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Programa de Pós-Graduação em Psicologia Social, do Trabalho e das Organizações

A dual-inheritance based social-cognitive model of theism declaration

(Um modelo social-cognitivo da declaração de teísmo baseado na dupla-herança)

Mestrado

Sérgio Paulo da Silveira Nascimento

Brasília, DF

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Dissertação de Mestrado apresentada ao Programa de Pós-Graduação em Psicologia Social, do Trabalho e das Organizações como requisito parcial à obtenção do grau de Mestre em Psicologia Social, do Trabalho e das Organizações.

Orientador: Prof. Dr. Ronaldo Pilati

Co-orientador: Prof. Dr. André Luiz Alves Rabelo

Brasília, DF

Fevereiro de 2020

UNIVERSIDADE DE BRASÍLIA

INSTITUTO DE PSICOLOGIA

Dissertação de mestrado defendida diante e avaliada pela banca examinadora constituída por:

_____

Prof. Dr. Ronaldo Pilati (Orientador)

Instituto de Psicologia

Universidade de Brasília

_____

Dr. Reinaldo José Lopes (Membro Externo)

Folha de São Paulo

_____

Prof. Dr. Mauro Silva Júnior (Membro)

Instituto de Psicologia

Universidade de Brasília

_____

Prof. Dr. Josemberg Andrade (Suplente)

Instituto de Psicologia

Universidade de Brasília

Agradecimentos

Inicio com meu agradecimento a estudantes que participaram das coletas de dados e gentis professores(as) que as autorizaram, na Faculdade Presbiteriana Mackenzie, no Centro Universitário Estácio e na Universidade de Brasília.

Sou grato também a colegas do Grupo de Estudos e Pesquisa em Psicologia Social (GEPS), pelas diversas contribuições a este trabalho, e pós-graduandos(as) do Programa de Pós-Graduação em Psicologia Social, do Trabalho e das Organizações (PSTO) – particularmente ao Rodrigo Castilho pela parceria e animação mútua para a difícil arte de equilibrar estudo, trabalho e família.

I am grateful to Jonathan Baron for his extensive criticism of a manuscript that included Study 1, which hinted me ideas for the experiment in Study 3 and presented compelling alternative perspectives for further investigations.

Minha enorme gratidão aos professores do PSTO e, especialmente, ao meu co-orientador Prof. André Rabelo, que foi praticamente um irmão mais velho a me guiar pelos caminhos da pesquisa em crenças – mesmo sendo bem mais novo! E ao orientador Prof. Ronaldo Pilati, todo meu reconhecimento e respeito pela maneira culta, gentil e exigente com que me conduziu na produção desta pesquisa.

A colegas e chefes do trabalho – dentre os quais destaco Herbert, Carol, Alexandre, Guilherme e toda a turma da CGRCN –, agradeço pelo incentivo e pela compreensão nas minhas ausências relacionadas ao mestrado.

Por fim, aos meus pais Adão Carlos e Hilda, que sempre trataram minha educação como prioridade, aos enteados Heitor e Miguel, pelo convívio alegre, ao precioso filho Davi, pela curiosidade que me inspira, e à amada Liz, pela perspicácia em seus conselhos e paciência nas conversas sobre tudo, dedico esta dissertação.

