyArXiv. October 11. https://doi.org/10.31234/osf.io/zsr78

Jenness, K. (2017). The unassailable self: Freud's image among post-war American intellectuals. *Psychoanalysis and History, 19*(1), 55-75.

Johnson, R., Watkinson, A., & Mabe, M. (2018). *The STM report: An overview of scientific and scholarly publishing*. The Hague, The Netherlands: International Association of Scientific, Technical and Medical Publishers.

Kuhn, T. S. (1970/2012). *The structure of scientific revolutions*. Chicago, IL: University of Chicago Press.

Ladyman, J. (2013). *Toward a Demarcation of Science from Pseudoscience*. In M. Pigliucci and M. Boudry (eds), Philosophy of Pseudoscience: Reconsidering the Demarcation Problem, pp. 45-60. Chicago, IL: University of Chicago Press.

Lakatos, I. (1978). *The methodology of scientific research programmes: Philosopher Papers Vol. 1*. Cambridge: Cambridge University Press.

Laskowski, K. (2020, January 29). What to do when you don't trust your data anymore. *Laskowski Lab at UC Davis*. https://laskowskilab.faculty.ucdavis.edu/2020/01/29/retractions/

Laudan L. (1983). *The Demise of the Demarcation Problem*. In R.S. Cohen and L. Laudan (eds), Boston Studies in the Philosophy of Science. Physics, Philosophy and Psychoanalysis: Essays in Honour of Adolf Grünbaum, Vol. 76, pp. 111–127.

Lenharo, M. (2023). Consciousness theory slammed as' pseudoscience'-sparking uproar. *Nature*. https://doi.org/10.1038/d41586-023-02971-1

Lesk, M. (2015). How many scientific papers are not original? *Proceedings of the National Academy of Sciences, 112*(1), 6-7.

Letrud, K. (2022). Do we Know it When we See it? A Review of 'Pseudoscience' Patterns of Usage. *Episteme*, 1-18.

Mahner, M. (2007). *Demarcating Science From Non-Science*. In T. A. F. Kuipers (ed.), General Philosophy of Science: Focal Issues, pp. 515-575. Amsterdam: Elsevier.

Mahner, M. (2013). *Science and pseudoscience how to demarcate after the (alleged) demise*. Philosophy of pseudoscience: Reconsidering the demarcation problem. In M. Pigliucci and M. Boudry (eds), Philosophy of Pseudoscience: Reconsidering the Demarcation Problem, pp. 29-43. Chicago, IL: University of Chicago Press.

Miller, G. F., & Penke, L. (2007). The evolution of human intelligence and the coefficient of additive genetic variance in human brain size. *Intelligence, 35*(2), 97-114.

Panofsky, A. (2014). *Misbehaving science*. Chicago, IL: University of Chicago Press.

Pigliucci, M. (2010). *Nonsense on stilts: How to tell science from bunk*. University of Chicago Press.

Pigliucci, M. (2013). *The demarcation problem. A (belated) response to Laudan*. In M. Pigliucci and M. Boudry (eds), Philosophy of Pseudoscience: Reconsidering the Demarcation Problem, pp. 9-28. Chicago, IL: University of Chicago Press.

Pigliucci, M., & Boudry, M. (2013). *Why the demarcation problem matters*. In M. Pigliucci and M. Boudry (eds), Philosophy of Pseudoscience: Reconsidering the Demarcation Problem, pp. 1-6. Chicago, IL: University of Chicago Press.

Popper, K. (1962). *Conjections and refutations: The growth of scientific knowledge*. New York: Basic Books.

Rushton, J. P., & Rushton, E. W. (2003). Brain size, IQ, and racial-group differences: Evidence from musculoskeletal traits. *Intelligence, 31*(2), 139-155.

Saini, A. (2019). *Superior: the return of race science*. Beacon Press.

Sharma, A., Czégel, D., Lachmann, M., Kempes, C. P., Walker, S. I., & Cronin, L. (2023). Assembly theory explains and quantifies selection and evolution. *Nature*, 1-8.

Sigl, L., Felt, U., & Fochler, M. (2020). “I am Primarily Paid for Publishing…”: The Narrative Framing of Societal Responsibilities in Academic Life Science Research. *Science and Engineering Ethics, 26*(3), 1569-1593.

Simonsohn, U., Simmons, J. & Nelson, L. (2021, August 17). Evidence of Fraud in an Influential Field Experiment About Dishonesty. *Data Colada*. https://datacolada.org/98

Simonsohn, U., Simmons, J. & Nelson, L. (2023, June 17). Data Falsificada (Part 1): “Clusterfake.” *Data Colada*. https://datacolada.org/109

Smith, S. E. (2020). Is evolutionary psychology possible? *Biological Theory, 15*(1), 39-49.

Sokal A. (2008). *Beyond the Hoax: Science, Philosophy and Culture*. Oxford: Oxford University Press.

Vicente-Saez, R., & Martinez-Fuentes, C. (2018). Open Science now: A systematic literature review for an integrated definition. *Journal of Business Research, 88,* 428-436.

Winston, A. S. (2020). Why mainstream research will not end scientific racism in psychology. *Theory & Psychology, 30*(3), 425-430.

Chapter 3 Religiosity Predicts Evidentiary Standards

3.1 Introduction

Multiple lines of research find that religious believers and non-believers are likely to differ in their cognitive dispositions and reasoning abilities. For example, avowed believers, in comparison to non-religious individuals, evince stronger tendencies to attribute agency and intentionality to natural processes (Crespi & Badcock, 2008), and show poorer abilities to understand nature in mechanistic terms (Baron-Cohen, 2002; Lindeman & Lipsanen, 2016). Similarly, strength of religious belief has been found to predict the likelihood of a person discounting base rate information in favor of intuitions in reasoning problems (Pennycook, Cheyne, Barr, Koehler, & Fugelsang, 2014). Additionally, religious believers are less likely than non-believers to be able to consistently distinguish between good reasons and bad reasons for beliefs about the existence of God (Cardwell & Halberstadt, 2019).

Several researchers have suggested that, in general, religious individuals may be less inclined to evaluate information critically, and may be more reliant than non-believers on an intuitive cognitive style and the use of cognitive heuristics than on a reflective, analytical cognitive style (Browne, Pennycook, Goodwin, & McHenry, 2014; Gervais & Norenzayan, 2012; Pennycook et al., 2014; Pennycook, Ross, Koehler, & Fugelsang, 2016; Shenhav, Rand & Greene, 2012). However, it should be noted that studies using the Cognitive Reflection Test (CRT; Frederick, 2005) as a measure of participants' dispositions towards analytical thinking have not consistently replicated the association between religiosity and analytical cognitive style (see Finley, Tang, & Schmeichel, 2015; Sanchez, Sundermeier, Gray, Calin-Jageman, 2017). Nevertheless, research generally converges on the finding that religious believers and non-believers differ in their cognitive dispositions.

Such differences in the cognitive dispositions of religious believers and non-believers may help explain why believers are generally less scientifically literate (Sherkat, 2011) and identify less with science (Rios, Cheng, Totton, & Shariff, 2015) than non-believers, despite the tendency for many scientists and members of the general public to believe there is no conflict between science and religion (Ecklund, Johnson, Scheitle, Matthews, & Lewis, 2016; Scheitle & Ecklund, 2017). The apparent disconnect between religiosity and scientific literacy or identification with science may be driven by differences in how religious and non-religious individuals set evidentiary standards for claims about the world (McPhetres & Zuckerman, 2017).

Beyond differences in cognitive style, religious and scientific claims also inherently differ in their falsifiability. Scientific claims are evaluated in terms of their concordance with empirical observations (Popper, 1959), and scientists confronted with inconsistent data will eventually develop new theories (Kuhn, 1970). By contrast, religious beliefs that make factual claims appear equipped with epistemological escape clauses that reframe apparent contradictions in ways that preserve belief (Boudry & Braeckman, 2012; Friesen, Campbell, & Kay, 2014; von Leeuwan, 2017).

Differences in the cognitive and reasoning abilities of religious believers and non-believers, as well as differences in the characteristics of religious and scientific claims, reveal a need to explore how people set evidentiary standards for believing a given claim. Exploring factors that influence how people evaluate religious and scientific claims in

light of empirical evidence is important for contributing to an understanding of religious and non-religious beliefs, as well as scientific literacy.

McPhetres and Zuckerman (2017) designed a novel method used across three studies to assess whether religious people differ regarding the amount of supporting evidence needed to believe either religious or scientific claims. In Study 1, participants read a brief vignette about a group of people trying to cure ill people using either a new medicine (i.e., a scientific method) or prayer (i.e., a religious approach). Participants read that this group has already tested their approach on one ill person who was subsequently cured. Afterwards, participants were asked how many additional people would need to be cured before they could confirm the approach being used was responsible for the effect. McPhetres and Zuckerman found that, relative to non-believers, religious participants required fewer instances in which prayer coincided with recovery to confirm the efficacy of prayer. Religious participants also required less evidence to confirm a claim about prayer healing relative to a scientific claim about medication efficacy. By contrast, the standard of evidence required to believe scientific claims was not significantly different between religious and non-religious participants. McPhetres and Zuckerman repeated this design to assess how people evaluated evidence for religious and scientific claims for predicting the outcome of coin tosses and for identifying a guilty suspect in a criminal investigation, finding similar patterns of results for both subsequent studies. These results are suggestive that religious believers are more credulous toward religious claims but not more doubtful of scientific claims, but these results are limited to evidence supporting a claim.

In a pre-registered replication study (http://osf.io/evhzu), we aim to extend the results of the first study reported in McPhetres and Zuckerman (2017) by exploring how religious and non-religious individuals treat disconfirming as well as supporting evidence. Disconfirming or contradictory evidence plays a central role in scientific discovery and advancement, driving the refinement or overturning of accepted scientific theories (Kuhn, 1970; Popper, 1959). In addition, in daily life, people regularly and immediately update their beliefs about mundane matters in response to contradictory evidence. By comparison, empirical religious claims do not typically get updated by believers in response to contradictory evidence (von Leeuwen, 2017).

If there is a general bias by religious individuals to believe religious claims, we would expect results consistent with McPhetres and Zuckerman (2017) regarding supporting evidence. Moreover, we would also expect religious individuals to require a greater number of failed replications before discounting a religious claim relative to a scientific claim. As such, we hypothesized that religious individuals would require fewer successful replications to be certain of a religious claim than for being certain of a scientific claim. We further hypothesized that religious individuals would need more failed replications before discounting a religious claim than would be needed to discount a scientific claim.

3.2 Methods

3.2.1 Participants

To account for possible overestimations of effect sizes in the original study, we set a target sample size per cell of 200% the sample size reported by McPhetres and Zuckerman. We initially recruited 847 participants through Amazon's Mechanical Turk,

in exchange for $.60 per participant, although 78 were never finished, resulting in an initial sample of 769. Because of recent concerns that Mechanical Turk participants may be using scripts or bots to complete studies automatically (Dreyfuss, 2018), we pre-registered exclusionary criteria to filter out data of questionable quality. Of the initial 769 participant data sets collected using these criteria, we further screened out data sets with missing responses, multiple datasets originated from the same IP address, and datasets that failed attention check items. Our final sample included 703 participants (M_{age} = 38.8 years, SD_{age} = 11.6 years, male = 378, female = 325). There were 396 participants who reported being non-religious, and 307 who reported being religious.

3.2.2 Materials

We adapted vignettes created by McPhetres and Zuckerman for our replication. Participants were randomly assigned to read one of four vignettes of a group of people trying to cure an illness. In the "science" domain condition, participants read about a group of scientists testing a medicine to see if it will treat an illness. In the "religion" domain condition, participants read about a group of people praying to God to see if it will treat an illness. In both conditions, participants are told that the group has tested the technique on one person who was cured. Then, participants are randomly assigned to respond to a question asking about how much evidence it would take before participants could be certain the medication or prayer did or did not work. In the "successful replication" condition, participants were asked how many additional people would need to be cured before they could be certain the medication or prayer was responsible for curing the illness. This condition recreates the design of McPhetres and Zuckerman (2017). In the "failed replication" condition extending the design of McPhetres and Zuckerman, participants were asked how many people would need to remain ill before they could be certain the medication or prayer does not cure the illness.

Participants also responded to a six-item religiosity measure used in McPhetres and Zuckerman's original studies and adapted from previous research on religiosity (α = .97; Cohen, Shariff & Hill, 2008). Participants rated how much they agreed or disagreed with statements such as "My faith or religion is an important part of my identity" on a 7-point Likert scale (1 = Strongly disagree; 7 = Strongly agree). In addition, participants responded to individual difference measures to explore possible moderation of evidentiary standards for confirming or rejecting a scientific or religious claim. These exploratory analyses are included in the Supplemental Online Material (SOM). The individual difference measures included (a) the Credibility of Science Scale (Hartmann et al., 2017); (b) a modified Political Issues Index (Dodd et al., 2012; Holbrook, López-Rodríguez, & Gómez, 2018); (c) the Conspiracy Mentality Questionnaire (Bruder et al., 2013); and (d) a modified Inclusion of Other in Self Scale (Holbrook et al., 2018).

3.2.3 Procedure

The design and procedure of this study were adapted from Study 1 reported by McPhetres and Zuckerman (2017). Our study employed a 2 (domain: science, religion) x 2 (evidence type: successful replication, failed replication) x 2 (participant religiosity: religious, non-religious) between-subjects design in which participants were randomly assigned to read a scenario describing a group of people curing an individual with either a scientific method (i.e., medicine) or a religious method (i.e., prayer; see SOM). After reading

through the vignette, participants were asked to respond to one question about either (a) how many successful replications would be needed for them to confirm the proposed causal mechanism or (b) how many failed replications would be needed for them to reject the proposed causal mechanism.

Next, participants responded to (a) a question asking whether they consider themselves to be religious; (b) the six-item religiosity measure (Cohen et al., 2008); and (c) a demographics form, presented in a fixed order. All of this constitutes a direct reproduction of the procedure used by McPhetres and Zuckerman. Following the primary measures of interest, participants then completed the individual difference measures described above for preregistered exploratory analyses (see SOM). Importantly, the effects of religiosity reported in what follows obtain when controlling for covarying individual differences in political orientation and the other trait measures (see SOM for analyses).

3.3 Results

To test for differences in evidentiary standards, we conducted a 2 (domain: science, religion) x 2 (evidence type: successful replication, failed replication) x 2 (religiosity: religious, non-religious) between-subjects ANOVA (see Figure 1). The data were heteroscedastic, therefore we subjected the data to a non-parametric Kruskall-Wallis analysis as well. Except where noted, results were consistent across both parametric and non-parametric analyses (see SOM). Results revealed significant main effects of domain [$F(1, 695) = 37.28$, $p < .001$, $\eta^2_p = .05$] and evidence type, $F(1, 695) = 15.85$, $p < .001$, $\eta^2_p = .02$. These main effects were qualified by several significant interaction effects. Results revealed a significant domain by evidence type two-way interaction [$F(1, 695) = 7.71$, $p = .006$, $\eta^2_p = .01$], a significant evidence type by religious two-way interaction [$F(1, 695) = 27.07$, $p < .001$, $\eta^2_p = .04$] and a significant domain by evidence type by religious three-way interaction, $F(1, 695) = 15.18$, $p < .001$, $\eta^2_p = .02$ (see Table 1 for descriptive statistics). Sensitivity analysis conducted using G*Power (Faul, Erdfelder, Bucher, & Land 2009) with power set to .80 and α set to .05 revealed our analysis was powered sufficiently to detect effect sizes as small as f = .10, corresponding roughly to $\eta^2_p = .01$.

3.3.1 Treatment of supportive evidence by religious and non-religious individuals

Follow-up pairwise comparisons revealed that our results mostly replicated the findings of McPhetres and Zuckerman (2017) regarding the number of successful replications required before confirming scientific and religious claims (see Figure 1). We found that religious participants required fewer successful replications to confirm a religious claim than to confirm a scientific claim, $p < .001$, $\eta^2_p = .04$. Religious participants needed fewer successful replications

Table 1. Mean (SD) Successful Replications/Failed Replications Requested for Scientific Versus Religious Claims by Religious or Non-religious Participants.

	Successful Replications		Failed Replications	
Participants	*Science*	*Religion*	*Science*	*Religion*
Religious	8.36 (3.83)	4.53 (3.88)	6.66 (4.03)	7.00 (4.40)
	n = 61	n = 77	n = 102	n = 67
Non-religious	9.48 (3.50)	7.76 (4.35)	6.96 (4.05)	4.54 (4.09)
	n = 87	n = 124	n = 105	n = 80

to confirm a religious claim than non-religious participants did, $p < .001$, $\eta^2_p = .04$. Likewise, our results showed that non-religious participants and religious participants did not significantly differ in the number of successful replications needed before confirming a scientific claim, $p = .097$, $\eta^2_p = .004$. However, whereas McPhetres and Zuckerman did not find that non-religious participants needed significantly different numbers of successful replications for scientific or religious claims in spite of a trend in that direction, we found that non-religious participants needed significantly more successful replications to confirm a scientific claim than to confirm a religious claim, $p = .002$, $\eta^2_p = .01$ (non-parametric analyses produced a non-significant comparison between these groups, see SOM). This discrepancy between our results and those of McPhetres and Zuckerman (2017) is likely due to differences in power. Overall, participants needed more successful replications to confirm a scientific claim than a religious claim and the most evidence required was by non-religious participants for a scientific claim. The pattern of results here is nearly identical to the pattern of results reported by McPhetres and Zuckerman (2017), suggesting that when it comes to evaluating supporting evidence for a claim, there appears to be a bias favoring the believability of religious claims among religious individuals. Interestingly, there may be a similar bias towards believing religious claims among non-religious individuals as well.

3.3.2 Treatment of disconfirming evidence by religious and non-religious individuals

Contrary to our hypothesis, religious participants did not need significantly more failed replications before rejecting a religious claim relative to the number of failed replications required before rejecting a scientific claim, $p = .589$, $\eta^2_p < .001$ (see Figure 1). However, non-religious participants reported needing significantly fewer failed replications before rejecting a religious claim relative to a scientific claim, $p < .001$, $\eta^2_p = .02$. Furthermore, non-religious participants and religious participants did not significantly differ in the number of failed replications required before rejecting a scientific claim, $p = .587$, $\eta^2_p < .001$. These results suggest non-religious individuals may have a bias in favor of rejecting religious claims.

3.3.3 Differences between supportive and disconfirming evidence across domains

We conducted exploratory follow-up pairwise analyses to further examine potential differences by religious and non-religious participants in their treatment of supportive versus disconfirming evidence. Non-religious participants needed more successful replications to confirm a scientific claim than failed replications needed to reject a scientific claim, $p < .001$, $\eta^2_p = .03$. This same pattern was true for non-religious participants' treatment of a religious claim, $p < .001$, $\eta^2_p = .04$. This suggests that non-religious participants may just generally be more skeptical, regardless of domain, and find less disconfirming evidence sufficient to reject claims.

By contrast, religious participants needed more successful replications to confirm a scientific claim than failed replications needed to reject a scientific claim ($p = .009$, $\eta^2_p = .01$), whereas they needed fewer successful replications to confirm a religious claim than failed replications to reject a religious claim, $p < .001$, $\eta^2_p = .02$. The evidentiary standard religious participants held for rejecting either claim fell between the high standard they had for believing a scientific claim and the low standard they had for believing a religious claim.

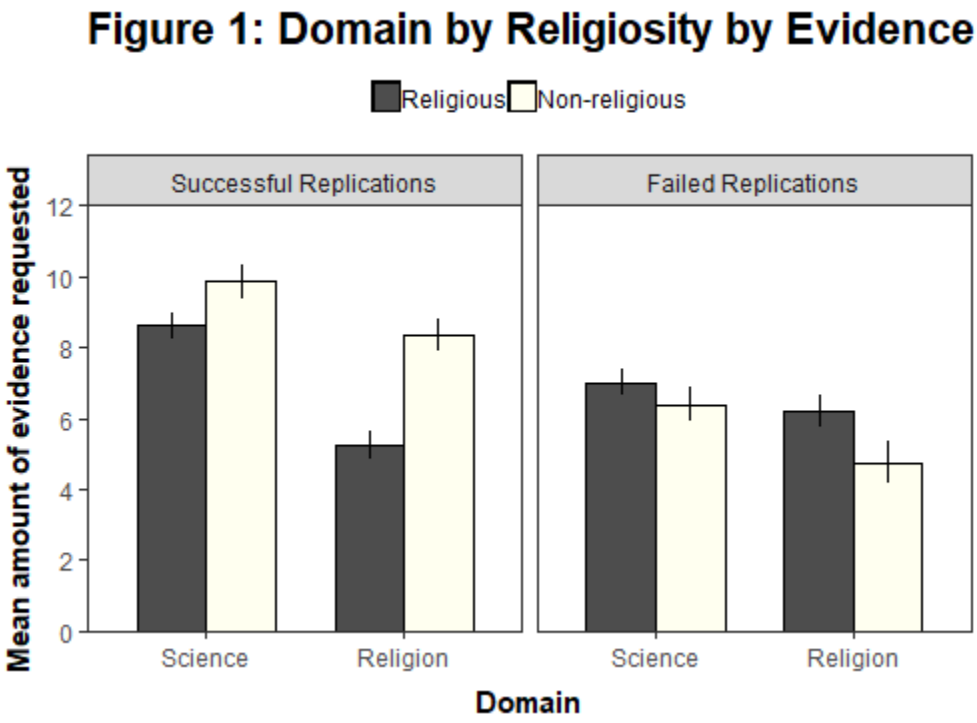

Figure 1. Interaction between domain, participant religiosity, and evidence type. Error bars represent 95% CI. Responses were made on a scale from 1 (one) to 12 (100+).

3.4 Discussion

We aimed to replicate and extend research by McPhetres and Zuckerman (2017) by examining how individuals treat supporting and disconfirming evidence relevant to either

scientific or religious claims. Our results partially replicated their observation of a bias among religious individuals to believe religious claims. However, our results also suggested a similar bias among non-religious individuals, albeit to a lesser degree. Importantly, our experiment extends work in this area by asking participants about how many failed replications are required to reject empirical claims. Contrary to our hypothesis, we did not find that religious believers needed more evidence to reject a religious claim than a scientific claim. Instead, our results showed a possible bias by non-religious individuals to reject religious claims rather than a general bias by religious believers to protect religious claims despite disconfirming evidence. Thus, it appears as though evidence is treated differently for religious claims than for scientific claims. Evidence relevant for a scientific claim was handled similarly by our religious and non-religious participants. By contrast, evidence relevant for a religious claim was treated by our participants in ways aligned with their identification as religious or non-religious. Religious participants needed less evidence than non-religious participants to confirm a religious claim, whereas non-religious participants needed less evidence than religious participants to reject a religious claim.

Of particular note, our findings revealed that religious and non-religious individuals generally treat evidence relevant for a scientific claim in a similar fashion. Both religious and non-religious individuals needed more evidence to confirm a scientific claim than a religious claim, although this effect was smaller for non-religious individuals. Further, religious and non-religious individuals were not found to differ in the amount of disconfirming evidence needed to reject a scientific claim. These findings are noteworthy considering research showing that, compared to non-religious individuals, religious individuals are less scientifically literate (Sherkat, 2011) and identify less with science (Rios et al., 2015). One explanation is that religious and non-religious individuals differ on their stances towards science in relation to their views on religion, rather than in relation to the other group of people. That is to say, relative to religious individuals' credulity for religious claims, they may appear less receptive to scientific claims. Likewise, relative to non-religious individuals' skepticism for religious claims, they may appear more receptive to scientific claims.

An alternative interpretation of our results is that both religious and non-religious individuals process evidence in a similar fashion but differ in their priors regarding the possibility of religious and scientific claims. The possibility that individuals may be engaging in Bayesian-style reasoning was not explicitly studied in the present research and should be followed up explicitly in future research.

Whereas religious participants needing fewer replications to confirm a religious claim than a scientific claim aligns with the suggestion of a bias by religious believers to believe religious claims, our finding that non-religious participants also needed fewer replications to confirm a religious claim than a scientific claim is curious. The comparable analysis reported in McPhetres and Zuckerman (2017) did not reveal such a significant difference, although the pattern of means was in the same direction as ours. One interpretation is that because the non-religious individuals in our study live in a culture that is highly deferential to and protective of religiosity, particularly Judeo-Christian denominations, non-religious individuals maintain a similar implicit pro-religion bias. Further, non-religious individuals in our sample may have also previously

been religious at some point in their lives, and explicit conversion to a non-religious affiliation may not necessarily translate to abandoning implicit pro-religion biases easily.

Although our findings successfully replicate and extend prior research, the present study has several limitations that should be addressed in future research. The evidence we asked participants about was limited to a single type, either successful replications or failed replications. By contrast, claims made in the real world are frequently evaluated based on both supporting and disconfirming evidence of different types and qualities, ranging from testimony to systematic experimentation by multiple independent experts. Additionally, we asked participants to make evaluations about the certainty of the cause-effect relationship they were presented with. Future research should ask participants about the probability of scientific or religious causal claims being true on the basis of evidence of any sort, as an additional way to explore how people use evidence when deciding to accept or reject a claim. This approach could be useful in determining whether, as noted above, religious and non-religious individuals treat evidence similarly but differ in the priors they assign to religious and non-religious claims.

Generally, we found that non-religious individuals are more skeptical when it comes to believing claims and have a lower threshold of disconfirming evidence for rejecting claims, particularly religious claims. Our study also showed that although religious individuals may be more credulous of religious claims and more skeptical of scientific claims, they are resistant to rejecting either kind of claim in the face of disconfirming evidence. Additional research is needed to understand the epistemological commitments of religious and non-religious individuals. For instance, because the claims participants responded to in this study are hypothetical, future research may explore the treatment of evidence for real-world empirical claims by scientists and religious leaders. Research by Shtulman (2013) found that individuals tend to justify their beliefs about the existence or non-existence of scientific and supernatural phenomena similarly. The most common type of justification participants in his study made was an appeal to an authority or worldview, with a substantially smaller proportion of justifications participants made including an explicit reference to evidence. Additionally, similar research by Lobato and Zimmerman (2019) found that individuals justified their beliefs about scientific issues that have become part of the socio-political landscape inconsistently, with only 11% of participants referencing evidence for their beliefs about all the topics they were asked about. This suggests that peoples' epistemological commitments for the believability of a claim vary from topic to topic, rather than by domain. More research examining how people set evidentiary standards for specific claims, whether religious or scientific or some other empirical claim, may help reveal factors relevant for understanding how people develop and maintain their beliefs about what is real and what is possible. For a subset of individuals, it may simply be the case that extraordinary claims do not actually require extraordinary evidence.

3.5 References

Baron-Cohen, S. (2002). The extreme male brain theory of autism. *Trends in Cognitive Sciences, 6*(6), 248-254.

Boudry, M., & Braeckman, J. (2012). How convenient! The epistemic rationale of self-validating belief systems. *Philosophical Psychology, 25*(3), 341-364.

Browne, M., Pennycook, G., Goodwin, B., & McHenry, M. (2014). Reflective minds and open hearts: Cognitive style and personality predict religiosity and spiritual thinking in a community sample. *European Journal of Social Psychology, 44*(7), 736-742.

Bruder, M., Haffke, P., Neave, N., Nouripanah, N., & Imhoff, R. (2013). Measuring individual differences in generic beliefs in conspiracy theories across cultures: Conspiracy Mentality Questionnaire. *Frontiers in Psychology, 4*, 1-15.

Cardwell, B. A., & Halberstadt, J. (2019). Religious believers do not distinguish good from poor reasons for God's existence. *The International Journal for the Psychology of Religion*, 1-14.

Cohen, A. B., Shariff, A. F., & Hill, P. C. (2008). The accessibility of religious beliefs. *Journal of Research in Personality, 42*(6), 1408-1417.

Crespi, B., & Badcock, C. (2008). Psychosis and autism as diametrical disorders of the social brain. *Behavioral and Brain Sciences, 31*(3), 241-261.

Dodd, M. D., Balzer, A., Jacobs, C. M., Gruszczynski, M. W., Smith, K. B., & Hibbing, J. R. (2012). The political left rolls with the good and the political right confronts the bad: connecting physiology and cognition to preferences. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 367*(1589), 640-649.

Ecklund, E. H., Johnson, D. R., Scheitle, C. P., Matthews, K. R., & Lewis, S. W. (2016). Religion among scientists in international context: A new study of scientists in eight regions. *Socius, 2*, 1-9.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149-1160.

Finley, A. J., Tang, D., & Schmeichel, B. J. (2015). Revisiting the relationship between individual differences in analytic thinking and religious belief: Evidence that measurement order moderates their inverse correlation. *PloS One, 10*(9), e0138922.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives, 19*(4), 25-42.

Friesen, J. P., Campbell, T. H., & Kay, A. C. (2015). The psychological advantage of unfalsifiability: The appeal of untestable religious and political ideologies. *Journal of Personality and Social Psychology, 108*, 515

Gervais, W. M., & Norenzayan, A. (2012). Analytic thinking promotes religious disbelief. *Science, 336*(6080), 493-496.

Hartman, R. O., Dieckmann, N. F., Sprenger, A. M., Stastny, B. J., & DeMarree, K. G. (2017). Modeling attitudes toward science: Development and validation of the credibility of science scale. *Basic and Applied Social Psychology, 39*(6), 358-371.

Holbrook, C., López-Rodríguez, L., & Gómez, Á. (2018). Battle of wits: Militaristic conservatism and warfare cues enhance the perceived intellect of allies versus adversaries. *Social Psychological and Personality Science, 8*, 670-678.

Kuhn, T. S. (1970). The structure of scientific revolutions, 2nd. Chicago: Univ. of Chicago Pr.

Lindeman, M., & Lipsanen, J. (2016). Diverse cognitive profiles of religious believers and nonbelievers. *The International Journal for the Psychology of Religion, 26*(3), 185-192.

Lobato, E. J. C., & Zimmerman, C. (2019). Examining how people reason about controversial scientific topics. *Thinking & Reasoning, 25*(2), 231-255.

McPhetres, J., & Zuckerman, M. (2017). Religious people endorse different standards of evidence when evaluating religious versus scientific claims. *Social Psychological and Personality Science, 8*(7), 836-842.

Pennycook, G., Cheyne, J. A., Barr, N., Koehler, D. J., & Fugelsang, J. A. (2014). Cognitive style and religiosity: The role of conflict detection. *Memory & Cognition, 42*(1), 1-10.

Pennycook, G., Ross, R. M., Koehler, D. J., & Fugelsang, J. A. (2016). Atheists and agnostics are more reflective than religious believers: Four empirical studies and a meta-analysis. *PloS One, 11*(4), e0153039.

Popper, K. (2005). *The logic of scientific discovery*. Routledge.

Rios, K., Cheng, Z. H., Totton, R. R., & Shariff, A. F. (2015). Negative stereotypes cause Christians to underperform in and disidentify with science. *Social Psychological and Personality Science, 6*(8), 959-967.

Sanchez, C., Sundermeier, B., Gray, K., & Calin-Jageman, R. J. (2017). Direct replication of Gervais & Norenzayan (2012): No evidence that analytic thinking decreases religious belief. *PloS One, 12*(2), e0172636.

Scheitle, C. P., & Ecklund, E. H. (2017). The influence of science popularizers on the public's view of religion and science: An experimental assessment. *Public Understanding of Science, 26*(1), 25-39.

Shenhav, A., Rand, D. G., & Greene, J. D. (2012). Divine intuition: Cognitive style influences belief in God. *Journal of Experimental Psychology: General, 141*(3), 423.

Sherkat, D. E. (2011). Religion and scientific literacy in the United States. *Social Science Quarterly, 92*, 1134–1150.

Shtulman, A. (2013). Epistemic similarities between students' scientific and supernatural beliefs. *Journal of Educational Psychology, 105*(1), 199.

Van Leeuwen, N. (2017). Do religious "beliefs" respond to evidence?. *Philosophical Explorations, 20*(S1), S52-S72.

Acknowledgements

Chapter 3, in full, is a reprint of the material as it appears in Religiosity Predicts Evidentiary Standards. Lobato, Emilio J. C.; Tabatabaeian, Shadab; Fleming, Morgan; Sulzmann, Sven; Holbrook, Colin. Sage, 2019. The dissertation author was the primary investigator and author of this paper.

Chapter 4 Factors Predicting Willingness to Share COVID-19 Misinformation

Abstract

We conducted a preregistered exploratory survey to assess whether patterns of individual differences in political orientation, social dominance orientation, traditionalism, conspiracy ideation, or attitudes about science predict willingness to share different kinds of misinformation regarding the COVID-19 pandemic online. Analyses revealed two orthogonal models of individual differences predicting the willingness to share misinformation over social media platforms. Both models suggest a sizable role of different aspects of political belief, particularly social dominance orientation, in predicting tendencies to share different kinds of misinformation, predominantly conspiracy theories. Although exploratory, results from this study can contribute to the formulation of a socio-cognitive profile of individuals who act as vectors for the spread of scientific misinformation online, and can be useful for computationally modeling misinformation diffusion.

4.1 Introduction

Currently, the world is experiencing a global pandemic of SARS-CoV-2, the virus causing the COVID-19 disease (World Health Organization, 2020). Scientific and medical information concerning the virus is being discovered and relayed quickly in efforts to inform the general public and policymakers about how best to respond. The demand for information related to COVID-19 is high, creating a prime environment for misinformation to spread.

The information environment surrounding the pandemic affords an opportunity to study the spread of scientific misinformation on social media platforms. We explored whether different patterns of individual differences predict the inclination to share different kinds of misinformation about a salient socio-cultural scientific topic. For the purposes of the present research, we limited our focus to individual differences in propensity toward conspiracy ideation, attitudes toward science, and facets of political ideology. Each of these individual differences has been previously found to relate either to the endorsement of misinformation or to how people respond to health threats from pathogens, as will be briefly described below.

4.1.1 Misinformation Diffusion Online

Research on the diffusion of information online consistently finds that misinformation diffuses faster and reaches broader audiences than correct information (del Vicario et al., 2016; Vosoughi, Roy, & Aral, 2018). Exploring information sharing over social media platforms can facilitate the scientific understanding of the spread of misinformation. Here, we focus on factors associated with willingness to disseminate misinformation online. It is important to note that spreading misinformation does not need to be indicative of a deliberate attempt to deceive nor does spreading misinformation necessarily stem from a person being gullible. Sharing misinformation online can occur under a variety of other circumstances, such as when people post a link to an article to try and generate discussion among their social network or to draw attention to a misinformed claim as being misinformed. The current work does not focus

on the specific motivations people may have for sharing misinformation, but rather the overall willingness to share claims regarding the current COVID-19 pandemic that happens to be untrue or unverifiable over social media.

Prior research investigating who shares misinformation on social media suggests that older individuals and people who are more politically conservative tend to share more political misinformation online relative to younger individuals, liberals, or moderates (Guess, Nagler, & Tucker, 2019). Additionally, individuals who tend to gravitate toward conspiracy narratives on social media platforms are more likely to positively engage with – in the form of "likes", sharing, and commenting – misinformation claims than are individuals who gravitate toward scientific narratives (Bessi et al., 2015). Much of the recent research examining the spread of specific information and misinformation over social media has focused on sharing political information, mostly surrounding elections (e.g., Buchanan & Benson, 2019; Guess et al., 2019; Mosleh, Pennycook, & Rand, 2020). However, relatively scant research has examined how these platforms are used for sharing and spreading information on specific scientific topics. By focusing on COVID-19 misinformation, the present research contributes to understanding the spread of misinformation on a specific scientific topic, albeit a scientific topic that has come to intersect with politics.

4.1.2 Individual Differences Pertaining to Misinformation

Conspiracy theorists typically posit explanations for large-scale events that contradict official or expert explanations (Goertzel, 1994). They tend to be distrustful of recognized legal or scientific cultural authorities. This distrust of authority is so pervasive in conspiracy ideation that people inclined to believe conspiracies will accept mutually exclusive conspiracy theories more than the official account of a major socio-cultural event (Wood, Douglas, & Sutton, 2012). On social media, groups focused on disseminating conspiracy-related content – frequently framed as trying to inform people of news not covered by the mainstream news – tend to be more active than groups focused on disseminating scientifically informed content (Bessi et al., 2015). Accordingly, we are investigating the influence of individual differences in conspiracy ideation on willingness to share misinformation.

Researchers have found that belief in conspiracies correlates with the rejection of science and endorsement of pseudoscience (Lewandowsky, Gignac, & Oberauer, 2013; Lewandowsky, Oberauer, & Gignac, 2013; Lobato, Mendoza, Sims, & Chin, 2014; Lobato & Zimmerman, 2019; van der Linden, 2015) and to a general attitude toward science as lacking credibility (Hartman et al., 2017). Misinformation pertaining to how COVID-19 spreads, how susceptible different groups are, and what kinds of treatment or prevention methods are effective can emerge and spread from individuals who are antagonistic toward rigorous scientific investigation or those with financial or other incentives at odds with scientific rigor. Relatedly, information and misinformation about COVID-19 that is being disseminated frequently takes the form of empirical claims or interpretations of the results of preliminary empirical investigations (e.g., the headline "Some Blood Types May Be Slightly More Susceptible to COVID-19, Paper Suggests" from Bowler, 2020). Therefore, understanding who is likely to spread misinformation about a scientific topic requires assessing attitudes about science in general.

Because the COVID-19 pandemic represents a pathogen threat, research on individual difference factors related to pathogen threat responses is relevant. Convergent studies provide evidence that political conservatives are relatively more disgust-prone than are liberals, an affective response theorized to functionally relate to pathogen avoidance (Inbar, Pizarro, Iyer & Haidt, 2012; Terrizzi, Shook, & McDaniel, 2013). Tybur and colleagues (2016) conducted a large multinational study to compare two theoretical accounts of the apparent positive correlation between pathogen sensitivity and political conservatism. According to one account of this relationship, which Tybur and colleagues call a "traditional norms" account, some cultural traditions and behavioral norms (particularly surrounding food preparation) arise because they help neutralize threats posed by pathogens. Under this model, the link between pathogen sensitivity and political conservatism is driven largely by adherence to the traditional moral values and lifestyles of the in-group. A distinct intergroup account of the relationship between political views and pathogen stress response, which Tybur and colleagues call an "out-group-avoidance" account, posits that over time individuals develop resistance to local pathogens but remain vulnerable to pathogens borne by out-group members. Under this account, the relationship between pathogen sensitivity and political views is driven primarily by ideologies favoring hierarchical social stratification, termed Social Dominance Orientation (Pratto et al., 2013), that place out-groups in subordinate positions. Tybur and colleagues (2016) tested both accounts in cross-cultural research spanning 30 nations, finding support for the traditional norms account over the out-group-avoidance account. Although inclinations toward social dominance and adherence to traditionalism are both associated with political conservatism, pathogen-avoidance responses appear to be driven more by traditionalism than social dominance. Here, we include both measures of social dominance orientation and traditionalism to explore their relative contributions to the spread of health-related misinformation in the midst of a global pandemic.

In sum, prior research provides evidence that interrelated dispositions may be related to conspiracy ideation, negative attitudes toward science, and political ideology. Further, these factors may also predict willingness to share misinformation. The goal of the present exploratory research is to begin characterizing the socio-cognitive profile of individuals likely to spread misinformation online. To achieve this goal, we questioned individuals about their willingness to share COVID-19 misinformation over social media platforms and took measures of their inclination to conspiracy ideation, their attitudes toward science, and their political ideology along several dimensions. Materials, data, and study preregistration documents are available on the Open Science Framework: https://osf.io/ytsr8/.

4.2 Method

4.2.1 Participants

We recruited 404 participants via Amazon's Mechanical Turk, comparable to other research on credulity about hazard claims (e.g., Samore, Fessler, Holbrook, & Sparks, 2018). We removed data on the basis of preregistered criteria: incomplete responses to the dependent measure or individual difference measures, completing the study in less than two minutes, and failure to respond or nonsensical response to an open-ended question asking them to describe the study. The final sample, after exclusions, was 296

participants (M_{age} = 36.23, SD_{age} = 10.96; 178 men, 117 women, 1 other). Participants were paid $0.75USD for participation.

4.2.2 Materials

We used fact-checking sites, such as Snopes.com and FactCheck.org, to create an ad hoc measure of peoples' willingness to share misinformation about COVID-19 over social media. Eighteen actual claims, either verified to be untrue or unverifiable, that have been made regarding COVID-19 were presented to participants. For each claim, participants used a slider to indicate how likely they would be to share that claim over their social media accounts. The slider bar ranged from scores of 0 to 100, with anchors of "Definitely not share" "Less likely to share" "More likely to share" and "Definitely share" located at the 0, 33, 66, and 100 marks respectively. We calculated mean scores for participants willingness to share misinformed claims about COVID-19. The items selected for this scale were *a priori* categorized as claims regarding: (a) severity and spread of COVID-19 (α = .91); (b) treatment and prevention of COVID-19 (α = .92); (c) COVID-19 conspiracy theories (α = .89); (d) miscellaneous incorrect or unverifiable claims (α = .78). Table 2 details the sets of claims and categorization scheme. The categorization scheme utilized in the current work was based on the categorization structure of claims from the originating fact-checking sites and was conducted by two authors. For example, Snopes.com created multiple webpages for fact-check coronavirus claims (available here: https://www.snopes.com/collections/new-coronavirus-collection/). The categorization scheme in this study was inspired by categorizations used on Snopes.com: "Origins and Spread", "Treatment and Prevention", and "Conspiracy Theories." We build on this by including a "Miscellaneous" category which includes claims from diverse categories on the Snopes collection webpage, such as "Media and Entertainment" or "Prophecies and Predictions."

4.2.3 Individual difference measures

We measured participants' disposition toward conspiracy ideation with the Conspiracy Mentality Questionnaire (α = .83; Bruder et al., 2013). Participants rated their level of certainty about various statements on an 11-point Likert scale (0% - *Certainly Not* to 100% - *Certain*). This 5-item measure includes statements such as "I think there are secret organizations that greatly influence political decisions."

We measured participants' general attitudes toward science with the Credibility of Science Scale (α = .94; Hartman et al., 2017). This 6-item measure asks participants to respond on a 7-point Likert Scale (1 = *Disagree Very Strongly*; 7 = *Agree Very Strongly*) to statements such as "People trust scientists a lot more than they should." The Credibility of Science Scale is scored such that higher scores represent less favorable views of science as credible.

We used a modified version of the Political Issues Index (α = .76; Dodd et al., 2012; Holbrook et al., 2018) as a proxy for where participants generally fall on the liberal-to-conservative political spectrum. This 20-item measure lists socio-political issues (e.g., "Same-sex marriage", "Reduce business regulations", "Right to abortion"), and participants indicate whether they *Agree*, *Disagree*, or are *Uncertain* about the issue. The Political Issues Index is scored from -1 to 1, reverse-scoring agreement with the

traditionally liberal items, such that lower values represent greater alignment with traditionally liberal policy positions, and higher values represent greater alignment with traditionally conservative policy positions ("Uncertain" responses are scored as zero).