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RESUMO

O objetivo desta dissertação foi desenvolver e testar um modelo social-cognitivo da declaração de teísmo, integrando abordagens cognitivas e de raciocínio motivado sobre declarações de crença. Inicialmente, apresenta-se o ateísmo analítico, a teorizada correlação negativa entre teísmo e estilo cognitivo analítico (medido pelo CRT), bem como a evidência conflitante a seu respeito. Em seguida, é introduzida a promissora perspectiva – derivada da Teoria da Dupla Herança – de que a transmissão cultural de crenças é facilitada por exibições que aumentam a credibilidade (CREDs): a hipótese do viés de CREDs. O modelo foi construído com a exposição a CREDs também como *proxy* de identidade religiosa, baseado em evidências de que perguntas sobre crenças pessoais eliciam um raciocínio de proteção à identidade. Assim, o modelo social-cognitivo propõe que a exposição a CREDs é moderada pelo CRT na estruturação da declaração de teísmo, o que se avaliou por meio de três estudos. No Estudo 1 (N = 220), CRT e CREDs interagiram na predição da declaração de teísmo diferencial em uma amostra universitária brasileira, em consonância com o modelo social-cognitivo. Participantes analíticos nos extremos da identidade religiosa foram mais enviesados ao adivinhar o teísmo médio entre colegas. No Estudo 2 (N = 88), essas variáveis independentes foram consistentes com medidas de validade convergente, mas os efeitos do Estudo 1 não foram replicados. No experimental Estudo 3 (N = 203), com participantes universitários dos EUA, os efeitos foram replicados no grupo de intervenção, mas não no grupo controle, conforme previsto pelo modelo. Curiosamente, o ateísmo analítico foi sistematicamente mais forte no modelo social-cognitivo do que no puramente cognitivo, indicando ganhos de sinergia. Combinados, esses achados podem ser vistos como evidência inicial de que, quando pessoas são questionadas sobre sua crença em Deus(es), a resposta muda com o estilo cognitivo: para intuitivos, é uma declaração ingênua de crença; para analíticos, uma racionalização da identidade religiosa herdada.

Palavras-chave: Teísmo, modelo dual da mente, dupla herança, aprendizado cultural, cognição social.

ABSTRACT

This research aimed to develop and test a social-cognitive model of theism, integrating cognitive and motivated reasoning accounts of belief. I initially present analytic atheism, the theory of a negative correlation between theism and analytic cognitive style (measured by CRT), and its conflicting evidence; then, I introduce a promising dual-inheritance hypothesis of cultural transmission of beliefs through credibility enhancing displays: the CREDs bias. Modeling uses the exposure to CREDs also as a proxy for (a)religious identity, due to evidence of identity-protective reasoning in belief declarations. The social-cognitive model in which CRT moderates the exposure to CREDs in structuring theism declaration is evaluated across three studies. In Study 1 (N=220), CRT and CREDs interacted in predicting differential theism declaration in a Brazilian college sample, in line with the social-cognitive model. Analytical participants at the extremes of (a)religious identity were biased in guessing average theism among colleagues. In Study 2 (N=88), independent variables were consistent with convergent validity measures, but the effects of Study 1 were not replicated. In experimental Study 3 (N=203), with US participants, the effects did replicate in the intervention group, but not in control, as predicted by the model. Interestingly, analytic atheism was stronger in the social-cognitive model than in the purely cognitive, indicating synergy gains. These findings can be seen as (soft) evidence that, when a person is asked about belief in God(s), the answer changes with cognitive style: from a naïve declaration of belief, for the intuitive, to a rationalization on inherited identity, for the analytical.

Keywords: Theism, dual-process theories, dual-inheritance, cultural learning, social cognition.

"The questions that interested me in my teens were philosophical – the meaning of life, the existence of God, and the reasons not to misbehave. But I was discovering that I was more interested in what made people believe in God than I was in whether God existed, and I was more curious about the origins of people's peculiar convictions about right and wrong than I was about ethics."

~ Daniel Kahneman, Biographical for the 2002 Nobel Prize in Economics

Why do some people believe in supernatural agents more than others? The varieties of religious experience and its social foundations are classic subjects of psychological and social sciences since William James and Durkheim. Yet, theorizations about the cognitive and social underpinnings of religious belief – in particular, of theism, the belief in God or gods – have only recently been tested with greater scientific rigor (McCauley, 2018).

Graham and Haidt (2010) have argued that social psychology can best contribute to scholarship on religion by being relentlessly social. The field, though, seems increasingly split between two apparently conflicting views of beliefs more generally: purely cognitive perspectives and accounts of motivated reasoning – the tendency of people to conform assessments of information to some goal or end extrinsic to accuracy (Dunning, 1999; Kunda, 1990). Pennycook and Rand (2019) recently rendered a newspaper illustration of this schism, presenting these two perspectives (in fake news research) as "two opposing camps".