Table 2. COVID-19 misinformation claims used in the study.

Severity / Spread	1. Health experts predicted the new coronavirus could kill 65 million people. 2. Chinese doctors confirmed that African people are "genetically resistant" to new coronavirus. 3. Warmer weather will inhibit the spread of the new coronavirus. 4. The novel coronavirus COVID-19 is more deadly than any known pathogen. 5. Only the elderly and people with preexisting medical conditions can catch the coronavirus. 6. People with Type-A blood are more susceptible to COVID-19.
Treatment / Prevention	7. Taking a few sips of water every 15 mins will prevent the new coronavirus from entering your windpipe and lungs. 8. If you can hold your breath without coughing, discomfort, stiffness, or tightness, your lungs do not suffer from fibrosis and therefore you have no COVID-19 infection. 9. Mass vaccination for COVID-19 in the African country of Senegal was started April 8th and the first 7 children who received it died on the spot. 10. Lemon Juice Tea has been shown to cure COVID-19.
Conspiracies	11. Democrats in New York stashed ventilators in a warehouse in an effort to make the COVID-19 pandemic worse. 12. The COVID-19 virus is a chimera. It includes SARS, an already weaponized coronavirus, along with HIV genetic material and possibly flu virus. 13. Donald Trump owns stock in a company the CDC uses for COVID-19 tests. 14. 5G cellular service technology is linked to the cause of the coronavirus. 15. COVID-19 was created in a virology lab as a potential bioweapon, but accidentally got released before it had been fully studied by its creators.
Miscellaneous	16. Sales of Corona beer dropped sharply in early 2020 because consumers mistakenly associated the brand name with the new coronavirus. 17. Idris Elba and other celebs have been paid to say they have coronavirus. 18. Nostradamus predicted the COVID-19 pandemic.

We used the Social Dominance Orientation short form (α = .74; Pratto et al., 2013) to measure approval of social hierarchies. Participants respond to this 4-item measure by using a 7-point Likert scale (1 = *Extremely Oppose*; 7 = *Extremely Favor*) to indicate how much they reject or support statements concerning social hierarchies and egalitarianism. An example item is "Superior groups should dominate inferior groups."

We used the 6-item Traditionalism subscale from the Authoritarian-Conservatism-Traditionalism scale (α = .83; Duckitt et al., 2010) to measure participants' valuation of traditional moral systems and lifestyles and resistance to modern challenges to such traditional values and lifestyles. Participants responded on a 7-point Likert scale (1 = *Strongly Disagree*; 7 = *Strongly Agree*) to statements such as "This country will flourish if young people stop experimenting with drugs, alcohol, and sex, and pay more attention to family values."

4.2.4 Procedure

After providing informed consent, participants were presented with the following instructions:

> We are interested in examining what types of things people share over social media. Sometimes people share information because they think it is true and want others to know it. Sometimes people share information even if they think it is false because they would like to warn other people to not believe it if they hear it from somewhere else. Sometimes people share information that they are not sure about as a way to see what their friends and family think. And sometimes people share information for other reasons entirely.
>
> In this task, you will be presented with a series of claims regarding the current COVID-19 (aka SARS-CoV-2) pandemic that have been made and shared over both traditional media outlets, such as TV news programs or newspapers, and over social media outlets, such as Facebook or Twitter. You may have even encountered some of these already.
>
> For each claim, use the slider bar provided to rate how likely you think you would be to share this over your own social media accounts.

After reading the instructions, participants completed the task. The 18 claims we used as stimuli were presented in a randomized order. Participants were informed that these were real claims that have been made on both traditional news media outlets and on social media platforms. Following this task, participants filled out the individual difference measures in randomized order. Finally, participants filled out a demographics form. Participants were debriefed as to the nature of the study and informed that the

claims they read regarding COVID-19 were not true. In the debriefing, we provided links to fact-checking and health agency websites for participants, to help provide participants with resources to keep up to date with COVID-19 information and misinformation.

Table 3 Descriptive statistics.

	M	*SD*	*Range*	*Skew*	*Kurtosis*
Conspiracy Mentality Questionnaire	7.73	1.80	1 – 11	-0.91	-0.23
Credibility of Science Scale	4.25	1.70	1 – 7	-0.48	-0.94
Political Issues Index	-0.05	7.41	-20 – 20	-0.48	-0.23
Social Dominance Orientation	2.95	1.39	1 – 7	-0.08	-1.21
Traditionalism	3.86	1.39	1 – 7	-0.12	-0.27
COVID-19 Claims total	41.67	27.31	1 – 100	0.19	-1.09
Severity/Spread	44.81	27.97	1 – 100	0.06	-1.08
Treatment/Prevention	38.48	31.53	1 – 100	0.24	-1.29
Conspiracies	40.39	28.47	1 – 100	0.17	-1.10
Miscellaneous	41.77	27.20	1 – 100	0.21	-0.93

Note. $N = 296$

4.4 Results

Table 3 presents the descriptive statistics for scores on the individual difference measures and for mean participant ratings of their likelihood to share the examined types of COVID-19 misinformation. On average, our sample was not inclined toward liberalism or conservatism, as measured by the modified Political Issues Index. Our sample was mildly inclined toward conspiracy ideation. Additionally, the sample was mildly above the midpoint for the Credibility of Science Scale, indicating a slight inclination toward rejecting science as credible. Our sample also averaged slightly below the midpoint on the Social Dominance Orientation scale, while averaging around the midpoint on the Traditionalism scale. Regarding willingness to share COVID-19 misinformation claims over social media, our sample averaged below the midpoint, suggesting an overall low willingness to share the COVID-19 claims we tested. All measures correlated significantly with each other at the $p < .001$ level; Table 4 shows the correlation matrix. Diagnostics for the inferential analyses reported below revealed no outliers that exerted sufficient influence on the models to warrant removal and that all assumptions necessary for linear analysis were met.

We assessed the relationship between the individual difference measures and self-reported willingness to share different kinds of COVID-19 misinformation over social media using a canonical correlation analysis. A canonical correlation analysis allows analysis of the relationship between sets of predictor and outcome variables by creating synthetic variates representing linear combinations of the predictor variables and linear combinations of the outcome variables. For each synthetic variate, the strength of the contribution to the synthetic variate for each variable produces a function coefficient. Additionally, the analysis produces a bivariate correlation between each predictor and criterion variable and the respective synthetic variate, known as the structure coefficient. This analysis strategy is designed to generate the highest correlation between the two

variable sets (Tabachnik & Fidell, 2007). In canonical correlation analysis, multiple orthogonal models are created, equal to the number of variables in the smaller set. The first model is created to maximally explain the variance between the two sets of predictors, and subsequent models are created to maximally explain the remaining variance not explained by prior models. Each model represents one unique linear combination of outcome variables regressed onto one unique linear combination of predictor variables. We chose this multivariate analysis strategy because of the exploratory nature of the research, as it is an approach that can reveal at once multiple potential ways in which sets of variables relate to each other, rather than running a series of univariate multiple regression analyses. Canonical analysis is useful for exploratory research where there are distinct sets of variables of interest, such as a set of potential independent variables and a set of potential dependent variables.

Table 4. Pearson product moment correlations.

	1	2	3	4	5	6	7	8	9	10
1. CMQ		.57	.34	.27	.33	.47	.45	.43	.49	.40
2. CoSS			.58	.54	.59	.62	.57	.58	.65	.54
3. PII				.32	.77	.28	.28	.28	.30	.17
4. SDO					.20	.44	.35	.43	.48	.43
5. Traditionalism						.35	.36	.35	.34	.21
6. COVID Claims							.96	.96	.96	.89
7. Severity/Spread								.89	.88	.81
8. Treatment/Prevention									.90	.81
9. Conspiracies										.84
10.Miscellaneous										

Note. $N = 296$. All correlations significant at the $p < .001$ level.
CMQ – Conspiracy Mentality Questionnaire
CoSS – Credibility of Science Scale (higher scores indicating greater skepticism of science)
PII – Political Issues Index (higher scores indicating greater conservatism)
SDO – Social Dominance Orientation short form

The full model across functions was significant, creating four functions with squared canonical correlations (canonical r^2) of .48 for the first function, .10 for the second function, .02 for the third function, and .01 for the fourth function. However, only the first function (Wilk's $\lambda = .45$, $F(20, 952.8) = 12.84$, $p < .001$) and second function (Wilk's $\lambda = .88$, $F(12, 762.3) = 3.16$, $p < .001$) were significant, and combined explained 58% of the total variance. Sensitivity analysis conducted using G*Power (Faul, Erdfelder, Bucher, & Land 2009) with power set to .90 and α set to .05 revealed our analysis was powered sufficiently to detect effect sizes as small as $f^2 = .056$, corresponding roughly to $r^2 = .053$.

For the first function (see Table 5), the synthetic predictor variate was primarily composed of participant scores on the Political Issues Index and the measure of Social Dominance Orientation, possessing standardized function coefficients greater than |.33|. The first synthetic criterion variable was primarily composed of participant's intention to spread conspiracy-related misinformation, with a standardized function coefficient of -1.02. Together, the first model reveals that participants who are primarily more liberal (in terms of the issues index) and less oriented toward social dominance were less inclined to

share COVID-19 claims that were conspiratorial in nature (see Figure 3). Additionally, the standardized structure coefficients revealed that all individual differences significantly correlated with the synthetic predictor variate, and all misinformation categories significantly correlated with the synthetic criterion variate.

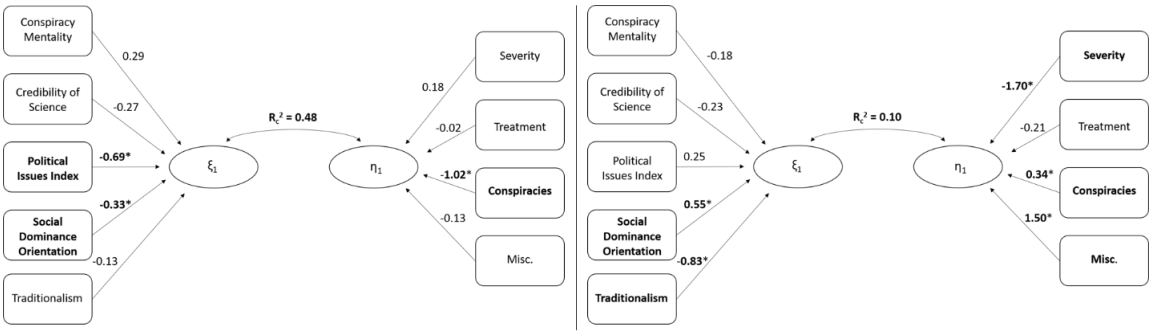

Figure 2. Diagram of the two significant canonical models. Substantial contributors to the synthetic predictor variate (ξ) and criterion variate (η) are bolded and noted with *. The squared canonical correlations (R^2_c) are significant at the $p < .001$ level. Left: More alignment with liberal policy positions and a low social dominance orientation predict a low willingness to share conspiracy theories about COVID-19 on social media. Right: A high social dominance orientation and a low endorsement of traditionalism predict a low willingness to share misinformation on social media related to the severity and spread of COVID-19, but a high willingness to share conspiracies about COVID-19 and miscellaneous cultural misinformation about COVID-19.

For the second function produced by the canonical analysis (see Table 5), the synthetic predictor was substantially composed of participant scores on the measure of Social Dominance Orientation and the measure of Traditionalism, with standardized function coefficients of at least |.55|. The second function's synthetic criterion variate was primarily composed of intention to spread misinformation regarding the severity and spread of COVID-19, COVID-19 conspiracies, and miscellaneous COVID-19 misinformation claims. Each criterion variable possessed standardized function coefficients of at least |.34| for the second synthetic criterion variate. The second model produced by the canonical analysis revealed that individuals high in Social Dominance Orientation and low in Traditionalism were less inclined to share misinformation claims regarding the severity and spread of COVID-19, but more inclined to share COVID-19 conspiracies and miscellaneous COVID-19 misinformation claims (see Figure 1). Additionally, the standardized structure coefficients revealed that participant scores on the Conspiracy Mentality Questionnaire and Traditionalism scale were significantly negatively correlated with the synthetic predictor variate and scores on Social Dominance Orientation measure significantly positively correlated with the synthetic variate, whereas inclination to share misinformation pertaining to COVID-19 severity and spread correlated negatively with the synthetic criterion variate.

Table 5. Standardized function and structure coefficients for the first and second canonical variates.

	Function		Structure	
Predictors	CV1	CV2	CV1	CV2
Individual Differences				
Conspiracy Mentality	0.29	-0.18	**-0.40**	**-0.58**
Credibility of Science	-0.27	-0.23	**-0.70**	-0.27
Political Issues Index	**-0.69**	0.25	**-0.93**	-0.18
SDO	**-0.33**	**0.55**	**-0.71**	**0.40**
Traditionalism	-0.13	**-0.83**	**-0.46**	**-0.79**
Kinds of Misinformation				
Severity/Spread	0.18	**-1.70**	**-0.85**	**-0.37**
Treatment/Prevention	-0.02	-0.21	**-0.89**	-0.20
Conspiracies	**-1.02**	**0.34**	**-1.00**	-0.09
Misc.	-0.13	**1.50**	**-0.87**	0.24

Note. N = 296. SDO = Social Dominance Orientation
Bolded Function items are substantial contributors to the synthetic variate.
Bolded Structure items are significantly correlated with the synthetic variate.

4.5 Discussion

The global COVID-19 pandemic has contributed to an environment allowing for the opportunistic study of the diffusion of misinformation over social media. We report on a preregistered exploratory study investigating theoretically relevant individual differences and willingness to spread different kinds of misinformation on a salient scientific topic, COVID-19. Overall, our canonical model revealed two distinct profiles predicting two patterns of willingness to share misinformation.

The first profile showed that individuals who are both more aligned with liberal policy positions and less oriented toward social dominance were substantially less willing to spread conspiracy-themed misinformation on social media. Whereas prior research has found that conservatism is positively related to spreading political misinformation on social media (Guess et al., 2019), our results suggest that liberals with a low disposition toward social dominance are less willing specifically to share conspiratorial misinformation than are conservatives with a high disposition toward social dominance, at least regarding a culturally salient scientific topic. This finding fits with recent research exploring the relationship between political ideologies, conspiracist ideation, and negative-biased credulity. Generally, the more conservative an individual is the more likely they are to endorse conspiracy theories and to hold a stronger general conspiracist worldview than for individuals who are more liberal, at least for political conservatism as practiced in the United States (van der Linden, Panagopolous, Azevedo, & Jost, 2020). Additionally, research by Samore and colleagues (2018) has found that even when political power dynamics favor conservatives, there exists a positive association between conservatism and conspiracist ideation. The results of our canonical analysis add to the growing body of literature that suggests that political conservatism, at least within the United States, may be partially defined by a conspiracist mindset.

The second profile showed that individuals who are both high in social dominance orientation and low in traditionalism are less willing to spread misinformation about the severity and spread of COVID-19, but more willing to spread conspiracy-themed misinformation, as well as miscellaneous culturally salient misinformation claims. This result is particularly interesting in light of prior research indicating that traditionalism,

more so than covarying social dominance inclinations, drives pathogen sensitivity (Tybur et al., 2016). Here, we found that individuals high in traditionalism and low in social dominance were more willing to share misinformation about the severity and spread of the COVID-19 pathogen, consistent with the hypothesis that traditionalism functionally relates to pathogen-sensitivity. Equally suggestively, a reverse pattern was obtained with regard to social dominance orientation and propensities to spread misinformation, such that individuals who favored social dominance but not traditionalism were less inclined to spread claims about the severity of illness, instead showing a willingness to spread conspiratorial claims, a thematically consistent association insofar as conspiracies inherently entail certain groups vying for advantage over others.

The significant structure coefficients for both profiles hint that the relationships between the selected individual difference variables and the subtypes of COVID-19 misinformation studied here are more complicated than could be revealed by the use of a general linear model approach. However, it is important to note that because of the nature of canonical analysis, the resulting models were algorithmically determined to explain the largest amount of variance, irrespective of the variates' theoretical context. Although every individual difference selected for inclusion in the present study was motivated by relevant prior literature, follow-up research is needed to validate the patterns of individual differences and misinformation-sharing inclinations reported here. In addition, many other variables likely relevant to a person's willingness to act as a vector for misinformation spread on social media were not included in the present study, such as degree of media literacy (Guess et al., 2019) or cognitive sophistication (Pennycook & Rand, 2019). Future research should expand the scope of individual differences examined. Further, we investigated only self-reported willingness to share, and did not collect any data related to actual sharing behaviors. Although prior research has found a moderate positive correlation between self-reported willingness to share information and actual rates at which that information is shared online (Mosleh et al., 2020), collecting behavioral data on who actually does share what kinds of specific misinformation is needed.

Another potential limitation of this research concerns our categorization scheme for the claims we tested. Our approach to categorizing coronavirus claims was qualitative and largely influenced by a categorization scheme created for the general public to navigate a fact-checking website. Although the scheme we used produced subscales with acceptable reliability coefficients, resulting in orthogonal models from the canonical analysis, other categorization schemes also warrant future investigation. For example, Pennycook and colleagues (2020) categorized 21 coronavirus misperceptions using the categories "Optimistic", "Pessimistic", "Magical", and "Conspiratorial" for their investigation about motivated reasoning and political polarization regarding coronavirus claims. Future research might examine additional categorization schemes.

4.6 Conclusion

The present study was exploratory by design. Accordingly, these results should be interpreted with caution, but may inform more sophisticated research and modeling into misinformation diffusion about a scientific topic. Despite the limitations of the present research, we find that factors primarily related to individuals' political beliefs, and in particular tendencies toward social dominance, are important for understanding how misinformation concerning COVID-19 diffuses online.

4.7 References

Bessi, A., Coletto, M., Davidescu, G. A., Scala, A., Caldarelli, G., & Quattrociocchi, W. (2015). Science vs conspiracy: Collective narratives in the age of misinformation. *PloS ONE*, *10*(2), e0118093.

Bowler, J. (2020, March 19). Some blood types may be slightly more susceptible to COVID-19 than others, paper suggests. Retrieved May 11, from https://www.sciencealert.com/paper-suggests-certain-blood-types-might-be-slightly-more-susceptible-to-covid-19

Bruder, M., Haffke, P., Neave, N., Nouripanah, N., & Imhoff, R. (2013). Measuring individual differences in generic beliefs in conspiracy theories across cultures: Conspiracy Mentality Questionnaire. *Frontiers in Psychology, 4*, 225.

Buchanan, T., & Benson, V. (2019). Spreading disinformation on Facebook: Do trust in message source, risk propensity, or personality affect the organic reach of "fake news"?. *Social Media+ Society, 5*(4), 2056305119888654.

del Vicario, M., Bessi, A., Zollo, F., Petroni, F., Scala, A., Caldarelli, G., ... & Quattrociocchi, W. (2016). The spreading of misinformation online. *Proceedings of the National Academy of Sciences*, *113*(3), 554-559.

Dodd, M. D., Balzer, A., Jacobs, C. M., Gruszczynski, M. W., Smith, K. B., & Hibbing, J. R. (2012). The political left rolls with the good and the political right confronts the bad: Connecting physiology and cognition to preferences. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 367*, 640–649.

Duckitt, J., Bizumic, B., Krauss, S. W., & Heled, E. (2010). A tripartite approach to right-wing authoritarianism: The authoritarianism-conservatism-traditionalism model. *Political Psychology, 31*(5), 685-715.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149-1160.

Goertzel, T. (1994). Belief in conspiracy theories. *Political Psychology, 15*, 731-742.

Guess, A., Nagler, J., & Tucker, J. (2019). Less than you think: Prevalence and predictors of fake news dissemination on Facebook. *Science Advances, 5*(1), eaau4586.

Hartman, R. O., Dieckmann, N. F., Sprenger, A. M., Stastny, B. J., & DeMarree, K. G. (2017). Modeling attitudes toward science: Development and validation of the credibility of science scale. *Basic and Applied Social Psychology, 39*, 358–371.

Holbrook, C., Lopez-Rodriguez, L., & Gomez, A. (2018). Battle of wits: Militaristic conservatism and warfare cues enhance the perceived intellect of allies versus adversaries. *Social Psychological and Personality Science, 8*, 670–678.

Inbar Y., Pizarro, D. A., Iyer R., & Haidt, J. (2012). Disgust sensitivity, political conservatism, and voting. *Social Psychological and Personality Science, 3*, 537–544

Lewandowsky, S., Gignac, G. E., & Oberauer, K. (2013). The role of conspiracist ideation and worldviews in predicting rejection of science. *PLoS ONE, 8*, e75637.

Lewandowsky, S., Oberauer, K., & Gignac, G. E. (2013). NASA faked the moon landing – Therefore, (climate) science is a hoax an anatomy of the motivated rejection of science. *Psychological Science, 24*, 622–633.

Lobato, E. J. C., Mendoza, J., Sims, V. K., & Chin, M. G. (2014). Examining the relationship between conspiracy theories, paranormal beliefs, and pseudoscience acceptance. *Applied Cognitive Psychology, 28,* 617–625

Mosleh, M., Pennycook, G., & Rand, D. G. (2020). Self-reported willingness to share political news articles in online surveys correlates with actual sharing on Twitter. *PLoS ONE, 15*(2), e0228882.

Pennycook, G., McPhetres, J., Bago, B., & Rand, D. (2020). Predictors of attitudes and misperceptions about COVID-19 in Canada, the UK, and the USA. PsyArXiv. https://doi.org/10.31234/osf.io/zhjkp

Pennycook, G., & Rand, D. G. (2020). Who falls for fake news? The roles of bullshit receptivity, overclaiming, familiarity, and analytic thinking. *Journal of Personality, 88,* 185-200.

Pratto, F., Cidam, A., Stewart, A. L., Zeineddine, F. B., Aranda, M., Aiello, A., ... & Eicher, V. (2013). Social dominance in context and in individuals: Contextual moderation of robust effects of social dominance orientation in 15 languages and 20 countries. *Social Psychological and Personality Science, 4*(5), 587-599.

Samore T., Fessler D. M. T., Holbrook C., Sparks A. M. (2018). Electoral fortunes reverse, mindsets do not. *PLoS ONE 13*(12), e0208653.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston: Pearson.

Terrizzi J. A., Shook N. J., & McDaniel M. A. (2013). The behavioral immune system and social conservatism: A meta-analysis. *Evolution Human Behavior, 34,* 99–108.

Tybur, J. M., Inbar, Y., Aarøe, L., Barclay, P., Barlow, F. K., De Barra, M., ... & Consedine, N. S. (2016). Parasite stress and pathogen avoidance relate to distinct dimensions of political ideology across 30 nations. *Proceedings of the National Academy of Sciences, 113*(44), 12408-12413.

Van der Linden, S. (2015). The conspiracy-effect: Exposure to conspiracy theories (about global warming) decreases pro-social behavior and science acceptance. *Personality and Individual Differences, 87,* 171-173.

van der Linden, S., Panagopoulos, C., Azevedo, F., & Jost, J. T. (2020). The Paranoid Style in American Politics Revisited: An Ideological Asymmetry in Conspiratorial Thinking. *Political Psychology*. DOI: 10.1111/pops.12681

Vosoughi, S., Roy, D., & Aral, S. (2018). The spread of true and false news online. *Science, 359*(6380), 1146-1151.

Wood, M. J., Douglas, K. M., & Sutton, R. M. (2012). Dead and alive: Beliefs in contradictory conspiracy theories. *Social Psychological and Personality Science, 3*(6), 767-773.

World Health Organization (2020). Naming the coronavirus disease (COVID-19) and the virus that causes it. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it.

Acknowledgements

Chapter 4, in full, is a reprint of the material as it appears in Factors Predicting the Willingness to Share COVID-19 Misinformation. Lobato, Emilio J. C.; Powell, Maia; Padilla, Lace; Holbrook, Colin. Lobato, Powell, Padilla, & Holbrook, 2020. The dissertation author was the primary investigator and author of this paper.

Chapter 5 Prejudice is Epistemically Unwarranted Belief

5.1 Introduction

Collectively, pseudoscience, conspiracy theories, and paranormal beliefs have been termed *epistemically unwarranted beliefs* (Lobato, Mendoza, Sims, & Chin, 2014), reflecting the common feature across these beliefs that they lack epistemic warrant, which refers to the "totality of evidence and knowledge that is available to human knowledge-seekers at the time in question" (p. 239, Hansson, 2009). Referencing these beliefs collectively also acknowledges the intermingling of pseudoscientific, conspiratorial, and paranormal components common within such claims. For example, paranormal claims about extraterrestrial visitations are frequently intermixed with conspiracy allegations of government cover-ups, Area 51, and "men in black". Despite the discrete labels "pseudoscience", "conspiracy theory", and "paranormal", there appears to be considerable overlap in the ways such claims are understood, embraced, and socially deployed. Here, we integrate the psychology of epistemically unwarranted beliefs with the psychology of social prejudices. The co-occurrence of prejudicial beliefs with other epistemically unwarranted beliefs has not received much explicit attention, even though socially prejudicial empirical claims frequently resemble and deploy rhetoric akin to other epistemically unwarranted beliefs. For example, the Great Replacement is a longstanding antisemitic allegation that a secret cabal of Jews – sometimes called the New World Order – is working towards world domination by replacing white populations with non-white populations (Joyce, 2021). In addition to being prejudicial, the claim is a conspiracy theory and contains pseudoscientific elements, specifically essentialist claims about race that run counter to consensus views in genetics (cf. ASGH, 2018). Insofar as prejudicial beliefs manifest themselves as empirical claims that are alleged to be scientific, assert the existence of conspiratorial plots, or entertain the existence of paranormal phenomena, we posit that prejudicial beliefs are epistemically unwarranted beliefs rather than something distinct. In this paper, we will present evidence across two studies of common socio-cognitive variables associated with level of endorsement of both prejudicial and non-prejudicial epistemically unwarranted beliefs, and we will argue based on the presented evidence that a more explicit integration of research on prejudice with research on epistemically unwarranted beliefs can benefit efforts to develop strategies intended to mitigate the endorsement and diffusion of epistemically unwarranted beliefs. The variety of negative individual, social, and environmental outcomes associated with believing epistemically unwarranted beliefs – ranging from individuals abstaining from evidence-based medicine in favor of alternative medical pseudoscientific claims (Hermes, 2018) to incidents of mass shootings motivated partly by racist pseudoscience and conspiracy theories (Wedow, Martschenko, & Trejo, 2022) – necessitates research such as this, building a more comprehensive understanding of epistemically unwarranted belief in service of efforts intended to inoculate and dissuade people from endorsing such nonsensical claims.

The relevance of prejudice to the study of epistemically unwarranted beliefs has gone largely unrecognized in prior research. Studies of belief in unwarranted pseudoscientific, conspiratorial, or paranormal claims rarely consider examples that intersect with social prejudices (e.g., Čavojová, Šrol, & Jurkovič, 2020; Dyer & Hall, 2019; Lewandowsky, Oberauer, & Gignac, 2013; Rizeq, Flora, & Toplak, 2021). In the

rare instances where researchers have included items measuring some prejudicial belief, these have typically accounted for but a few items in the ad hoc questionnaires deployed, without comment concerning their prejudicial nature (e.g., Fasce & Picó, 2019; Lobato et al., 2014; McLaughlin & McGill, 2017).

Despite a lack of research broadly examining prejudice in the context of epistemically unwarranted beliefs, there are a few studies that have more narrowly related specific epistemically unwarranted beliefs to specific prejudices. Swami (2012) found that endorsement of antisemitic conspiracy theories was correlated both with a general conspiracist ideation and with a measure of anti-Chinese racism. Similarly, Kofta and colleagues (2020) reported that inducing a sense of political uncontrollability resulted in an increase in endorsement of antisemitic conspiracy beliefs and stereotypes about Jewish people, and that belief in antisemitic conspiracies predicted belief in other conspiracy theories as well as a general tendency towards conspiracist ideation. Jolley, Meleady, and Douglas (2020) as well reported a study finding that exposure to antisemitic conspiracy theories not only increased antisemitic sentiments, but increased prejudicial sentiments to unrelated outgroups. In fact, the most studied intersection of prejudice with epistemically unwarranted beliefs is the specific intersection of conspiracy beliefs and antisemitism (for review, see Biddlestone, Chichoka, Zezelj, & Bilewicz, 2020). Beyond that particular line of research, Dambrun (2004) reported two studies examining astrology beliefs and prejudice towards marginalized groups in France, finding small-to-modest positive relationships with prejudicial views about Arab people, women, overweight people, and poor people. Most recently, there is evidence of a link between racist and homophobic attitudes and the rejection of biological evolutionary theory, partially mediated by speciesist attitudes categorizing human beings as intrinsically distinct from and superior to non-human animals (Syropoulos et al., 2022). Syropoulos and colleagues found that this link between rejection of evolutionary theory and endorsement of prejudicial views included increased endorsement of militaristic and conflict-oriented views towards outgroups. The latter association with conflictual intergroup attitudes suggests a possible role for social dominance orientation (SDO; Ho et al., 2015; Kugler et al., 2010) in the endorsement of epistemically unwarranted beliefs. Social dominance orientation refers to "an individual's preference for group-based hierarchy and inequality" (p. 584, Ho et al., 2015). Though SDO is associated with broad socio-cognitive constructs such as political orientation (i.e., higher SDO is associated with stronger political conservatism), the emphasis on the naturalness and desirability of a socially stratified and unequal society makes the construct of SDO an ideal socio-cognitive variable for exploring the potential relationship between epistemically unwarranted beliefs that are overtly prejudicial and those that are not overtly prejudicial. There is a robust association between a SDO and various intergroup prejudices (Ho et al., 2015), and SDO has also been found to predict both belief in and willingness to spread COVID-19 pandemic conspiracy theories (Lobato, Powell, Padilla, & Holbrook, 2020; Zubielevitch, Satherley, Sibley, & Osborne, 2024) as well as climate change denialism (Jylhä, Cantal, Akrami, & Milfont, 2016).

Nonetheless, existing work provides a fruitful foundation for understanding the potential shared psychological profile underlying endorsement of prejudice and other non-prejudicial epistemically unwarranted beliefs. For example, there is a robust association between cognitive style and endorsement of epistemically unwarranted beliefs, such that an analytical cognitive style predicts low endorsement of epistemically

unwarranted beliefs and an intuitive cognitive style predicts greater endorsement (e.g., Lindeman, 2011; Lindeman & Aarnio, 2007; Lobato et al., 2014; Pennycook, Fugelsang, & Koehler, 2015; Swami et al., 2014). These findings parallel research linking cognitive style and racist attitudes (Epstein et al., 1996; Hogan & Mallet, 2005) and preferences for social inequality (Kugler, Cooper, & Nosek, 2010). This suggests a possible association between a person's cognitive style and their inclination to endorse prejudicial epistemically unwarranted beliefs alongside non-prejudicial unwarranted beliefs.

When considered together, the foregoing results are consistent with the premise that prejudicial and non-prejudicial unwarranted beliefs are rooted in common socio-cognitive mechanisms. We investigated this putative relationship by testing two broadly related predictions: (1) there are significant positive correlations between peoples' beliefs in prejudicial and non-prejudicial epistemically unwarranted beliefs, and (2) there is a shared socio-cognitive profile predicting (dis)belief in both prejudicial and non-prejudicial epistemically unwarranted beliefs. We collected a number of candidate variables which might plausibly make up part of this putative socio-cognitive profile, specifically cognitive style, SDO, and perceptions of the credibility of science. We predicted that: (2a) analytical, reflective thinking would negatively correlate with both prejudicial and non-prejudicial epistemically unwarranted beliefs, (2b) intuitive, experiential thinking would positively correlate with endorsement of both prejudicial and non-prejudicial epistemically unwarranted beliefs, (2c) SDO would positively correlate with endorsement of both prejudicial and non-prejudicial epistemically unwarranted beliefs, and (2d) perceptions of science as credible would negatively correlate with endorsement of both prejudicial and non-prejudicial epistemically unwarranted beliefs.

5.1.1 Open Practices Statement

Preregistered design and analysis plans, as well as full data and stimuli for these studies are uploaded to OSF and can be reviewed at https://osf.io/75ema/?view_only=dfc7b1aa072945509249ca963288866c. Of note, the present studies represent the first phase of a larger, multi-phase project examining epistemically unwarranted beliefs. Some measures administered during the studies reported below are not described in this manuscript as they were not analyzed at this phase of the project, though they are included in the OSF website for this study.

5.2 Study 1

5.2.1 Method

5.2.1.1 Participants

We recruited a convenience sample of 411 adult U.S. online participants via Prolific, in exchange for $2 in compensation. After removing participant response sets with incomplete data, our final sample size was 401 (age: M = 36.5 years, SD = 12.8 years; Male = 189, Female = 195, Other/Non-binary = 15; Prefer not to say = 2).

5.2.1.2 Materials and Procedure.

We used Qualtrics to design and administer our survey, comprised of several questionnaires. The first questionnaire was an ad hoc Epistemically Unwarranted Beliefs Questionnaire (see Table 7) developed for this study and based on prior literature examining endorsement of various epistemically unwarranted beliefs (e.g., Fasce & Picó,

2019; Lewandowsky et al., 2013; Lobato et al., 2014; McLaughlan & McGill, 2017; Swami, 2012). Participants were asked to rate their level of agreement on a six-point Likert scale (1 = *Strongly disagree*; 6 = *Strongly agree*) with 18 claims categorized *a priori* as pseudoscience claims, conspiracy theories, or paranormal claims. Half of the claims are connected to socially prejudicial beliefs and half are not. As such, the questionnaire is intended to tap into six distinct varieties of epistemically unwarranted belief: Non-Prejudicial Pseudoscience, Prejudicial Pseudoscience, Non-Prejudicial Conspiracies, Prejudicial Conspiracies, Non-Prejudicial Paranormal beliefs, and Prejudicial Paranormal beliefs. Each statement was worded such that agreement represents endorsement of an epistemically unwarranted belief on the underlying topic. The questionnaire was presented to participants as a questionnaire assessing their agreement with a variety of cultural, historical, and scientific topics that have been a part of popular culture discussions over the past several decades.

We next administered the following individual difference measures:

The Rational-Experiential Inventory (REI, Norris & Epstein, 2011) is a 42-item measure of participants' dispositions towards Type 1 and Type 2 thinking styles. The questionnaire has four subscales, Rational, Imaginative, Emotional, and Intuitive. The Rational subscale is a coherent measure of an analytical, reflective thinking style. The Imaginative, Emotional, and Intuitive subscales measure different facets of an overall experiential thinking style. Participants are asked to respond on a 5-point Likert scale (1 = *Strongly Disagree*, 5 = *Strongly Agree*) to statements such as "I enjoy problems that require hard thinking" and "I trust my initial feelings about people." For this study, we only pre-registered predictions and analyses for the Rational (ω_t = .93, 95% CI [.92, .95]) and Intuitive subscales (ω_t = .81, 95% CI [.69, .87]), given that we could not find prior relevant research for the Imaginative or Emotional measures for which we could justify predictions.

The SDO_7 scale (Ho et al., 2015) is a 16-item measure of SDO comprised of two subscales, one measuring the Dominance facet of SDO (ω_t = .91, 95% CI [.90, .96]) and one measuring the Anti-Egalitarian facet of SDO (ω_t = .94, 95% CI [.94, .96]). Participants use a 7-point Likert scale (1 = *Strongly Oppose*, 7 = *Strongly Favor*) to indicate how much they favor or oppose ideas represented in statements such as "Some groups of people are simply inferior to other groups" and "We should work to give all groups an equal chance to succeed."

The Credibility of Science Scale (CoSS, Hartman et al., 2017) is a 6-item questionnaire measuring participants' general attitudes about science (ω_t = .96, 95% CI [.95, .97]). Participants are asked to rate their level of agreement with statements about the credibility and influence of the scientific community such as "Sometimes I think we put too much faith in science," using a 7-point Likert scale (1 = *Disagree very strongly*, 7 = *Agree very strongly*).

Finally, participants completed a brief demographics questionnaire.

5.2.2 Data Analysis Plan

In this section, we will describe our pre-registered data analysis strategy and explain where we deviate from our pre-registered plan. To assess the validity of our *a priori* categorization of the epistemically unwarranted beliefs, we first planned to examine the internal reliability of the items in the *ad hoc* epistemically unwarranted beliefs scale via

Table 6. Epistemically Unwarranted Belief Questionnaire items and mean level of agreement

	Study 1 Mean (SD)	Study 2 Mean (SD)
Non-Prejudicial Pseudoscience		
1) Childhood vaccines have been shown to cause disorders such as autism.	1.77 (1.13)	2.00 (1.29)
2) Due to well demonstrated biological reasons, negative emotions and unsolved conflicts or traumas increase the probability of having cancer.	2.96 (1.34)	2.94 (1.29)
3) Most human beings only use approximately 10% of their brain.	2.69 (1.56)	2.73 (1.58)
Prejudicial Pseudoscience		
4) Black people's skin is thicker than white people's.	2.01 (1.19)	2.07 (1.18)
5) Racial groups vary in their abilities because of biological differences between them.	2.49 (1.50)	2.46 (1.43)
6) A person chooses to be homosexual, bisexual, or heterosexual.	2.12 (1.50)	2.36 (1.60)
Non-Prejudicial Conspiracy Theories		
7) The Apollo moon landings never happened and were staged in a Hollywood film studio.	1.54 (1.00)	1.59 (0.98)
8) The assassination of John F. Kennedy was not committed by the lone gunman, Lee Harvey Oswald, but was rather a detailed, organized conspiracy to kill the President.	2.73 (1.45)	2.84 (1.51)
9) In the 1980s, the Coca-Cola company intentionally changed to an inferior formula with the intent of driving up demand for their classic product, later reintroducing it for their financial gain.	3.10 (1.39)	2.96 (1.30)
Prejudicial Conspiracy Theories		
10) A powerful and secretive group known as the New World Order is planning to eventually rule the world by replacing the white race with easier to control non-white people.	1.67 (1.05)	1.84 (1.26)
11) COVID-19 was deliberately created in a Chinese virology lab to be released as a bioweapon.	2.24 (1.41)	2.58 (1.58)
12) World banking is dominated by Jewish families.	2.04 (1.28)	2.29 (1.40)
Non-Prejudicial Paranormal Claims		
13) It has been scientifically proven that some people have extrasensory abilities (such as telepathy or precognition).	2.37 (1.46)	2.37 (1.43)
14) After people die, they still interact with the living as ghosts.	2.51 (1.40)	2.40 (1.34)
15) An ape-like mammal, sometimes called Bigfoot, roams the forests of America.	2.15 (1.35)	2.13 (1.25)
Prejudicial Paranormal Claims		
16) Alien visitors to earth taught ancient uncivilized cultures the technology to build pyramids.	2.03 (1.22)	2.06 (1.26)
17) The Ancient Maya people predicted that the world would end in 2012.	3.02 (1.59)	2.93 (1.57)
18) An ancient curse placed on the tomb of Egyptian Pharaoh King Tut actually killed people.	2.10 (1.19)	2.05 (1.23)

Notes. Study 1 $N = 401$; Study 2 $N = 575$

Cronbach's alpha. However, upon subsequent readings on psychometric reliability, we deviated from this planned analysis in favor of measuring mean inter-item correlations, which is preferable when there are few indicators being assessed (Clark & Watson, 1995). Following this analysis, we planned to conduct a confirmatory factor analysis (CFA). The initial plan, contingent on acceptable reliability of the six factors, was to examine the validity of a six-factor structure. Deviating from this plan slightly, and following a recommendation from reviewers, we subsequently conducted a two-factor and three-factor model CFA, allowing us to compare which factor structure we should retain for subsequent analyses.

After examining the psychometric structure of our *ad hoc* measure of epistemically unwarranted beliefs, we planned to analyze the relationship between epistemically unwarranted belief acceptance and participant scores on the socio-cognitive measures we administered. We planned to conduct a canonical correlation analysis (CCA). This multivariate analytic technique is well-suited for examining relationships between sets of predictor variables and sets of criterion variables, by creating synthetic variates representing linear combinations of the set of predictor or set of criterion variables and then regressing the synthetic criterion variate onto the synthetic predictor variate (Stevens, 2009; Tabachnik & Fidell, 2013; Wang et al., 2020). This analysis strategy is analogous to the more familiar univariate linear multiple regression in several ways. In linear multiple regression, beta weights are applied to the observed scores of the predictor variables and then the sum of these weighted observed variables produces the predicted value of the outcome variable. Then, the predicted outcome value is correlated with the actual outcome value. In CCA, the analogue of the standardized beta weights is called the standardized canonical function coefficients. However, whereas in univariate regression there is only one outcome variable, and thus only requires one linear equation applied to the predictor variables, CCA is a multivariate analysis and a similar linear equation is used on the set of outcome variables, which are similarly weighted by their own canonical function coefficients. Then the synthetic outcome variate is regressed onto the synthetic predictor variate, producing a squared canonical correlation that is the CCA analogue to the R^2 from linear regression. This process repeats, creating orthogonal models attempting to explain residual variance from the earlier-created model(s) until either all variance between the predictor and outcome variables is explained or until the analysis produces a number of models equal to the number of variables in whichever set of predictors or outcomes is smaller. In addition to the function coefficients, this analysis produces structure coefficients, which are the bivariate Pearson's *r* between the observed variable and the synthetic variate and are used to aid interpreting the nature of the synthetic variate. A high ratio of participants to variables (>20:1) is recommended for reliably interpreting the results of CCA (Stevens, 2009). In study 1, we had a ratio of 44:1; in study 2 we had a ratio of 63:1.

We conducted our analyses in R (version 4.2.1 "Funny-Looking Kid") using RStudio (Build 561 "Mountain Hydrangea"). We used the *lavaan* package (Rosseel, 2012, version 0.6-14) for conducting the CFAs and the *candisc* package (Friendly & Fox, 2021, version 0.8-6) for conducting the CCAs.

Table 7. Correlation matrix of the Epistemically Unwarranted Beliefs questionnaire subscales and individual difference measures, Study 1. 95% Confidence Intervals in brackets.