The present research aimed to develop and test an integrative model of cognitive and social processes that structure theism declaration, contributing to bridge the divide in religious belief research with a synergistic social-functionalist approach (Powell & Clarke, 2012).

In 2012, three now influent articles proposed a cognitive explanation for individual differences in theism, the belief in God(s), based on the dual model of the mind (Gervais & Norenzayan, 2012; Pennycook et al., 2012; Shenhav et al., 2012). According to the "analytic atheism" theory, as devised by Gervais and Norenzayan (2012), the inclination to an analytic cognitive style allows individuals to suppress intuitive predispositions to supernatural belief and even religious socialization, determining lower individual theism. These authors also found experimental evidence of reduced theism caused by the induction of a reflective mindset, but all these studies were supported by data collected in WEIRD samples (Henrich et al., 2010) and some effects have not been replicated in other societies (Sanchez et al., 2017).

These theories are distinct from those regarding the link between religiousness and cognitive ability or intelligence (Kirkegaard & Lasker, 2020; Saribay & Yilmaz, 2017; Zuckerman et al., 2013) – although some theorized mechanisms are similar (Dutton & Van der Linden, 2017). Dual-process theories state that human cognition can be depicted as composed of Type 1 and Type 2 processes: Type 1 processes are automatic and relatively fast, and Type 2 are slower and deliberative (Kahneman, 2011). According to this theory, people vary in their inclination to these types of processing, what is termed "cognitive style". People more disposed to engage in deliberative Type 2 processing are characterized as having a more analytic or reflective cognitive style. One of the most widely used measures of cognitive style is the Cognitive Reflection Test (Frederick, 2005) or CRT, in which higher scores indicate an analytic disposition.

Despite the cumulating evidence in support of analytic atheism, in a recent self-criticism after a cross-cultural replication in 13 culturally diverse countries, Gervais et al. (2018) have concluded that its effect was small and unstable among cultures. In fact, in a sample of college students in the United Kingdom (N = 150), their study found a

positive correlation between CRT and belief in God(s). The authors conjectured that the degree of religiosity of the country could moderate the causal relationship between analytic thinking and theism, making the effect more pronounced in more religious countries. According to this reformulation, more analytical people could be more prone to a counter-cultural attitude, which would make them more inclined to atheism in religious countries than in countries with a more secular culture, *ceteris paribus*.

Following this unexpected result in the UK, Stagnaro et al. (2019), in a much bigger and demographically diverse online sample (N = 547), provided evidence that the expected negative association between CRT and theism probably also holds for the British population at large. The authors observed that this new British evidence was not consistent with the counter-cultural analytic effect conjectured by Gervais et al. (2018), so the college student sample inversed correlation remains unexplained – or could be just a type 1 error, a false positive.

On a different theoretical front in the cognitive science of religion, an evolutionary explanation about the cultural learning of belief emphasizes its facilitation by cognitive biases. Like other mental modules that would have evolved precisely by facilitating learning and cultural accumulation (Boyd & Richerson, 2005), humans would be predisposed to believe in credibility-enhancing displays (CREDs) or demonstrations made by a model that would be personally costly if he/she had beliefs other than what verbally expresses (Henrich, 2009).

CREDs: A Dual-Inheritance Addition to the Cognitive Modeling of Theism

In the aftermath of the human sociobiology debate, a new evolutionary approach to the study of human behavior committed itself to understanding genetic and cultural evolution simultaneously, by focusing on their interaction. This highly technical and

explicitly mathematical field is known as “gene-culture coevolutionary theory” or “dual-inheritance theory”, the first term having been coined by Stanford geneticists Marcus Feldman and Luca Cavalli-Sforza, and the second by UCLA and UC Davis anthropologists Robert Boyd and Peter Richerson – for an in-depth yet accessible introduction to the field, see Laland and Brown (2011, pp. 793–810).