	1	2	3	4	5	6	7	8	9	10	11
1. Pseudoscience Non-Prejudice	-	0.48 [0.40, 0.55]	0.47 [0.39, 0.54]	0.55 [0.47, 0.61]	0.47 [0.39, 0.54]	0.54 [0.47, 0.61]	-0.02 [-0.12, 0.08]	0.30 [0.21, 0.39]	-0.49 [-0.56, -0.41]	0.26 [0.16, 0.35]	0.24 [0.15, 0.33]
2. Pseudoscience Prejudice		-	0.45 [0.37, 0.52]	0.66 [0.60, 0.71]	0.34 [0.25, 0.43]	0.43 [0.35, 0.51]	-0.05 [-0.14, 0.05]	0.18 [0.08, 0.27]	-0.53 [-0.60, -0.46]	0.56 [0.49, 0.63]	0.52 [0.45, 0.59]
3. Conspiracy Non-Prejudice			-	0.61 [0.54, 0.66]	0.46 [0.38, 0.53]	0.51 [0.43, 0.58]	-0.06 [-0.16, 0.04]	0.25 [0.16, 0.34]	-0.50 [-0.57, -0.42]	0.17 [0.07, 0.26]	0.15 [0.06, 0.25]
4. Conspiracy Prejudice				-	0.46 [0.38, 0.54]	0.53 [0.46, 0.60]	-0.04 [-0.14, 0.06]	0.23 [0.14, 0.32]	-0.64 [-0.69, -0.57]	0.46 [0.38, 0.54]	0.46 [0.38, 0.54]
5. Paranormal Non-Prejudice					-	0.70 [0.64, 0.75]	0.01 [-0.09, 0.10]	0.39 [0.31, 0.47]	-0.37 [-0.45. , -0.28]	0.13 [0.04, 0.23]	0.09 [-0.01, 0.19]
6. Paranormal Prejudice						-	-0.01 [-0.11, 0.08]	0.33 [0.24, 0.42]	-0.44 [-0.51, -0.35]	0.25 [0.15, 0.34]	0.18 [0.09, 0.28]
7. REI Rational							-	0.00 [-0.09, 0.10]	0.09 [-0.01, 0.19]	-0.01 [-0.11, 0.09]	0.01 [-0.09, 0.11]
8. REI Intuitive								-	-0.29 [-0.38, -0.20]	0.10 [0.00, 0.19]	0.00 [-0.09, 0.10]
9. Credibility of Science Scale									-	-0.35 [-0.43, -0.26]	-0.42 [-0.50, -0.34]
10. SDO_7 Dominance										-	0.72

										[0.66, 0.76]
11. SDO_7 Anti Egalitarian										-

Note. N = 401
REI = Rational-Experiential Inventory
SDO_7 = Social Dominance Orientation

5.2.3 Results

We first analyzed the *a priori* factor structure of the epistemically unwarranted beliefs questionnaire. Based on the small number of indicators for each subscale, we calculated the mean inter-item correlation between the three indicators for each subscale: Pseudoscience Non-prejudice items (r = .29), Pseudoscience Prejudice (r = .41), Conspiracy Non-prejudice (r = .40), Conspiracy Prejudice (r = .56), Paranormal Non-prejudice (r = .58), Paranormal Prejudice (r = .39). These values generally suggest the items in each subscale are sufficiently related without indicating problematic redundancy between the items, although the values for Conspiracy Prejudice items and Paranormal Non-Prejudice items were slightly higher than recommended (Clark & Watson, 1995).

We next conducted a confirmatory factor analysis (CFA) with maximum likelihood estimation to assess the validity of the six-factor model structure. Fit indices generally revealed acceptable-to-good model fit with the data, χ^2 = 335, df = 120, p < .001, CFI = .92, TLI = .90, RMSEA = .067, and SRMR = .052, with only the χ^2 index suggesting less than good model fit. Further, this model was identified, with a factor complexity of 1. For comparison, we assessed the fit of a two-factor (prejudicial, non-prejudicial) and a three-factor (pseudoscience, conspiracy, paranormal) model alternative. For the two-factor model, fit indices were generally poor, χ^2 = 743, df = 134, p < .001, CFI = .78, TLI = .75, RMSEA = .107, and SRMR = .077, with only the SRMR indicating acceptable model fit. For the three-factor model, fit indices improved but were still generally poorer than the six-factor solution, χ^2 = 425, df = 132, p < .001, CFI = .90, TLI = .88, RMSEA = .074, and SRMR = .062, with only the CFI and SRMR suggesting acceptable model fit. We therefore retained the six-factor model for subsequent analysis on the predictors of epistemically unwarranted beliefs. Consistent with Prediction 1, there were medium to strong positive correlations (ranging from r = .34 to r = .70) between endorsement of prejudicial and non-prejudicial epistemically unwarranted beliefs (see Table 8). A sensitivity analysis conducted with G*Power 3.1 (Faul et al., 2009) revealed that our sample size was sufficient to reliably detect correlations greater than |0.10| at 95% power with α = 0.05.

Next, we conducted a CCA where the six factors in the Epistemically Unwarranted Belief questionnaire (Pseudoscience Non-Prejudice, Pseudoscience Prejudice, Conspiracy Non-prejudice, Conspiracy Prejudice, Paranormal Non-prejudice, and Paranormal Prejudice) were entered as criterion variables, and the individual difference measures (REI – Rational and Intuitive subscales, CoSS, and SDO_7 Dominance and Anti-Egalitarian subscales) were entered as predictor variables.

Table 8. Standardized canonical function coefficients for Study 1

	Function 1	Function 2	Function 3
Individual Difference Measures			
REI - Rational	0.00	-0.05	0.13
REI - Intuitive	-0.10	**-0.55**	**0.82**
Credibility of Science	**0.65**	**0.53**	**0.76**
SDO_7 - Dominance	**-0.40**	**0.42**	**0.50**
SDO_7 – Anti-Egalitarian	-0.15	**0.47**	0.05
Epistemically Unwarranted Belief subscales			
Pseudoscience Non-prejudice	-0.13	**-0.36**	-0.06
Pseudoscience Prejudice	**-0.46**	**0.71**	**0.55**
Conspiracy Non-prejudice	0.03	**-0.56**	**-0.78**
Conspiracy Prejudice	**-0.54**	**0.23**	**-0.56**
Paranormal Non-prejudice	0.05	**-0.57**	**0.76**
Paranormal Prejudice	-0.08	-0.04	0.29

Note. REI = Rational-Experiential Inventory; SDO = Social Dominance Orientation.
Bolded items indicate coefficients > |.30|

The full model was significant, Wilk's $\lambda = .32$, $F(5, 395) = 73.08$, $p < .001$, producing five functions with squared canonical correlations of .56, .21, .05, .007, and < .001 respectively. Only the first three functions were significant with $p < .001$, < .001, and = .021 respectively (see Tables 3 and 4).

The first function explained 79% of the explained variance in the full model, canonical $R^2 = 0.56$, Wilk's $\lambda = .33$, $F(30, 1562) = 16.87$, $p < .001$. The criterion variables that substantially contributed to the synthetic criterion variate (i.e., had standardized coefficients greater than |.30|) were the Pseudoscience Prejudice and Conspiracy Prejudice subscales of the Epistemically Unwarranted Beliefs questionnaire (see Table 9). The predictor variables that substantially contributed to the synthetic predictor variate (i.e., had standardized coefficients greater than |.30|) were the Credibility of Science Scale and the Dominance subscale of the SDO_7. This function suggests that higher perceptions of science as a credible enterprise and lower dispositions towards social dominance predict lower endorsement of both pseudoscientific and conspiratorial claims of an overtly prejudiced nature.

For the first function, the standardized canonical structure coefficients (see Table 10) reveal substantial correlations between the Intuitive subscale of the REI and the Anti-Egalitarian subscale of the SDO_7 alongside the Credibility of Science Scale and Dominance subscale of the SDO_7 measure with the synthetic predictor variate, and substantial correlations of all the epistemically unwarranted belief subscales with the synthetic criterion variate. These correlations suggest that a latent socio-cognitive profile largely made up of skeptical perceptions of science and a dominance orientation are also strongly associated with an intuitive cognitive style and an anti-egalitarian orientation, and that for individuals with this socio-cognitive profile, all manner of epistemically unwarranted beliefs are treated relatively similarly, regardless of their content containing elements of pseudoscience, conspiracy, paranormality, or prejudice.

The second function explained 17% of the explained variance in the full model, canonical $R^2 = 0.21$, Wilk's $\lambda = .74$, $F(20, 1298) = 6.17$, $p < .001$. The criterion variables that substantially contributed to the synthetic criterion variate were the Pseudoscience Non-Prejudice, Pseudoscience Prejudice, Conspiracy Non-Prejudice, and Paranormal Non-Prejudice subscales of the Epistemically Unwarranted Beliefs questionnaire (see Table 9). The predictor variables that substantially contributed to the synthetic predictor variate were the Intuitive subscale of the Rational-Experience Inventory, the Credibility of Science Scale, and the Dominance and Anti-Egalitarian subscales of the SDO_7. This function suggests that individuals with a low disposition towards an intuitive cognitive style, a greater perception of science as credible, and greater dispositions towards social dominance and anti-egalitarianism were less likely to endorse the non-prejudicial epistemically unwarranted beliefs yet more likely to endorse pseudoscientific epistemically unwarranted beliefs that were overtly prejudicial.

Table 9. Standardized canonical structure coefficients for Study 1

	Function 1	Function 2	Function 3
Individual Difference Measures			
REI - Rational	0.06	-0.01	0.20
REI - Intuitive	**-0.33**	**-0.66**	**0.65**
Credibility of Science	**0.88**	**0.34**	**0.34**
SDO_7 - Dominance	**-0.74**	**0.51**	**0.35**
SDO_7 – Anti-Egalitarian	**-0.71**	**0.54**	0.09
Epistemically Unwarranted Belief subscales			
Pseudoscience Non-prejudice	**-0.65**	**-0.44**	0.05
Pseudoscience Prejudice	**-0.89**	0.23	0.19
Conspiracy Non-prejudice	**-0.59**	**-0.55**	**-0.40**
Conspiracy Prejudice	**-0.92**	-0.12	-0.19
Paranormal Non-prejudice	**-0.46**	**-0.67**	**0.51**
Paranormal Prejudice	**-0.59**	**-0.48**	**0.33**

Note. REI = Rational-Experiential Inventory; SDO = Social Dominance Orientation.
Bolded items indicate coefficients > |.30|

Finally, the third significant canonical function explained only 3% of explained variance in the full model, canonical $R^2 = 0.05$, Wilk's $\lambda = .94$, $F(12, 1037) = 2.00$, $p = .02$. The criterion variables that substantially contributed to the synthetic criterion variate were the Pseudoscientific Prejudice, Conspiracy Non-prejudice, Conspiracy Prejudice, and Paranormal Non-Prejudice subscales of the Epistemically Unwarranted Beliefs questionnaire (see Table 9). The predictor variables that substantially contributed to the synthetic predictor variate were the Intuitive subscale of the Rational-Experience Inventory, the Credibility of Science Scale, and the Dominance subscale of the SDO_7. This function suggests that individuals with a greater disposition towards an intuitive cognitive style, who held greater perceptions of science as credible, and who had higher dispositions towards social dominance were more likely to endorse prejudicial

pseudoscience beliefs and non-prejudiced paranormal beliefs, but were less likely to endorse either prejudicial or non-prejudicial conspiracy theories.

5.2.3 Discussion

Study 1 provides clear support for our prediction of substantial positive correlations between endorsing prejudicial and non-prejudicial unwarranted claims. Further, the canonical models revealed nuanced relationships between the assessed individual difference variables and endorsement of epistemically unwarranted beliefs. Contrary to our prediction, an analytical disposition was neither a substantial contributor to nor substantially correlated with any of the synthetic predictor variates. Regarding our other predictions, our findings suggest that there are distinct socio-cognitive profiles corresponding to greater or lesser endorsement of different kinds of epistemically unwarranted beliefs as a function of dispositions towards an intuitive style, social dominance, and perceptions of science. However, the nature of CCA is to find the linear combination of variables within a set that maximally explains the variance in a linear combination of variables within another set (Tabachnik & Fidell, 2013; Wang et al., 2020). As such, the resulting models may be an artifact of the sample, necessitating replication to confirm the analysis models. We therefore conducted a direct replication of Study 1.

5.3 Study 2

5.3.1 Method

5.3.1.1 Participants

We recruited a convenience sample of 600 participants from Prolific, using the same compensation and exclusion criteria in Study 1, additionally excluding participants from the first study. After removing participants with incomplete data, our final sample size was 575 (age: M = 39.1 years, SD = 14.5 years; Males = 310, Females = 249, Other/Non-binary = 14, Prefer not to say = 2).

5.3.1.2 Materials and Procedure

The materials and procedure were identical to those in Study 1. Reliability estimates and 95% CIs for the individual difference measures in Study 2 are as follows: REI-R (ω_t = .94 [.92, .96]), REI-I (ω_t = .83 [.82, .90]), SDO_7 Dominance (ω_t = .92 [.92, .97]), SDO_7 Anti-Egalitariansim (ω_t = .95 [.95, .97]), and CoSS (ω_t = .97 [.96, .98]).

5.3.2 Results

As in Study 1, we first calculated inter-item correlations for the three indicator items in each subscale: Pseudoscience Non-prejudice (r = .31), Pseudoscience Prejudice (r = .46), Conspiracy Non-prejudice (r = .37), Conspiracy Prejudice (r = .59), Paranormal Non-prejudice (r = .57), and Paranormal Prejudice (r = .38). These values were comparable to those found in Study 1.

We next conducted a CFA to assess whether the underlying assumed factor structure of the ad hoc Epistemically Unwarranted Belief Questionnaire would replicate. Fit indices generally revealed acceptable-to-good model fit with the data, χ^2 = 447, df = 120, p < .001, CFI = .92, TLI = .90, RMSEA = .069, and SRMR = .052, with only the χ^2 index suggesting less than good model fit. As with Study 1, this model was identified, with a factor complexity of 1. We therefore once again retained this six-factor model for

subsequent analysis. Closely replicating the results from Study 1, and again supporting our first prediction, endorsement of prejudicial and non-prejudicial epistemically unwarranted beliefs were positively correlated, with values ranging from $r = .33$ to $r = .68$ (see Table 11). As with study 1, a sensitivity analysis revealed that our sample was sufficient to reliably detect correlation values greater than |0.08| at 95% power with $\alpha = 0.05$.

We then carried out another CCA, identical in structure to that performed in Study 1. Participants' individual difference measure scores were entered as the set of predictor variables, and responses to the six Epistemically Unwarranted Beliefs Questionnaire subscales were entered as the set of criterion variables. As with Study 1, the full model was significant, Wilk's $\lambda = .40$, $F(5, 569) = 107.2$, $p < .001$, producing five functions with squared canonical correlations of .53, .09, .05, .01, and .001 respectively. Only the first three functions were significant with $p < .001$ for all three (see Tables 12 and 13).

As in Study 1, the first significant canonical function, which accounted for 87% of the explained variance in the full model (canonical $R^2 = 0.53$, Wilk's $\lambda = .40$, $F(30, 2258) = 19.29$, $p < .001$), had a synthetic predictor variate comprised substantially of a linear combination of the Credibility of Science Scale and the Dominance subscale of the SDO_7. Deviating slightly from the findings in Study 1, the contributions to the synthetic predictor variate by the Intuitive subscale of the REI were greater, with a standardized canonical function coefficient of -0.24 (compared to -0.10 in Study 1, compare Tables 9 and 12), only slightly below a typical cutoff of |0.30| to be considered a substantial contributor to the synthetic variate. Also as in Study 1, the synthetic criterion variate in this model was made up of substantial contributions by the Conspiracy Prejudice and the Pseudoscience Prejudice subscales, although the Pseudoscience subscale was now a much smaller contributor, with a standardized canonical function coefficient of -.26 (relative to -0.46 in Study 1, compare Tables 9 and 12). As with the results from Study 1, this function suggests that higher perceptions of science as a credible enterprise and a low disposition towards social dominance predicts a low endorsement of both pseudoscientific and conspiratorial claims of an overtly prejudicial nature. This model also suggests that a low disposition towards an intuitive cognitive style contributes to the latent socio-cognitive profile of people who reject prejudicial pseudoscience and conspiracy theories. The pattern of standardized canonical structure coefficients was identical to those found in Study 1 (compare Table 13 to Table 10).

The other two significant canonical functions from Study 1 did not replicate as cleanly. Given that the nature of CCA is to create orthogonal models to explain remaining variance not explained by earlier-created model(s) in the analysis, this is not entirely unexpected (Tabachnik & Fidell, 2013; Wang et al., 2020). The first canonical function explained more variance in the replication than in Study 1, leaving less residual variance for orthogonal models to explain. We describe the second and third canonical function here for the sake of completeness, though due to their substantial differences than the functions found in Study 1, we refrain from interpreting their explanatory value in the General Discussion.

Table 10. Correlation of the Epistemically Unwarranted Beliefs questionnaire subscales and individual difference measures, Study 2. 95% Confidence Intervals in brackets.

	1	2	3	4	5	6	7	8	9	10	11
1. Pseudoscience Non-Prejudice	-	0.51 [0.45, 0.57]	0.55 [0.49, 0.60]	0.61 [0.55, 0.65]	0.52 [0.45, 0.57]	0.52 [0.45, 0.57]	-0.12 [-0.20, -0.03]	0.28 [0.20, 0.35]	-0.52 [-0.58, -0.46]	0.30 [0.22, 0.37]	0.29 [0.21, 0.36]
2. Pseudoscience Prejudice		-	0.45 [0.39, 0.52]	0.66 [0.61, 0.71]	0.33 [0.25, 0.40]	0.43 [0.36, 0.49]	-0.16 [-0.24, -0.08]	0.18 [0.10, 0.26]	-0.52 [-0.57, -0.45]	0.49 [0.43, 0.55]	0.45 [0.38, 0.51]
3. Conspiracy Non-Prejudice			-	0.65 [0.59, 0.69]	0.51 [0.45, 0.57]	0.50 [0.44, 0.56]	-0.11 [-0.19, -0.03]	0.24 [0.16, 0.31]	-0.50 [-0.56, -0.44]	0.32 [0.25, 0.39]	0.28 [0.20, 0.35]
4. Conspiracy Prejudice				-	0.46 [0.39, 0.52]	0.49 [0.42, 0.55]	-0.15 [-0.23, -0.07]	0.25 [0.17, 0.33]	-0.64 [-0.68, -0.59]	0.50 [0.44, 0.56]	0.50 [0.43, 0.56]
5. Paranormal Non-Prejudice					-	0.68 [0.63, 0.72]	-0.13 [-0.20, -0.04]	0.36 [0.28, 0.43]	-0.34 [-0.41, -0.26]	0.25 [0.17, 0.32]	0.18 [0.10, 0.26]
6. Paranormal Prejudice						-	-0.11 [-0.19, -0.03]	0.33 [0.25, 0.40]	-0.39 [-0.46, -0.32]	0.31 [0.24, 0.38]	0.24 [0.16, 0.32]
7. REI Rational							-	-0.06 [-0.14, 0.02]	0.23 [0.15, 0.31]	-0.16 [-0.24, -0.08]	-0.11 [-0.19, -0.03]
8. REI Intuitive								-	-0.21 [-0.29, -0.13]	0.07 [-0.01 0.15]	0.01 [-0.07, 0.10]
9. Credibility of Science Scale									-	-0.47 [-0.53, -0.40]	-0.53 [-0.59, -0.47]
10. SDO_7 Dominance										-	0.75 [0.71, 0.78]
11. SDO_7 Anti Egalitarian											-

Note. N = 575. REI = Rational-Experiential Inventory. SDO_7 = Social Dominance Orientation

The second function explained 7% of the explained variance in the full model, canonical $R^2 = 0.09$, Wilk's $\lambda = .85$, $F(20, 1875) = 4.56$, $p < .001$. The predictor variables that substantially contributed to the synthetic predictor variate were the Intuitive subscale of the Rational-Experience Inventory and the Anti-Egalitarian subscale of the SDO_7. The criterion variables that substantially contributed to the synthetic criterion variate were the Pseudoscience Non-Prejudice, Pseudoscience Prejudice, Conspiracy Prejudice, and Paranormal Non-Prejudice subscales of the Epistemically Unwarranted Beliefs questionnaire (see Table 7). This function suggests that individuals with a high disposition towards an intuitive cognitive style and a low disposition towards anti-egalitarianism were more likely to endorse the non-prejudicial pseudoscience and both kinds of paranormal claims yet less likely to endorse overly prejudicial pseudoscientific or conspiratorial claims.

Finally, the third significant canonical function explained only 4% of explained variance in the full model, canonical $R^2 = 0.51$, Wilk's $\lambda = .93$, $F(12, 1498) = 3.23$, $p < .001$. The Pseudoscience Non-prejudice and Conspiracy Non-prejudice subscales contributed positively to the synthetic criterion variate, while the Pseudoscience Prejudice and Paranormal Non-Prejudice subscales contributed negatively. For the synthetic predictor variate, the Rational subscale of the REI contributed positively, while the Intuitive subscale of the REI, the CoSS, and the Dominance subscale of the SDO_7 contributed negatively. This function suggests individuals who are highly disposed to a reflective thinking style, have a low disposition towards an intuitive thinking style, have low perceptions of science as credible, and are not inclined towards SDO are more likely to endorse non-prejudicial pseudoscience and conspiracy claims, but less likely to endorse prejudicial pseudoscience claims and non-prejudicial paranormal claims.