Henrich (2009) has proposed a dual-inheritance based mechanism of cultural learning and accumulation in which humans would be predisposed to learn beliefs from others to the extent that these beliefs are backed up by credibility enhancing displays, or CREDs. When someone behaves in a way that is credible and consistent with their beliefs, such as by eating a mushroom they claim is not poisonous, or by giving tithes to the church they claim to believe in, their associated beliefs become more plausible and more likely to be acquired by observers. This “CREDs bias hypothesis” is presented by the author as similar but distinct from those derived from signaling theories of religion, because CREDs need not have an actual net fitness cost to affect cultural learning and because it concerns the transmission of beliefs rather than the signaling of commitment to a group – for a taxonomy of signaling theories of religion that, instead, includes CREDs, see Brusse (2019).

The complex process of detoxification of manioc roots for the human diet is one of the textbook examples of such CREDs mechanism at work (Henrich, 2015). Developed by South American indigenous people, this pre-scientific yet very effective processing protocol is characterized by causal opacity – the lack of a clear link between the performance and the expected outcome –, thus, it is indistinguishable from a ritual. Operating over generations as individuals unconsciously attend to and learn from committed members of their communities, this evolutionary process of belief transmission could generate cultural adaptations. Selective pressures would favor more

those who are CREDs biased than strict conformists, whilst more effective detoxifying rituals – selected following small variations – could also co-evolve. “Such complex adaptations can emerge precisely because natural selection has favored individuals who often place their *faith* in cultural inheritance – in the accumulated wisdom implicit in the practices and beliefs derived from their forebearers – over their own intuitions and personal experiences” (Henrich, 2015, p. 100). The empirical evidence that the exposure to CREDs is associated with increases in beliefs is very compelling, from studies with conspiracy theorists to experiments on the social learning of tasks in children.

Franks, Bangerter, Bauer, Hall, and Noort (2017) presented an alternative typology to the usual monologic/binary view of believers in conspiracy theories (CTs). In semi-structured interviews conducted with CT believers, they identified five ascending such types, which vary according to their positions on some dimensions of their worldviews. In the interviews, participants typically presented admiration towards individuals who had accepted the threat to worldly prestige associated with challenging the status quo – i.e., CREDs in which CT declarations gain extra force by their declarers’ paying the costs of exposure to humiliation. Synthetizing the phenomenon as “public vilification amounts to proof of concept”, the authors observed that this personal and moral admiration is an(other) aspect of the conspiracist worldview consistent with quasi-religiosity.

Wilks, Kapitany, and Nielsen (2016) noted that previous studies demonstrated an efficiency bias in the social learning of manual tasks whereby young children preferentially imitate the functional actions of an outgroup individual over an unsuccessful ingroup member. Their experiment, however, painted a more nuanced picture. Children can differentiate the actions of ingroup members in causally transparent or causally opaque, preferring to imitate the latter – very similar to rituals

(i.e., CREDs). In essence, children showed a willingness to engage in a band behavior rather than to acquire a functional skill. The authors argue that children interpret causally opaque actions as socially informative and will opt to copy them when they are performed by the ingroup rather than copying explicitly successful causally transparent actions of outgroup individuals.

But it is on religious belief that the theory of CREDs has been most fruitful, gathering much empirical support. Figure 1 depicts a word cloud generated from titles and abstracts of the 171 articles that cited Henrich (2009) in mid-January 2020, as indexed by Web of Science. The word cloud illustrates the main topic of the citing literature, with the centrality of the most frequent word/form, “religious”.

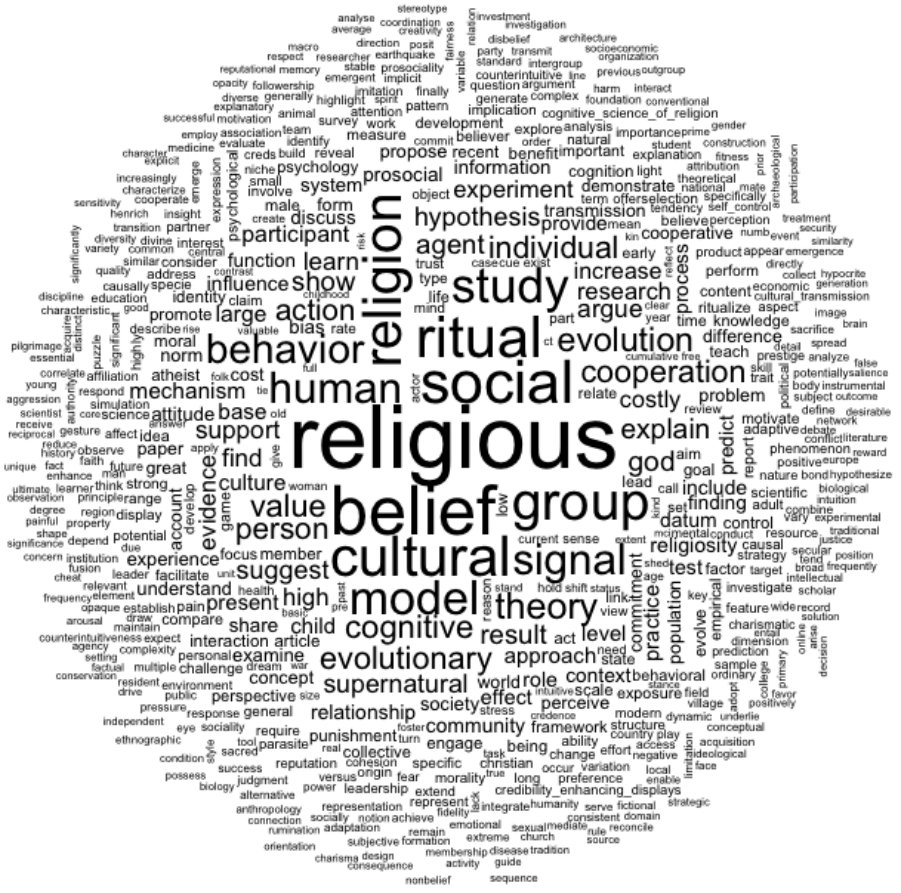

Figure 1. Word cloud generated from titles and abstracts of the 171 articles citing Henrich (2009) in mid-January 2020, as indexed by Web of Science.

Specifically about religious belief, Lanman and Buhrmester (2017) developed a CREDs exposure scale and presented evidence that the construct predicts current theism vs. non-theism, certainty of God's existence/non-existence, and religiosity while controlling for overall religious socialization. Willard and Cingl (2017) presented evidence that exposure to religious CREDs explains most of the difference in religiosity observed between residents of the Czech Republic and Slovakia. Langston et al. (2018) reported that, in two large New Zealand samples (N = 5,153 and N = 3,210), the exposure to CREDs was negatively associated with the age at which a religiously socialized individual became an atheist, controlling for many other variables that influence religious transmission processes. Drawing in previous investigations on the ontogeny of rituals, Wen et al. (2016) provided evidence that, even in early childhood, the participation in rituals (i.e., being exposed to CREDs) increases in-group affiliation to a greater degree than group membership alone, in line with theory and evidence about the social identity effects of the doctrinal mode of religiosity – a way of codifying and transmitting creeds that leads to identification with large, centralized, hierarchical traditions (Whitehouse & Lanman, 2014).

The exposure to religious CREDs may constitute a similar explanation, but at the individual level, to the aforementioned conjecture of Gervais et al. (2018) that the relationship between cognitive style and theism could be moderated by the degree of religiosity of the country. Indeed, such a relevant predictor should not be absent in the specification of a cognitive model of theism.

Formalizing a CREDs Based Social-Cognitive Model of Theism Declaration

Kahan's (2013) study of the relationship between cognitive style and political beliefs provides an approach that could lead to a social-cognitive model of theism,

integrating these cognitive and cultural learning theories of belief. Faced with competing models for the role of cognitive style in shaping political beliefs, Kahan found a better empirical fit in the "expressive utility" paradigm of belief: the greater the analytic capacity of the individual, the better is her/his ability to form, maintain, and express beliefs that signal loyalty to the ingroup, increasingly incurring in motivated reasoning. In other words, the more analytical a person is, the more identity-protective reasoning will lead to identity-affirming declarations of belief and to decreased accuracy.