Table 11. Standardized canonical function coefficients for Study 2

	Function 1	Function 2	Function 3
Individual Difference Measures			
REI – Rational	-0.00	-0.02	**0.31**
REI – Intuitive	-0.24	**0.80**	**-0.41**
Credibility of Science	**0.67**	-0.13	**-0.98**
SDO_7 – Dominance	**-0.34**	-0.08	**-0.78**
SDO_7 – Anti-Egalitarian	-0.07	**-0.58**	-0.14
Epistemically Unwarranted Belief subscales			
Pseudoscience Non-prejudice	-0.14	**0.38**	**0.84**
Pseudoscience Prejudice	-0.26	**-0.51**	**-0.69**
Conspiracy Non-prejudice	-0.09	0.14	**0.62**
Conspiracy Prejudice	**-0.57**	**-0.56**	0.06
Paranormal Non-prejudice	-0.01	**0.65**	**-0.68**
Paranormal Prejudice	-0.12	**0.31**	**-0.28**

Note. REI = Rational-Experiential Inventory; SDO = Social Dominance Orientation.
Bolded items indicate coefficients > |.30|

Table 12. Standardized canonical structure coefficients for Study 2

	Function 1	Function 2	Function 3
Individual Difference Measures			
REI – Rational	0.23	-0.03	0.25
REI – Intuitive	**-0.40**	**0.82**	-0.28
Credibility of Science	**0.92**	0.03	**-0.38**
SDO_7 – Dominance	**-0.72**	**-0.39**	**-0.51**
SDO_7 – Anti-Egalitarian	**-0.68**	**-0.55**	-0.25
Epistemically Unwarranted Belief subscales			
Pseudoscience Non-prejudice	**-0.73**	**0.36**	**0.36**
Pseudoscience Prejudice	**-0.81**	-0.28	-0.29
Conspiracies Non-prejudice	**-0.72**	0.24	**0.31**
Conspiracies Prejudice	**-0.95**	-0.12	0.06
Paranormal Non-prejudice	**-0.56**	**0.71**	**-0.33**
Paranormal Prejudice	**-0.64**	**0.53**	-0.27

Note. REI = Rational-Experiential Inventory; SDO = Social Dominance Orientation.
Bolded items indicate coefficients > |.30|

5.4 General Discussion

We obtained evidence in two pre-registered studies that prejudicial and non-prejudicial epistemically unwarranted beliefs are both substantially positively associated and predicted by a common socio-cognitive profile. This profile appears to be largely characterized by a combination of pessimism regarding the scientific establishment's credibility and high SDO, while also associated with an intuitive thinking style. These patterns replicated in both the initial study and the direct replication to a notably similar extent in the primary canonical functions explaining the great majority of variance for both studies, notwithstanding variation in the second and third canonical functions obtained in each study. Accordingly, the results support our proposed integration of research on epistemically unwarranted beliefs with research on the determinants of prejudicial social attitudes. Research on epistemically unwarranted beliefs should more directly and explicitly attend to prejudice, as our evidence favors viewing prejudicial claims as one manifestation of epistemically unwarranted beliefs.

The term "epistemically unwarranted belief" originated in the empirical literature as a category encompassing a very diverse array of beliefs (Lobato et al., 2014). Prior to that work, much of the empirical psychological literature that examined, for example, determinants and consequences of conspiracy theory endorsement tended to not explicitly address the contributions of science denial and pseudoscience promotion as important for understanding why some people endorsed conspiracy theories (though there were exceptions, e.g. Lewandowski et al., 2013). Since then, there has been a robust and informative program of research looking at epistemically unwarranted beliefs collectively. For example, the role of ontological confusions or category mistakes, originating from research showing that endorsement of paranormal beliefs increases positively with endorsement of ontological confusions (Lindeman & Aarnio, 2007), has

been found to generalize to conspiracy theories and pseudoscience (Lobato et al., 2014; Rizeq et al., 2021). As another example, research has also found evidence of reduced susceptibility to epistemically unwarranted beliefs as a result of taking college courses on critical thinking, including for beliefs not addressed directly by the course (Dyer & Hall, 2019; McLaughlin & McGill, 2017). The purpose of the present research is, partially, as a continuation of the research by Lobato and colleagues (2014) assessing the degree of shared covariation and predictors for kinds of beliefs that have typically been examined in isolation.

In this instance, as reviewed in the Introduction, the empirical research on epistemically unwarranted beliefs typically has predominantly overlooked the role of prejudice in the formation, maintenance, or revision of epistemically unwarranted beliefs (though there are again some exceptions, e.g., Syropoulos et al., 2022). Our results demonstrate both systematic covariation between the overtly prejudicial unwarranted beliefs and the not-overtly prejudicial unwarranted beliefs and shared socio-cognitive profiles associated with sets of these beliefs. However, as illustrated by the better fitting six-factor CFA model that differentiated between the prejudicial and non-prejudicial forms of the three major categories of epistemically unwarranted beliefs compared to the two- or three-factor models, these kinds of beliefs are not perfectly overlapping and do not represent a unitary dimension. Thus, the results of the CCA revealed not merely a single socio-cognitive profile predicting endorsement of epistemically unwarranted beliefs, but several different socio-cognitive profiles associated with endorsement of different subsets of epistemically unwarranted beliefs. This is not unexpected. Even though fewer items per factor relative to more items per factor can result in lower factor stability when sample sizes are low (Lloret-Segura, Ferreres-Traver, Hernández-Baeza, & Tomás-Marco, 2014), our sample size was relatively large and our results align with prior research on the multidimensionality of epistemically unwarranted beliefs (termed "contaminated mindware" in Rizeq et al., 2021). It is our hope that the research we present here can serve to motivate expanding research on epistemically unwarranted beliefs in a promising direction by explicitly attending to the contributions that peoples' beliefs about prejudicial claims make to their beliefs about other epistemically unwarranted claims, whether paranormal claims about extraterrestrial visitations or pseudoscientific claims about vaccine efficacy or some other nonsensical claim. Our treatment of prejudicial epistemically unwarranted beliefs as measured distinctly from non-prejudicial epistemically unwarranted beliefs should not, even considering the results of the CFA, be taken to mean that these different "kinds" of beliefs are truly separate constructs. Rather, just as Lobato and colleagues (2014) pointed out that "it can be difficult to tease apart when a pseudoscience or paranormal claim ends and a conspiracy claim begins" (p. 617) as reason for introducing the broad term 'epistemically unwarranted beliefs' in the first place, we are noting that prejudicial empirical claims do in fact frequently contain pseudoscientific, conspiratorial, or even paranormal elements. Thus, factors typically associated with prejudicial beliefs have the potential to have explanatory value for understanding epistemically unwarranted belief more generally.

It is worth noting that we assessed a limited selection of both epistemically unwarranted beliefs and socio-cognitive individual differences. Given the body of research examining the dimensionality of endorsing epistemically unwarranted beliefs (Čavojová et al., 2020; Dyer & Hall, 2019; Fasce & Picó, 2019; Lewandowsky et al.,

2013; Lobato et al., 2014; McLaughlin & McGill, 2017; Rizeq et al., 2021; Swami, 2012), there are hundreds of claims that we might have asked about, and should be explored in future work. Further, we did not systemically vary the items in our measure in terms of valence. For example, Pennycook and colleagues (2022) created an ad hoc measure of endorsement of 21 COVID-19 falsehoods, some of which were optimistic and some of which were pessimistic. For our study, the claims we investigated tended more towards negative valences, with no comparable set of epistemically unwarranted claims that promoted positive or optimistic unwarranted claims (e.g., about crystal healing or benevolent sexism). The generalizability of our findings is thus an open question due to this stimulus sampling problem (Wells & Windschitl, 1999). Likewise, the socio-cognitive variables we measured represent only a subset of socio-cognitive variables that have been assessed in the context of epistemically unwarranted belief acceptance (e.g., performance-based measures of cognitive style or measures of susceptibility to the conjunction fallacy) or prejudice (e.g., measures of authoritarianism or measures of essentialist thinking), which future research should explore. On this last point, authoritarianism is of particular interest to examine for future research, as recent research findings show that although both SDO and right-wing authoritarianism (RWA) are associated with endorsement of anti-LGBTQ+ conspiracy theories, the association of such prejudiced conspiracy theories with RWA is stronger than the association with SDO (Salvati, Pellegrini, De Cristofaro, Costacurta, & Giacomantonio, 2024). By contrast, other research shows that SDO is more strongly associated than RWA is with specific COVID-19 conspiracies alleging the disease was lab-created and that the health risks were deliberately exaggerated (Zubielevitch et al., 2024). This suggests that the relationship between epistemically unwarranted beliefs and various components of political orientation or worldview is likely quite nuanced, necessitating that research into unwarranted beliefs avoid viewing political orientation as a unidimensional construct of interest.

Future research efforts exploring the socio-cognitive dimensions associated with epistemically unwarranted beliefs should also examine how replicable prior findings are when considering overtly prejudicial pseudoscience or conspiracy claims. For example, both Lobato and colleagues (2014) and Rizeq and colleagues (2021) found that a propensity towards endorsing ontological confusions, or inappropriately ascribing essential features from one core ontological category (physical, biological, or psychological) to another category (e.g., ascribing psychological properties to purely physical phenomena), predicts higher endorsement of pseudoscientific, conspiratorial, and paranormal claims (see also, Lindeman & Aarnio, 2007). Given that many socially prejudicial views include aspects of dehumanization towards out-groups, which can be considered an analogous kind of category mistake, it is reasonable to examine the association of an ontologically confused worldview with the endorsement of explicitly prejudicial epistemically unwarranted beliefs.

Our findings have implications for the development of strategies to combat epistemically unwarranted beliefs. The association between SDO and the endorsement of a broad array of epistemically unwarranted belief types, including prejudicial unwarranted beliefs, suggests that scholarly communities should not focus solely on increasing their perceived credibility with the public. Rather, in addition to efforts to enhance trust in scientific expertise, scholarly communities should leverage science to

subvert empirically unwarranted assumptions prerequisite to social dominance motivations.

For example, let us consider race pseudoscience. Race pseudoscience is intrinsically hierarchical, advocates for a rigidly stratified society, and depends on the continued pseudoscientific claim of biological race categories. A unified scientific front rejecting this unfounded proposition may undermine efforts to maintain the veneer of scientific legitimacy that race pseudoscientists pretend to have. Indeed, professional organizations like the American Society for Human Genetics (2018), the American Association for Biological Anthropology (Fuentes et al., 2019), and the American Sociological Association (2003) have released anti-racism statements that explicitly reject the idea that "race" is a biological construct. By contrast, organizations like the Association for Psychological Science or Psychonomic Society do not explicitly reject "race" as a biological construct in their anti-racism statements (e.g., APS, 2020, 2021; Psychonomic Society, 2020). A recent meta-analysis on consensus messaging about socially controversial science topics such as climate change or genetically modified foods reveals positive effects for public endorsement of scientifically supported beliefs (van Stekelenburg et al., 2022), a pattern which should plausibly generalize to combating prejudicial forms of misinformation. The example of scientific messaging about the non-reality of biological race exemplifies an approach that combines credibility-enhancement—by promoting scientific consensus rather than allowing for the perception of scientific controversy—with a direct challenge of social dominance motivations—by rebuking a foundational claim that is used to advocate for intergroup dominance. Analogous approaches might be taken with respect to other forms of prejudice.

There is precedent for scholarly communities mobilizing at large scales to protect the integrity of science. When legislation requiring the teaching of creationism in U.S. public schools was pushed during the 1990s and 2000s, scholars from across disciplines and nations rallied in opposition. Scholarly communities should mobilize at similar scales in opposition to prejudice, as combating epistemically unwarranted beliefs may require scholars demonstrating that we are, for example, as vigorously anti-racist as we are anti-creationist.

5.5 References

American Society of Human Genetics (ASGH). (2018). ASGH Denounces Attempts to Link Genetics and Racial Supremacy. *American Journal of Human Genetics, 103*(5), 636.

American Sociological Association. (2003). The importance of collecting data and doing social science research on race. Retrieved September 15, 2023 from https://www.asanet.org/wp-content/uploads/race_statement.pdf

Association for Psychological Science. (2020, June 2). APS Statement on Confronting Racism and Discrimination. Retrieved September 15, 2023 from https://www.psychologicalscience.org/news/aps-statement-on-confronting-racism.html

Association for Psychological Science. (2021, May 5). Statement on Racism, Bias, and Intolerance. Retrieved September 15, 2023 from https://www.psychologicalscience.org/news/statement-on-racism-bias-and-intolerance.html

Biddlestone, M., Cichocka, A., Žeželj, I., & Bilewicz, M. (2020). Conspiracy theories and intergroup relations. In M. Butter & P. Knight (Eds.) *Routledge Handbook of Conspiracy Theories* (pp. 219-230). Routledge.

Čavojová, V., Šrol, J., & Jurkovič, M. (2020). Why should we try to think like scientists? Scientific reasoning and susceptibility to epistemically suspect beliefs and cognitive biases. *Applied Cognitive Psychology, 34*(1), 85-95.

Clark, L. A., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment, 7*(3), 309-319.

Dambrun, M. (2004). Belief in paranormal determinism as a source of prejudice toward disadvantaged groups: "The dark side of stars". *Social Behavior and Personality: An International Journal, 32*(7), 627-636.

Dyer, K. D., & Hall, R. E. (2019). Effect of critical thinking education on epistemically unwarranted beliefs in college students. *Research in Higher Education, 60*, 293-314.

Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in intuitive–experiential and analytical–rational thinking styles. *Journal of Personality and Social Psychology, 71*(2), 390.

Fasce, A., & Picó, A. (2019). Conceptual foundations and validation of the Pseudoscientific Belief Scale. *Applied Cognitive Psychology, 33*(4), 617-628.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149-1160.

Friendly, M. & Fox, J. (2021). *candisc: Visualizing generalized canonical discriminant and canonical correlation analysis*. R package version 0.8-6. https://cran.r-project.org/package=candisc

Fuentes, A., Ackerman, R. R., Athreya, S., Bolnick, D., Lasisi, T., Lee, S., McLean, S., & Nelson, R. (2019). AAPA Statement on Race and Racism. *American Journal of Physical Anthropology, 169*(3), 400-402.

Hansson, S. O. (2009). Cutting the Gordian knot of demarcation. *International Studies in the Philosophy of Science, 23*, 237–243.

Hartman, R. O., Dieckmann, N. F., Sprenger, A. M., Stastny, B. J., & DeMarree, K. G. (2017). Modeling attitudes toward science: development and validation of the credibility of science scale. *Basic and Applied Social Psychology, 39*(6), 358-371.

Hermes, B. M. (2018). An inside look at naturopathic medicine: A whistleblower's deconstruction of its core principles. In A. B. Kaufman & J. C. Kaufman (Eds.). *Pseudoscience: The conspiracy against science* (pp. 137–170). MIT Press.

Ho, A. K., Sidanius, J., Kteily, N., Sheehy-Skeffington, J., Pratto, F., Henkel, K. E., ... & Stewart, A. L. (2015). The nature of social dominance orientation: Theorizing and measuring preferences for intergroup inequality using the new SDO_7 scale. *Journal of Personality and Social Psychology, 109*(6), 1003.

Hogan, D. E., & Mallott, M. (2005). Changing racial prejudice through diversity education. *Journal of College Student Development, 46*(2), 115-125.

Jylhä, K. M., Cantal, C., Akrami, N., & Milfont, T. L. (2016). Denial of anthropogenic climate change: Social dominance orientation helps explain the conservative male effect in Brazil and Sweden. *Personality and Individual Differences, 98*, 184-187.

Jolley, D., Meleady, R., & Douglas, K. M. (2020). Exposure to intergroup conspiracy theories promotes prejudice which spreads across groups. *British Journal of Psychology, 111*(1), 17-35.
Joyce, S. (2021). Conspiracy narratives and American apocalypticism in The Turner Diaries. In B. Carver, D. Craciun, & T. Hristov (Eds.), *Plots: Literary Form and Conspiracy Culture*, pp. 130-143. Routledge.
Kofta, M., Soral, W., & Bilewicz, M. (2020). What breeds conspiracy antisemitism? The role of political uncontrollability and uncertainty in the belief in Jewish conspiracy. *Journal of Personality and Social Psychology, 118*(5), 900.
Kugler, M. B., Cooper, J., & Nosek, B. A. (2010). Group-based dominance and opposition to equality correspond to different psychological motives. *Social Justice Research*, *23*, 117-155.
Lewandowsky, S., Oberauer, K., & Gignac, G. E. (2013). NASA faked the moon landing—therefore, (climate) science is a hoax: An anatomy of the motivated rejection of science. *Psychological Science*, *24*(5), 622-633.
Lindeman, M. (2011). Biases in intuitive reasoning and belief in complementary and alternative medicine. *Psychology and Health, 26*(3), 371-382.
Lindeman, M., & Aarnio, K. (2007). Superstitious, magical, and paranormal beliefs: An integrative model. *Journal of Research in Personality, 41*(4), 731-744.
Lloret-Segura, S., Ferreres-Traver, A., Hernández-Baeza, A., & Tomás-Marco, I. (2014). Exploratory item factor analysis: A practical guide revised and updated. *Anales de Psicología, 30*(3), 1151-1169.
Lobato, E. J. C., Mendoza, J., Sims, V., & Chin, M. (2014). Examining the Relationship between Conspiracy Theories, Paranormal Beliefs, and Pseudoscience Acceptance among a University Population. *Applied Cognitive Psychology, 28*(5): 617–625.
Lobato, E. J., Powell, M., Padilla, L. M., & Holbrook, C. (2020). Factors predicting willingness to share COVID-19 misinformation. *Frontiers in Psychology, 11*, 566108.
Lobato, E. J., & Zimmerman, C. (2019). Examining how people reason about controversial scientific topics. *Thinking & Reasoning, 25*(2), 231-255.
McLaughlin, A. C., & McGill, A. E. (2017). Explicitly teaching critical thinking skills in a history course. *Science & Education, 26*(1), 93-105.
Norris, P., & Epstein, S. (2011). An experiential thinking style: Its facets and relations with objective and subjective criterion measures. *Journal of Personality, 79*(5), 1043-1080.
Pennycook, G., Fugelsang, J. A., & Koehler, D. J. (2015). Everyday consequences of analytic thinking. *Current Directions in Psychological Science*, *24*(6), 425-432.
Pennycook, G., McPhetres, J., Bago, B., & Rand, D. G. (2022). Beliefs about COVID-19 in Canada, the United Kingdom, and the United States: A novel test of political polarization and motivated reasoning. *Personality and Social Psychology Bulletin, 48*(5), 750-765.
Psychonomic Society. (2020, June 5). Statement on Racism. Retrieved September 15, 2023 from https://www.psychonomic.org/page/antiracismstatement
Rizeq, J., Flora, D. B., & Toplak, M. E. (2021). An examination of the underlying dimensional structure of three domains of contaminated mindware: paranormal

beliefs, conspiracy beliefs, and anti-science attitudes. *Thinking & Reasoning, 27*(2), 187-211.
Rosseel, Y. (2012). "lavaan: An R Package for Structural Equation Modeling." *Journal of Statistical Software, 48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02
Salvati, M., Pellegrini, V., De Cristofaro, V., Costacurta, M., & Giacomantonio, M. (2024). Antecedent Ideological Profiles and Negative Socio-political Outcomes of LGBTQ+ Conspiracy Beliefs. *Sexuality Research and Social Policy*, 1-13.
Stevens, J. P. (2009). *Applied multivariate statistics for the social sciences (5th ed.).* Routledge.
Sutton, R. M., & Douglas, K. M. (2020). Conspiracy theories and the conspiracy mindset: Implications for political ideology. *Current Opinion in Behavioral Sciences, 34*, 118-122.
Swami, V. (2012). Social psychological origins of conspiracy theories: The case of the Jewish conspiracy theory in Malaysia. *Frontiers in Psychology, 3*, 280.
Swami, V., Voracek, M., Stieger, S., Tran, U. S., & Furnham, A. (2014). Analytic thinking reduces belief in conspiracy theories. *Cognition, 133*(3), 572-585.
Syropoulos, S., Lifshin, U., Greenberg, J., Horner, D. E., & Leidner, B. (2022). Bigotry and the human–animal divide: (Dis)belief in human evolution and bigoted attitudes across different cultures. *Journal of Personality and Social Psychology, 123*(6), 1264-1292.
Tabachnick, B. G. & Fidell, L. S. (2017). *Using Multivariate Statistics (6th ed.)*. Pearson.
van Stekelenburg, A., Schaap, G., Veling, H., van't Riet, J., & Buijzen, M. (2022). Scientific-consensus communication about contested science: A preregistered meta-analysis. *Psychological Science, 33*(12), 1989-2008.
Wang, H. T., Smallwood, J., Mourao-Miranda, J., Xia, C. H., Satterthwaite, T. D., Bassett, D. S., & Bzdok, D. (2020). Finding the needle in a high-dimensional haystack: Canonical correlation analysis for neuroscientists. *NeuroImage, 216*, 116745.
Wedow, R., Martschenko, D. O., & Trejo, S. (2022). Scientists must consider the risk of racist misappropriation of research. *Scientific American*. https://www.scientificamerican.com/article/scientists-must-consider-the-risk-of-racist-misappropriation-of-research/
Wells, G. L., & Windschitl, P. D. (1999). Stimulus sampling and social psychological experimentation. *Personality and Social Psychology Bulletin, 25*(9), 1115-1125.
Zubielevitch, E., Satherley, N., Sibley, C. G., & Osborne, D. (2024). Social dominance and authoritarianism have mostly countervailing associations with attitudes about COVID-19 and its management. *Group Processes & Intergroup Relations*, 1-27. https://doi.org/10.1177/13684302231208382

Chapter 6 Explicit Reasoning about Prejudicial and Non-Prejudicial Epistemically Unwarranted Beliefs

Understanding the content of peoples' beliefs benefits from understanding how people reason about their beliefs. One way to accomplish this is to directly ask people why they hold the beliefs they do. There are several drawbacks to this approach. People may not be fully aware of some reasons they have for their beliefs, may not be able to clearly articulate some reasons for their belief, or may actively wish to hide or obfuscate reasons for their beliefs. However, in spite of these limitations for drawing conclusions as to the suite of reasons people have for their beliefs, explicitly asking people why they hold their beliefs still provides useful information that can inform a more complete understanding of why people may endorse or reject epistemically unwarranted beliefs and how to develop strategies intended to persuade people to abandon or revise epistemically unwarranted beliefs they may endorse. Responses can be examined, for example, to assess the nature of the epistemological commitments people evince when they are asked to justify their beliefs. Likewise, asking people to consider or imagine the conditions that might convince them to change their mind can also be instructive. Not only can similar themes regarding epistemological commitments be assessed, but so too can the degree to which people assert a kind of epistemic stubbornness and express outright refusal to consider their beliefs challengeable.