Applied to religious belief, an identity-protective model of theism declaration would be a social-cognitive alternative to the formulation of Gervais et al. (2018) about a supposed analytic inclination to counterculture. The valence of prevalent religious belief (theistic or atheistic) in a country may not be an issue per se. Instead, the latent social identity threat to an individual from a (a)religious minority could activate the expressive utility of (dis)belief declarations, making them signs of belonging. For example, the unexpected positive correlation between CRT and theism in a college student sample in UK may have been caused by identity-protective reasoning elicited by a latent social identity threat perceived by highly analytical college students who were religiously socialized, which made them shot their declared theism up. This paradigm seems reasonably consistent with CREDs theory, but instead of only a relevant covariate, the exposure to CREDs could also function as a proxy for a (a)religious social identity (Wen et al., 2016), with an expected interaction with CRT in predicting theism declaration. The conceptual diagram of this social-cognitive model of theism declaration is presented in Figure 2.

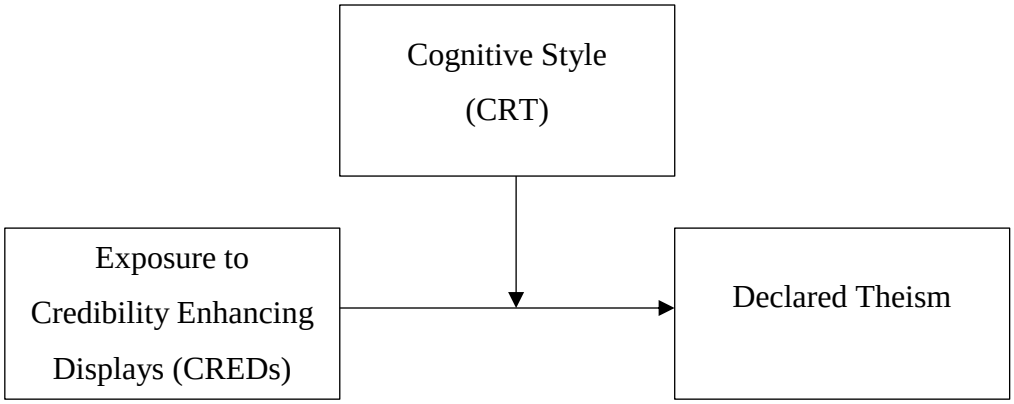

Figure 2. Conceptual diagram of the social-cognitive model of theism declaration.

The model in Figure 2 situates the exposure to religious CREDs as the primary variable in predicting the declaration of theism of an individual, in accordance with extant evidence. In this model, cognitive style moderates the relationship since analytical individuals should be more prone to identity-affirming declarations of theism, and the exposure to CREDs functions also as a proxy of (a)religious social identity. Analytic atheism is viable in this social-cognitive model because it is coherent with the supposed suppressing of religious socialization, and CRT may still have an effect on his own. However, it is the interaction of the two variables what synergistically increases the fitness of this model, compared to the purely cognitive or the merely combined.

With a social-cognitive model of theism set up, I tested it across three empirical studies. Correlational Study 1 contrasts purely cognitive and merely combined predictions of theism declaration with those of the social-cognitive model. Still correlational Study 2 tries to replicate the initial findings and to assess their soundness through various convergent validity measures. Study 3 evaluates experimental evidence of the model, using a different culture also to assess its external and cross-cultural validity.

Study 1: Initial Test of the Social-Cognitive Model of Theism Declaration

In this study, I conduct an initial test of the proposed social-cognitive model of theism declaration and analyze evidence of its validity. The main goal is to test the effect of identity-protective reasoning in theism declaration, while contrasting predictions from the purely cognitive model and from my social-cognitive model.