The research presented in this chapter represents a qualitative follow-up study to the research presented in Chapter 5. The study's design is inspired from my earlier work examining how people justify their beliefs regarding socio-politically controversial scientific conclusions: evolutionary theory, anthropogenic climate change, vaccine safety, and genetically modified food safety (Lobato & Zimmerman, 2019). That research found topic-specific reasoning patterns across participants' beliefs concerning those four topics. For example, regarding evolutionary theory, participants were more likely to justify their beliefs and consider challenges to their beliefs in the context of features of their identity (namely, religious identity) than they did for the other topics. By contrast, participants referenced their personal experience(s) with vaccines as relevant for both their justification for their beliefs concerning vaccine safety, but also as relevant for what could constitute a challenge to their beliefs. Generally, the results illustrated some facets of how non-experts reason about socio-politically controversial scientific claims. The present study is an attempt to accomplish something similar, albeit intended to shed some light on the manners in which people think about a variety of epistemically unwarranted beliefs.

6.1 Method

6.1.1 Participants

Participants who completed either study reported in Chapter 5 were invited back, via Prolific, to participate in a follow-up study several months after their initial participation. Initially, 267 participants began the follow-up study and 232 completed the study. Because of researcher error in setting up the study, an additional 14 responses had to be excluded because participant responses could not be linked their responses from the earlier study they participated in. Thus, the final sample reported here is 218 (M_{age} = 41.4

years, SD_{age} = 14.3 years; 110 women, 105 men, 3 other). Participants were compensated $2.00.

6.1.2 Materials and Procedure

The follow-up study only administered the epistemically unwarranted belief survey created for the studies reported in Chapter 5 and a demographics survey. Participants were informed that they were going to be asked to again fill out a questionnaire about their agreement with a variety of cultural, historical, and scientific topics that have been a part of popular culture discussions over the past several decades, but that this time they would be asked open-ended follow-up questions for a subset of the items they responded to.

After completing the survey, participants were shown six of the items from the survey, one at a time. The six items were the same for each participant and were as follows, with how they will be labeled in subsequent tables in parentheses:

- Due to well demonstrated biological reasons, negative emotions and unsolved conflicts or traumas increase the probability of having cancer. (Neg. Emotions)
- Racial groups vary in their abilities because of biological differences between them. (Race)
- The assassination of John F. Kennedy was not committed by the lone gunman, Lee Harvey Oswald, but was rather a detailed, organized conspiracy to kill the President. (JFK)
- COVID-19 was deliberately created in a Chinese virology lab to be released as a bioweapon. (COVID-19)
- After people die, they still interact with the living as ghosts. (Ghosts)
- Alien visitors to earth taught ancient uncivilized cultures the technology to build pyramids. (Aliens)

The items selected for this follow-up reflect one item from each of the six categories of epistemically unwarranted belief: a non-prejudicial pseudoscience, a prejudicial pseudoscience, a non-prejudicial conspiracy theory, a prejudicial conspiracy theory, a non-prejudicial paranormal claim, and a prejudicial conspiracy claim. After each item, participants were shown the following text:

"You responded that you {participant response: Strongly disagree to Strongly agree} with this statement. Please answer the two questions below about your response."

Participant responses were piped into the text, so as to accurately display participant's actual response to the associated item. Below that text were the two following open-ended questions. "What reasons do you have for your position on this claim?" and "What possible reasons can you think of that could convince you to change your mind about how you feel about this claim?" These two questions asked participants to provide justifications for their beliefs and potential refutations of their beliefs. As such, responses to these questions will subsequently be referred to as justifications and refutations. After completing the follow-up questions, participants completed a demographics survey. Average completion time was approximately 15 minutes.

Following the completion of data collection, the results from the present study were merged with participants' data from the studies reported in Chapter 5, matched by participants' Prolific IDs and, in a few cases where a Participant's Prolific ID was not recorded, identical IP address with identical or near-identical demographic information ("near-identical" in this case refers to one participant whose reported age in the present study was one-year older than their reported age when they participated in the previous study and I am inferring that they had a birthday in the intervening months). The purpose of this merge was to facilitate analyzing associations between themes emerging in participant responses and the measures of individual differences collected in the previous studies (section 6.5 below).

6.2 Coding participant responses

Coding participant data built upon established coding schemes from comparable research (Lobato & Zimmerman, 2019; Shtulman, 2013). Participant responses varied in length, and occasionally included multiple thematic elements. As such, for justifications, there were 1500 coded segments across the 218 participant responses. For refutation responses, there were 1361 coded segments.

Participant responses that included reference to evidence, data, proof, possible causal mechanisms, or included otherwise overtly empirical statements as reasons for the participant's degree of belief were coded as *evidential* responses. As the nature of this project was focused on understanding the epistemological commitments people evince in their explicit reasoning about their beliefs, this category included generic or non-specific references to evidence, references to specific evidence, as well as claims of an absence of evidence. The validity or truth value of the referenced evidence or mechanism or empirical statement was not taken into consideration. As an example of this category, a participant responded to the claim of biologically essential differences in racial groups by stating "The genes of every racial groups *[sic]* differs and varies likewise each family background." Independent of the truth value of a statement, it is presented as matter-of-fact empirical support for the participants' belief.

Participant responses that referred to an external source of information as part of the participant's justification were coded as *deferential*. This included any external source, such as a teacher, a media outlet, relevant experts (e.g. scientists, historians), or government sources (e.g. the United States Federal Bureau of Investigations). For example, one participant's response about their level of belief in the claim that negative emotions can cause cancer included the segment "It seems vague; I'd need more information from a reputable source like the CDC or NIH or Kaiser Family Foundation." Instances where participants referenced an external source as not trustworthy were included in this category (e.g., "Again, I don't trust the government.").

Responses were coded as having a *subjective* component when participants included reference to any of the following: an aspect of their own identity (e.g., "It's nonsense. I was an FBI agent for 30 years."), personal experience or knowledge with the topic (e.g., "I have not seen an article out *[sic]* study pointing to this being true. It's more so that I'm uninformed than I do not agree."), a moral component (e.g., "This is 19th century scientific racism created to support racism"), gut-feelings or intuition, or explicit wishful thinking (e.g, "Im *[sic]* a bit iffy cause I want to believe in ghost…" *[sic]*).

Segments of participant responses that were not explicitly about justifying their level of agreement with the epistemically unwarranted belief asked about were considered *non-justifications*. This category included participant responses that clarified or qualified their degree of belief (e.g., "I think aliens exist, but that they did not help build the pyramids"), null responses, and responses that were vague or otherwise not codable as any of the other following categories.

I used a similar categorization scheme for participant refutation responses, with two exceptions. One, *non-justifications* were now considered *non-refutations*, and this category also included responses in which participants stated they were unsure of what could be presented to them to get them to change their mind. Secondly, there is an additional category of *denial* responses. *Denial* responses included responses in which the participant either (a) explicitly stated only that nothing they could think of would change their mind or (b) dismisses the possibility of any challenge to their existing degree of belief. Participant responses including statements about being unsure about what would change their mind or challenge their belief were not included in this category and were instead included as an instance of a *non-refutation*.

A preliminary review of the data to establish the suitability of the above codes for the data was conducted by the author and an additional coder. After establishing suitability of the codes for this data, the author and two additional, separate coders coded 20% of the data together to establish inter-rater reliability, then split up the remaining data to code separately. Krippendorf's alpha coefficient, a measure of inter-rater reliability when there are more than two coders, was a = 0.63. This value is below a conventional threshold for acceptability of a = .667, and thus the interpretation of the data in this section should be considered tentative. Disagreements between coders were resolved via discussion.

6.3 Belief Justifications

Table 14 shows the frequency with which participant responses expressed the justification codes. Participants most commonly (38% of responses) justified their beliefs by expressing themes of subjective rationales. Response rates for this category were relatively consistent across topics. Participant responses to the Negative Emotions topic showed the lowest frequency of subjective themes with 74 instances, whereas responses to the Ghosts topic showed the highest frequency with 115 instances. Response frequencies for the other four topics were comparable, in the mid- to high-90s.

Table 13. Frequency of belief justifications per topic.

	Topic						
Code	Neg. Emotion	Race	JFK	COVID-19	Ghosts	Aliens	Total
Evidential	95	85	65	63	64	91	463
Deferential	36	14	35	36	9	7	137
Subjective	74	93	99	96	115	94	571
Non-Justification	61	63	52	55	52	46	329
Total	266	255	251	250	240	238	1500

Following the subjective rationales, participants next most commonly expressed themes referencing evidence (30.8% of responses). The frequency of evidential responses showed a different pattern than that for the subjective responses. Half of the topics – concerning the JFK assassination and COVID-19 conspiracies and the existence of ghosts – showed comparable low frequencies of expressing evidence, all around the mid-60s. By contrast, the remaining topics – concerning negative emotions causing cancer, race essentialism, and ancient aliens as responsible for pyramids – showed higher response frequencies, from the mid-80s to the mid-90s in occurrences.

The third most frequent justification category was non-justification responses, accounting for approximately 22% of all coded responses. Across topics, this response category was expressed with comparable frequency.

Finally, the lowest frequency coded category were responses that were deferential, accounting for approximately 9.1% of all responses. This least frequent response category also showed a pattern of occurring at comparably low rates for half of the topics – in this case, the topic of race essentialism and the two paranormal topics of ghosts and ancient aliens – and comparably higher rates for the remaining half – the topic of negative emotions causing cancer and the JFK and COVID-19 conspiracy theories.

Table 15 shows the frequency and proportions of participants who expressed each of the justification codes across the six topics. Comparable with prior research (Lobato & Zimmerman, 2019), it was infrequent that participants expressed the same themes across all or even most of the topics they responded to. Only approximately 18% of participants justified their beliefs for four or more topics by referencing evidence in some capacity, whereas roughly 29% of participants referenced a subjective source of justification for their reported level of belief in at least four of the topics.

Table 14. Frequency (proportion) of participants' use of each justification code.

Code	0 Topics	1 Topic	2 Topics	3 Topics	4 Topics	5 Topics	6 Topics
Evidential	33 (.15)	52 (.24)	50 (.23)	44 (.20)	23 (.11)	9 (.04)	7 (.03)
Deferential	122 (.56)	68 (.31)	17 (.08)	9 (.04)	2 (.01)	0 (.00)	0 (.00)
Subjective	18 (.08)	37 (.17)	52 (.24)	49 (.22)	36 (.17)	17 (.08)	9 (.04)
Non-Justification	63 (.29)	62 (.28)	40 (.18)	32 (.15)	15 (.07)	5 (.02)	1 (.00)

Proportions across a row may not sum to 1 due to rounding.

6.4 Belief Refutations

Table 16 shows the frequency of participants' refutation responses codes across the six topics. The most common theme that participants expressed in response to a question of what possible reasons they could think of that could challenge their beliefs was the theme of evidence, expressed in 43.1% of responses. Interestingly, the two pseudoscience topics were the topics for which evidential refutations were least likely to be expressed. By contrast, the two pseudoscience topics were the topics in which participants most expressed deferential refutations, which was the next most-frequent category of responses, at 25.9% of all responses. Explicit denial was the third most frequent response, occurring 16.6% of the time. Denial was least often present in

response to the negative emotion pseudoscience claim but most frequently present in the race essentialism pseudoscience claim. Non-refutations were the fourth most common type of response, mostly of the form of the participant stating they were unsure of what could get them to change their mind. Lastly, subjective refutations were the least common response, almost absent in every category except the paranormal claim about ghosts. The higher frequency of the subjective refutations for the ghost topic compared to the others is due to participants who tended to disbelieve the claim stating they would change their mind if they themselves experienced a ghost sighting.

Table 15. Frequency of belief refutation codes per topic.

	Topic						
Code	Neg. Emotion	Race	JFK	COVID-19	Ghosts	Aliens	Total
Denial	16	55	30	33	47	45	226
Evidential	66	67	115	110	99	130	587
Deferential	122	73	55	64	11	28	353
Subjective	9	14	7	5	47	4	86
Non-refutation	11	21	20	14	24	19	109
Total	224	230	227	226	228	226	1361

Table 17 shows the frequency and proportions of participants who expressed each of the refutation codes across the six topics. As with the justification response frequencies across topics, participants were generally inconsistent in the thematic elements expressed in their refutation responses. In spite of the inconsistency, over half of participants explicitly expressed that for at least one topic, they reject the possibility of changing their mind. However, no participant expressed explicit denial across all six topics, which is nice. By contrast, approximately 93% of participants expressed that for at least one topic, evidence in some form would constitute a possible challenge to their existing beliefs, despite only five participants expressing such a thought across all six topics. Though, it is worth restating that the evidential category broadly encompasses generic and non-specific references to evidence. To what degree people are, in fact, evidence-responsive is a separate question. Likewise, the degree to which people's beliefs are in fact impervious to challenge is separate from how people express their beliefs.

6.5 Predictors of participant response types

I analyzed possible predictors of participants' justification and refutation codes using a series of multiple regression analyses (Tables 5 and 6). Participant responses to the individual difference measures of disposition towards analytical thinking, disposition towards intuitive thinking, perceptions of the credibility of science, and the two social dominance orientation subscales of anti-egalitarianism and dominance were entered as predictor variables.

For participant justifications, none of the models were significant, with all *p*s > .05 (see Table 18).

Table 16. Frequency (proportion) of participants' use of each refutation code.

Code	0 Topics	1 Topic	2 Topics	3 Topics	4 Topics	5 Topics	6 Topics
Denial	94 (.43)	61 (.28)	35 (.16)	20 (.09)	5 (.02)	3 (.01)	0 (.00)
Evidential	16 (.07)	35 (.16)	42 (.26)	57 (.22)	48 (.22)	15 (.07)	5 (.02)
Deferential	44 (.20)	62 (.28)	65 (.30)	30 (.14)	15 (.07)	1 (.00)	1 (.00)
Subjective	152 (.70)	49 (.22)	14 (.06)	3 (.01)	0 (.00)	0 (.00)	0 (.00)
Non-refutation	153 (.70)	40 (.18)	12 (.06)	9 (.04)	2 (.01)	2 (.01)	0 (.00)

Proportions across a row may not sum to 1 due to rounding.

For refutations, participants' perceptions of science as credible and their degree of anti-egalitarian dispositions predicted the frequency of explicit denial responses [adj. R^2 = .06, $F(5, 212) = 3.77$, $p = .002$], such that lower perceptions of science as credible predicted more denial responses and lower dispositions towards anti-egalitarianism predicted more denial responses. Evidential refutations were significantly predicted only by perceptions of the credibility of science [adj. $R^2 = .03$, $F(5, 212) = 2.45$, $p = .03$] such that higher perceptions predicted more frequent evidential refutations. Similarly, deferential refutations were significantly predicted only by perceptions of the credibility of science [adj. $R^2 = .06$, $F(5, 212) = 3.89$, $p = .002$] such that higher perceptions of science as credible predicted a higher frequency of deferential refutations. The models for subjective refutations and non-refutation responses were not significant, both *p*s > .05 (see Table 19).

Table 17. Frequency of justifications predicted by individual difference measures.

	Evidential		Deferential		Subjective		Non-Justification	
	β	*t*	*β*	*t*	*β*	*t*	*β*	*t*
REI-R	-0.30	-1.64	0.06	0.58	-0.24	-1.30	-0.22	-1.34
REI-In	-0.14	-0.56	-0.21	-1.43	-0.27	-1.05	0.54	2.37
CoSS	0.07	0.88	0.01	0.13	-0.03	-0.37	0.08	1.15
SDO_7-a	0.01	0.42	<0.01	0.28	0.01	0.34	-0.01	-0.39
SDO_7-d	0.02	0.89	<0.01	0.29	-0.03	-1.75	<-0.01	-0.03

Note: N = 218

REI-R: Rational-Experiential Inventory Rational subscale; REI-In: Rational-Experiential Inventory Intuitive subscale; CoSS – Credibility of Science Scale; SDO_7-a: Social Dominance Orientation$_7$ Anti-egalitarian subscale; SDO_7-d: Social Dominance Orientation$_7$ Dominance subscale

6.6 Discussion and Conclusion

In this Chapter, I reported on qualitative data concerning how people explicitly justify their beliefs on a subset of epistemically unwarranted beliefs. Results of this analysis build upon the research reported by Lobato and Zimmerman (2019) in several important aspects. Lobato and Zimmerman examined agreement with scientific consensus views on major socio-politically controversial topics. By contrast, the present research examined agreement with a wider variety epistemically unwarranted claims, and includes claims that are not allegedly scientific, but also sometimes historical. The topics studied by Lobato and Zimmerman were also all topics that do not explicitly connect to

issues of prejudice whereas half of the epistemically unwarranted beliefs examined in the present research are explicitly prejudicial in nature. Further, participants recruited by Lobato and Zimmerman were university students and staff, whereas the sample for this study was recruited from Prolific.

Table 18. Frequency of refutations predicted by individual difference measures.

	Denial**		Evidential*		Deferential**		Subjective		Non-refutations	
	β	*t*	*β*	*t*	*β*	*t*	*β*	*t*	*β*	*t*
REI-R	0.19	1.39	0.23	1.37	-0.17	-1.19	-0.25	-3.12	-0.21	-1.84
REI-In	0.22	1.13	-0.33	-1.38	-0.24	-1.23	0.16	1.49	0.26	1.68
CoSS	-0.17	-2.75**	0.17	2.22*	0.16	2.47*	<0.01	-0.00	-0.05	-1.07
SDO_7-a	-0.02	-2.12*	0.02	1.34	0.01	0.68	<0.01	0.35	-0.01	-0.87
SDO_7-d	0.01	0.97	0.02	1.01	-0.02	-1.26	<0.01	-0.96	<-0.01	-0.15

Note: N = 218, * p < 0.05, ** p < 0.01
REI-R: Rational-Experiential Inventory Rational subscale; REI-In: Rational-Experiential Inventory Intuitive subscale; CoSS – Credibility of Science Scale; SDO_7-a: Social Dominance $Orientation_7$ Anti-egalitarian subscale; SDO_7-d: Social Dominance $Orientation_7$ Dominance subscale

Even with these substantive differences, there are some similar patterns of results. Namely, participants in the present study were similarly inconsistent in the themes that emerged from their open-ended responses. Additionally, the most frequent type of response by participants in both Lobato and Zimmerman's study and the present research to the refutation question were evidential refutations. As noted above, given that this category included responses that were vague and generic appeals to evidence, it is unclear in what manner many participants conceive of potential evidence that would contradict or challenge their present belief. It may be the case that people are engaging in a degree of impression management, trying to avoid appearing either stubborn or that they have not given much thought to their beliefs. Or perhaps participants were unwilling to spend more time than necessary on a short survey to provide answers to the refutation questions. Additional research conducting in-depth interviews with individuals to allow for follow-up questions is needed to investigate these possible explanations.

Another interesting result is that there do not appear to be systematic differences in how participants reasoned about the non-prejudicial items and the prejudicial items, nor do there appear to be systematic differences between the two pseudoscience claims, the two conspiracy theories, and the two paranormal claims. Even when there were differences in the frequency of certain justification or refutation codes across topics, there were no clear groupings that aligned with any of the manners in which these claims could be categorized. However, there was only one candidate item for each of the six factors represented in this follow-up study. Perhaps in a research study that asked participants open-ended questions about multiple representative prejudicial and non-prejudicial pseudoscientific, conspiratorial, and paranormal claims would systematic differences in how people reason about different kinds of epistemically unwarranted beliefs emerge.

Of note is how some participants explicitly referenced prejudices in their responses. While it is unsurprising that participants did sometimes reference prejudice, as three of the items were explicitly chosen because of an overtly prejudicial component, the

manner in which they did so is informative. One participant justified their disagreement regarding the COVID-19 conspiracy theory item by stating "This is a racist remark to create animosity against Asians." Another participant, in response to justifying their disagreement with the claim that extraterrestrials taught ancient civilizations how to build pyramids stated, "This is an example of racism. People can't seem to accept that Africans (Egypt is part of Africa) built the pyramids. All evidence shows they did." For some participants, it appears that association with prejudicial ideologies indicates the epistemic worth of a claim. This also appears to occur in at least some people who agree with a prejudicial claim. One participant's response stated "… It is not racist or negative to understand that different peoples have different talents and abilities." Conversely, one participant noted in their justification response to the race essentialism item that "Yes, it IS possible to acknowledge this fact WITHOUT being racist. But it's too dangerous for most people to handle, unfortunately." This type of response suggests that for some people, a claim's prejudicial element is to be treated as separate from the truth value of the claim. Despite the recognition by some participants that some of the items had a prejudicial component to them, the overall pattern of responses does not indicate that people generally differ in how they reason about their beliefs regarding prejudicial and non-prejudicial empirical claims. However, the present results do suggest an avenue for future research would be to investigate how people see the relationship between a claim potentially being prejudicial and a claim potentially being true.

It should also be pointed out that the effect sizes of the few regression analyses that came out as significant were small, with adjusted R^2 values ranging from .03 to .06. Thus, while it is interesting to note that higher perceptions of science as credible are associated with considering challenges to one's beliefs along the lines of evidence and deferring to others (possibly to experts) and being less likely to explicitly deny the possibility of changing one's mind, it is important not to overinterpret this finding. Certainly, there does not seem to be any harm in efforts to increase the public's perceptions of science as credible in terms of how people reason about their beliefs, but while the present results suggest that doing so might benefit the manner in which people think about their own beliefs, the small effect sizes indicate that it is unlikely to, by itself, result in major shifts in how people engage with their beliefs around epistemically unwarranted claims.

Perhaps more interesting than the significant regression models with small effect sizes are the more numerous non-significant models. In Chapter 5, I reported two studies showing how several of these individual difference variables are associated with the strength of belief in a variety of epistemically unwarranted beliefs. It is instructive that socio-cognitive variables associated with the contents of peoples' beliefs do not, with the exception of perceptions of the credibility of science, appear to be associated with how people reflect on their beliefs. This suggests that efforts to address how people reason about their own beliefs might have limited effects on what people believe. Efforts to inoculate people against or dissuade people away from epistemically unwarranted beliefs could benefit from adopting two-pronged strategies, with one component informed by research about the socio-cognitive profiles associated with what people believe, while a separate component is informed by research on what kinds of reasons people explicitly and spontaneously evoke when discussing their beliefs.

In what can laughingly be called my Introduction to this Chapter – so scant because much of the reasoning behind this study was detailed in the Intro to Chapter 5, and I cannot just copy and paste it here otherwise some dingus like Christopher Rufo might accuse me of plagiarism – I noted that there are drawbacks to trying to draw inferences about why people believe what they believe based on how they explicitly respond to such questions. I want to reiterate that here. By no means do I think the present analyses indicate the full suite of reasons people actually have for their level of belief or disbelief in epistemically unwarranted claims. Rather, this research should be understood as providing information regarding some elements or features that are present in how people explicitly reason about their own beliefs regarding some epistemically unwarranted claims. Such information can still be useful for educators or science and history communicators in designing or refining messaging intended to promote beliefs that are more epistemically warranted.

6.7 References

Lobato, E. J., & Zimmerman, C. (2019). Examining how people reason about controversial scientific topics. *Thinking & Reasoning*, *25*(2), 231-255.

Shtulman, A. (2013). Epistemic similarities between students' scientific and supernatural beliefs. *Journal of Educational Psychology*, *105*(1), 199.

Chapter 7 General Conclusions

Across this dissertation, I have laid a foundation for understanding the role that prejudice in the context of epistemically unwarranted beliefs. I have argued that efforts at demarcating science from pseudoscience should do better to attend to how members of scientific communities engage in behaviors that serve to promote pseudoscientific ideas. I have presented empirical evidence on how differences in worldviews (i.e., religious versus secular) are associated with systematic differences in how people engage with evidence for and evidence against a claim. I have presented original research showing an association between social dominance orientation and the spread of conspiratorial misinformation. Finally, I have argued for and presented original research showing how prejudicial claims fit within the nature of what I had termed epistemically unwarranted beliefs over a decade ago. Consequently, the field of epistemically unwarranted belief research should expand to include a more explicit focus on understanding the full scope of how prejudice plays a part in the development, maintenance, and spread of epistemically unwarranted worldviews. I am not usually one to toot my own horn, but I think that's pretty cool.

Taken together, the research presented across this dissertation allows for some tentative overall conclusions concerning the development or refinement of strategies intended to address the problems associated with belief in epistemically unwarranted claims.

As discussed in Chapter 2, reframing the issue of demarcation to emphasize epistemic conduct as important for separating legitimate science from scientific pretentions can provide additional motivation for the adoption of practices that fall under the umbrella of the Open Science movement. Beyond promoting Open Science practices, though, an increasing recognition that several unwarranted claims can and do come from scientific communities should serve to motivate efforts to combat pseudoscience from within. Rather than seeing the issue of pseudoscience as a problem of unscrupulous or uninformed people from outside of scientific circles, it is important to consider that some people may endorse pseudoscientific claims precisely because they "trust the science", as the saying goes. Or at least, they trust some of what is presented as science. Several pseudoscientific ideas continue to find successful purchase within mainstream scientific communities, including overtly prejudicial claims such as race science (see Saini, 2019 for review). As long as the scientific community continues to tolerate such incoherent claims as legitimate areas of scientific disagreement, then the general public is perhaps justified in thinking that some nonsensical claims are possible or even probable.

Translating that into recommendations for addressing epistemically unwarranted beliefs, members of scholarly communities whose work touches on aspects of the human condition for which prejudicial beliefs form can work towards communicating their research – both to their colleagues and to the public – in ways that preemptively close off interpretations that are prejudicial (see also, Wedow, Martschenko, & Trejo, 2022). Additionally, scholars need to demand better justifications before ideas that lend themselves to prejudicial interpretations should be considered acceptable claims for sincere scholarly discourse. One red flag to alert scholars of the potential of an idea to lead to prejudicial interpretations is the presence of claims of a psychologically essentialist nature.

Psychological essentialism is the idea that all things possess necessary features, often not able to be directly observed, that determines that thing's identity or membership in a category (Gelman, 2004). There is an underlying immutable essence that makes a thing what it is, distinct from other things. While essentialist thinking can be useful for understanding or navigating aspects of one's environment (for example, by helping to distinguish between animate and inanimate objects; Gelman & Kremer, 1991), the utility of such thinking may come at the cost of accurately describing the world. Essentialist thinking can lead to overgeneralizing or making additional assumptions about the underlying essences of groups of entities.

This type of thinking is on display in a variety of epistemically unwarranted beliefs. Essentialist thinking is at the root of creationist opposition to evolutionary theory on the basis of a form of life being unable to produce offspring of a different "kind" (Scott, 2005). Such essentialist thinking is also part of the naturalistic fallacy that underpins many complementary and alternative medical arguments for "natural" cures and treatments and against the "artificial" cures being developed by pharmaceutical companies (Gorski, 2014, 2018). Homeopathy is alleged to work due to a claim that "like cures like", an explicitly essentialist argument that the same features necessary for diseases to occur are necessary for diseases to be cured. Conspiracy theories also showcase something akin to essentialist thinking, whereby all major events are necessarily directly and deliberately caused by agentic forces, and all the agents who are allegedly the cause of events are necessarily secretive and malevolent. As perhaps a consequence of the monological nature of conspiracy theories (Goertzel, 1994), the adoption of one conspiracy theory provides the essential components (i.e., an incredibly powerful and malevolent group of people), which are then inappropriately generalized (independent of evidence) to explain subsequent events. In these instances, the relevant scholarly communities tend to do a good, albeit imperfect, job gatekeeping out of the body of scholarly record (i.e., peer-reviewed publications) these ideas.

Social prejudices likewise tend to presume essential characteristics of social groups of people, typically presented as having a strong biological etiology (Bastian & Haslam, 2006; Dar-Nimrod & Heine, 2011). These essential characteristics result in stereotypes, either negative or positive, about entire groups. Typical human heterogeneity surrounding any trait is ignored or downplayed for out-group members, and members of an out-group are projected as by default having qualities such as high propensity to violence, high athletic talent, low driving skills, high mathematical abilities, low intelligence, and so on. However, in contrast to successes of scholarly communities at keeping out the non-prejudicial epistemically unwarranted beliefs that express an essentialist component, scholarly communities appear much less successful at keeping out the prejudicial unwarranted beliefs that contain essentialist thinking.

There is a longstanding effort across multiple disciplines to defend several prejudices on allegedly scientific grounds that typically end up being an attempt to reify essentialist thinking gone awry. "Scientific racism" or "race realism", for example, is a pseudoscientific field with a long history of alleging biologically deterministic and essentialist accounts of differing racial groups, often with the intention of justifying or promoting various forms of discrimination on racial grounds (Gillborn, 2016; Lewontin et al., 1984/2017; Saini, 2019; Smedley & Smedley, 2005; Winston, 2020). The alleged science behind such claims often fails to meet the traditional standards of evidence,

methodological rigor, theoretical coherence, or data integrity expected of other scientific endeavors in the respective field (see, e.g., Lewontin et al., 1984/2017 for a dissection of the scientific integrity of various attempts to promote biologically deterministic justifications for prejudiced claims). Comparable efforts have existed within mainstream scientific practice perpetuating prejudices concerning sex, gender, and sexual orientation (Mohr, 2008; Morton, Postmes, Haslam, & Hornsey, 2009). However, because the conclusions of such shoddy science tend to conform to desired outcomes (sometimes explicit, sometimes implicit) or preexisting beliefs of people who inhabit positions of social, economic, academic, or political power, these research programs enjoy the privilege of experiencing less scrutiny by gatekeeping forces in science or public policy informed by science.

For example, consider research on the heritability of intelligence (Lewontin et al., 1984/2017). Intelligence testing made its way to the United States and United Kingdom in the early 1900s via scientists advocating eugenicist ideologies. This process transformed the concept of an intelligence quotient (IQ) from what Alfred Binet developed it as, from a labile expression of academic accomplishment that could be boosted in response to environmental intervention, to a fixed genetically heritable and deterministic trait according to the theorizing by Lewis Terman, Cyril Burt, and other scholars following in the Galtonian eugenicist tradition. The concept of IQ specifically and intelligence generally was changed from a diagnostic measure to identify children in need of additional educational resources to facilitate classroom accomplishment on par with that of the average age-matched peer to a means by which genetic defectives could be identified, justifying social and legal policies intended to curtail their reproductive rights or prohibit immigration. In the United States, results from intelligence tests were used the scientific basis for forced sterilization programs targeting people with disabilities (e.g. epilepsy), women deemed promiscuous, racial and ethnic minorities, and non-English speaking immigrants; programs which were upheld nationally by the United Supreme Court in Buck v. Bell (1927), a decision that has still not yet been formally overturned wherein Justice Oliver Wendell Holmes declared “three generations of imbeciles are enough.”

Underneath all of this social and political ugliness is the disturbing fact that the foundational research marshalled in support of viewing intelligence as a fixed genetically heritable trait was either outright fraudulent or of such poor quality that it likely would never have been published were the topic of investigation anything other than human intelligence presented in such a way as to validate pre-existing socio-cultural prejudices about the hierarchy of socially salient groups of people. For instance, Cyril Burt simply faked data for decades, and even in one instance faked the existence of researchers, about alleged IQ test results of participants of varying genetic relatedness (Lewontin et al., 1984/2017, p. 101-106). Further, studies on monozygotic twins raised in separate families reported a substantial number of those twins living in the same neighborhoods or attending the same schools, frequently even knowing about each other and having formed lasting friendships, thus confounding the ability to estimate heritability due to the highly correlated environmental conditions of their upbringing in upwards of half of the sample sizes in those studies (*ibid.* p. 106-110; see also Joseph, 2022). Yet, despite their origins in scientific fraud and spectacularly poor scientific rigor, the assumptions that intelligence (a) exists as a measurable phenomenon and (b) has strong genetic heritability

remains *in vogue* in mainstream scientific circles even today, even though both assumptions are also critiqued in mainstream scientific circles. These assumed truths by many mainstream academics for over one hundred years now have been and still are recruited in service of race realism and other pseudoscientific justifications for other prejudices.

When research findings allegedly supporting Cold Fusion in 1989 were found to be the result of gross experimenter errors, the existence of the phenomenon was considered dead by mainstream physics by the end of that year, with subsequent cold fusion research being relegated to either fringe science or outright pseudoscience (Lewenstein, 1992). When a team of physicists reported findings of supposedly faster-than-light neutrinos in September of 2011, the discoverers themselves advised caution, describing the results as simply an "anomaly"; the subsequent discovery (by the same scientists who reported the initial anomaly) of a very precise and highly technical mechanical problem as the reason for the appearance of faster-than-light neutrinos led to the suggestion that faster-than-light neutrinos were real being fully abandoned by February of 2012 (Orzel, 2018). For all the physics-envy observed across the social, cognitive, and other so-called "soft" sciences, it is a little surprising to me that there does not appear to be, in those sciences, the same willingness that we see in physics to abandon concepts resulting from outright fraud, wishful thinking by the experimenters, or measurement error.

Scientific disciplines that explore the role of biology in understanding the human condition provide opportunities for proponents of social prejudices to cloak claims of immutable and essential characteristics about socially or culturally salient groups of people in an air of scientific authority (Lewontin et al., 1984/2017; Saini, 2019, Winston, 2020). Criticisms, even criticism coming from other researchers in those very fields, are deflected not on empirical or rational grounds but through some combination of cherry-picking evidence and allegations of political correctness (or, in today's vernacular, "woke culture") stifling academic freedom (Larsen et al., 2020; Pigliucci, 2013; Roseman, 2014). Scholars wishing to engage with these areas of research would benefit by being attentive to the presence of essentialist thinking as well as to the presence of allegations of censorship or threats to academic freedom as reasons to support the continued presence of a given conclusion as legitimately scholarly. If present, these likely signal an attempt to lend epistemic legitimacy to epistemically unwarranted prejudicial claims.

From both Chapters 4 and 5, we can draw a general inference that part of fighting the spread of various forms of misinformation or epistemically unwarranted belief should incorporate messaging that directly opposes social dominance motivations. A disposition to think it desirable or natural for societies to be socially stratified, with some groups being treated as low-status and some being treated as high-status, can be a major source of bias for interpreting historical and scientific information. Confronting that bias directly provides an opportunity for scholars and experts to exert some control over the discourse, giving them the opportunity to more effectively present good quality historical analysis or scientific research about a topic.

It is also worth discussing causal relationships. The work presented in this dissertation lends itself to provisional speculations about causal mechanisms for the development and maintenance of epistemically unwarranted beliefs, and by extension prospective avenues for combating such unwarranted beliefs. Namely, a probable causal

mechanism here is that prejudicial beliefs form first due to enculturation of societally normalized attitudes, and their epistemically unwarranted nature creates the conditions necessary for people subsequently be vulnerable to the persuasiveness of non-prejudicial epistemically unwarranted beliefs later in life.

People are born into cultures and systems and institutions that have normalized many hierarchies along race, ethnic, sex, class and other dimensions to the point that those hierarchical systems are invisible or treated as natural (see, e.g., Bonilla-Silva, 2022). Developmentally, by the age of 3-months, preferences for looking at members of racial groups that are prototypical in the environment can be observed (Bar-Haim, Ziv, Lamy, & Hodes, 2006), and by 3-years-old children show evidence of implicit attitudes in line with culturally dominant views about the negative traits of low-status racial groups (Dunham Chen, & Banaji, 2013). Around the world, children are exposed to constant messaging about the traits, capacities, and values of different categories of people, and observe how people from different demographics are treated. Implicit associations and biases stemming from the enculturation of these messages are observed early in life (Cvencek, Greenwald, & Meltzoff, 2011; Gonzalez, Dunlop, & Baron, 2017). By contrast, exposure to other, non-prejudicial epistemically unwarranted beliefs typically comes later in life. This is likely, in part, because society does not seem to place as much importance on conveying messages to children about who really shot former president Kennedy as it does on reinforcing and reifying the idea that, for example, girls are just not as smart as boys in math.

This trajectory by which people are exposed to different kinds of epistemically unwarranted beliefs also suggests some specific directions for the development of strategies intended to dissuade people from or inoculate people against epistemically unwarranted beliefs. Specifically, anti-conspiracist messaging or pro-science messaging should, as stated in Chapter 5, demonstrate that epistemic authorities are "as vigorously anti-racist as we are anti-creationist." In Chapter 5, I presented the recommendation towards scientific consensus-messaging rejecting a foundational racist empirical claim – the false assumption of a biological or genetic basis of racial categories – but there is no reason to limit such anti-racist scientific consensus messaging to adults. Just as anti-creationist messaging by members of scholarly communities has also included components that are explicitly aimed at schoolchildren – either as part of official educational curricula or as part of extracurricular programs like science camps – members of scholarly communities can also work to develop and advocate for the inclusion of scientifically-supported anti-racist messaging appropriate for children.

There is plenty of progress still to be made in promoting science literacy in society. While the work in this dissertation serves as an initial step in a new direction for making that progress, it is still a step in the right direction. Reducing prejudicial beliefs is a means to increase a scientifically and historically warranted worldview. And, because I am the consummate class clown, I will end this with a reference to a joke that one of my committee members told me years ago. To any member of my dissertation committee: if you have has made it this far, I owe you a beer.

7.1 References

Bar-Haim, Y., Ziv, T., Lamy, D., & Hodes, R. M. (2006). Nature and nurture in own-race face processing. *Psychological Science*, *17*(2), 159-163.

Bastian, B., and Haslam, N. (2006). Psychological Essentialism and Stereotype Endorsement. *Journal of Experimental Social Psychology, 42*(2), 228–235.
Bonilla-Silva, E. (2022). *Racism without racists: Color-blind racism and the persistence of racial inequality in the United States, 6th Ed.*. Rowman & Littlefield Publishers.
Cvencek, D., Greenwald, A. G., & Meltzoff, A. N. (2011). Measuring implicit attitudes of 4-year-olds: The preschool implicit association test. *Journal of Experimental Child Psychology, 109*(2), 187-200.
Dar-Nimrod, I., & Heine, S. J. (2011). Genetic essentialism: on the deceptive determinism of DNA. *Psychological Bulletin, 137*(5), 800.
Dunham, Y., Chen, E. E., & Banaji, M. R. (2013). Two signatures of implicit intergroup attitudes: Developmental invariance and early enculturation. *Psychological Science, 24*(6), 860-868.
Gelman, S. A. (2004). Psychological Essentialism in Children. *Trends in Cognitive Sciences, 9*, 404–409.
Gelman, S. A., and Kremer, K. E. (1991). Understanding Natural Cause: Children's Explanations of How Objects and Their Properties Originate. *Child Development, 62*(2): 396–414.
Gillborn, D. (2016). Softly, Softly: Genetics, Intelligence and the Hidden Racism of the New Geneism. *Journal of Education Policy, 31*(4), 1–24.
Goertzel, T. (1994). Belief in conspiracy theories. *Political Psychology, 15*, 731–742.
Gonzalez, A. M., Dunlop, W. L., & Baron, A. S. (2017). Malleability of implicit associations across development. *Developmental Science, 20*(6), e12481.
Gorski, D. (2018). "Integrative" Medicine: Integrating Quackery with Science-Based Medicine. In Allison B. Kaufman and James C. Kaufman (Eds.), *Pseudoscience: The Conspiracy Against Science,* pp. 309-329. Cambridge, MA: MIT Press.
Gorski, D. H. (2014). Integrative Oncology: Really the Best of Both Worlds? *Nature Reviews Cancer, 14*(10), 692–700.
Joseph, J. (2022). A reevaluation of the 1990 "Minnesota Study of Twins Reared Apart" IQ study. *Human Development, 66*(1), 48-65.
Larsen, R. R., Cruz, H. D., Kaplan, J., Fuentes, A., Marks, J., Pigliucci, M., ... & Schroeder, L. (2020). More than provocative, less than scientific: A commentary on the editorial decision to publish Cofnas (2020). *Philosophical Psychology, 33*(7), 893-898.
Lewenstein, B. V. (1992). Cold fusion and hot history. *Osiris, 7*, 135-163.
Lewontin, R. C., Rose, S., & Kamin, L. J. (2017). *Not In Our Genes: Biology, Ideology, and Human Nature* (2nd Ed). New York: Pantheon Books. (Original work published in 1984)
Mohr, J. M. (2008). Oppression by Scientific Method: The Use of Science to "Other" Sexual Minorities. *Journal of Hate Studies, 7*(21), 21–45.
Morton, T. A., Postmes, T., Haslam, S. A., and Hornsey, M. J. (2009). Theorizing Gender in the Face of Social Change: Is There Anything Essential about Essentialism?. *Journal of Personality and Social Psychology, 96*(3), 653-664.
Orzel, C. (2018). Scientific Failure as a Public Good: Illustrating the Process of Science and Its Contrast with Pseudoscience. In Allison B. Kaufman and James C. Kaufman (Eds.), Pseudoscience: The Conspiracy Against Science, pp. 239-261. Cambridge, MA: MIT Press.

Pigliucci, M. (2013). What are we to make of the concept of race?: Thoughts of a philosopher–scientist. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences, 44*(3), 272-277.

Roseman, C. C. (2014). Troublesome reflection: Racism as the blind spot in the scientific critique of race. *Human Biology*, *86*(3), 233-239.

Saini, A. (2019). *Superior: The Return of Race Science*. Beacon Press.

Scott, E. C. (2005). *Evolution vs. Creationism: An Introduction*. Berkeley, CA: University of California Press.

Smedley, A., and Smedley, B. D. (2005). Race as Biology Is Fiction, Racism as a Social Problem Is Real: Anthropological and Historical Perspectives on the Social Construction of Race. *American Psychologist*, *60*(1), 16-26.

Wedow, R., Martschenko, D. O., & Trejo, S. (2022). Scientists must consider the risk of racist misappropriation of research. *Scientific American*. https://www.scientificamerican.com/article/scientists-must-consider-the-risk-of-racist-misappropriation-of-research/

Winston, A. S. (2020). Why mainstream research will not end scientific racism in psychology. *Theory & Psychology*, *30*(3), 425-430.