Theism declarations, like other measures of religion and spirituality, are subject to floor and ceiling complications (Slater et al., 2001). Indeed, open data from Gervais et al. (2018) show 4% of atheists (belief = 0) and 49% of full-blown theists (belief = 100) in the US sample, whereas respondents from the Netherlands were 36% atheist and 6% theist. Correlations with belief scores from such skewed samples may be attenuated, and factor analysis results are expected to be unstable (e.g., Bufford et al., 1991). Thus, a better measure to evaluate if theism declaration is subject to identity-protective reasoning would be the discrepancy between the belief in God(s) stated by the individual and his/her perception of the average theism in a reference group, what will be called the individual's differential theism. According to our social-cognitive model, analytical participants with extreme responses in theism are elicited by the next question about the average to use it as an "extended canvas" where they may express their religious identity as prominently more divergent from the average, in a typical expressive utility phenomenon (Kahan, 2013). Contrary to the prediction of the social-cognitive model I put forward, a purely cognitive, rational model would expect, a priori, no interaction effect between CRT and social identity (CREDs, as a proxy) in determining differential theism – although eventual interactions might give rise to alternative falsifiable explanations, such as anchorings (Furnham & Boo, 2011).

An even better measure to confront predictions from these models would be the error in guessing the group's average theism – a measure of accuracy. The purely

cognitive model would predict, a priori, only a negative correlation of CRT and this variable, since more analytical individuals should attain higher accuracy, being more capable of inferring and calculating the average. The social-cognitive model additionally predicts that the more analytical the individual, the more she/he incurs in identity-protective reasoning (Kahan, 2013), so a bigger error is expected when CRT interacts with social identity.

My first hypothesis is that cognitive style positively moderates the relationship between the exposure to CREDs and differential theism (H1.1) – positive because I expect to see steeper lines for more analytical participants, with areligious ones biasing their differential theism down and religious ones biasing it up. I also test the same positive moderation in predicting declared theism (H1.2) but expecting to find a weaker result due to a ceiling effect in this dependent variable, as Brazilians are known to be highly religious (Pew Research Center, 2015). Lastly, I hypothesize that the interaction factor between cognitive style and exposure to CREDs is negatively related to the error in guessing the group's average theism (H1.3).

Method

Participants.

Participants were college students (N = 220) who volunteered to participate during classes from two higher education institutions, with different degrees of expected average theism: from University of Brasilia ("UnB"; N = 95; 36 female; mean age 23.2, SD = 3.8; mean theism = 79.0, SD = 33.1), and from a college in Brasilia outskirts ("Tag"; N = 125; 67 female; mean age 24.3, SD = 6.6; mean theism = 96.6, SD = 12.1), both in Federal District, Brazil. This sampling method was applied to control possible covariates of theism, like age (Bengtson et al., 2015; Shulgin et al., 2019), and to allow for more variability in the dependent variables, emulating previous cross-cultural

studies with university samples (Gervais et al., 2018). Higher education students were not chosen for convenience. As most participants in previous studies were recruited from this (reference) group, it was necessary to restrict sampling for replication, considering the social identity threat supposition of our social-cognitive model.

For a WEIRDness evaluation, it should be pointed that Brazil is known for its striking differences in westernization by socioeconomic status (SES) and region (Haidt et al., 1993). “Tag” students predominantly come from peripheral, low SES households and should be seen as much less WEIRD than the median “UnB” student (de Oliveira et al., 2019) – despite the racial and social affirmative action policies for which this elite public university has become known (Francis & Tannuri-Pianto, 2012). The resulting sample was expected to reflect a SES-balanced picture of higher education students in the Federal District, which is the federative unit with the highest GDP per capita in the country.

Compensating the elevated WEIRDness expected from this sample of relatively well-off urban students, it is relevant to note that Brazil is an extreme outlier in the religious commitment gender gap, with a ratio of only 1.05 (Stark, 2002). It is also important to note that Brazilians are very religious: 74% of the population affirm that religion is very important in their daily lives – the biggest percentage in the Americas (e.g., USA 54%, Argentina 35%, Chile 27%) and 19p.p. higher than world median (55%), according to Pew (2015). Indeed, in a scale of cultural distance generated with religious belief as the relevant dimension, the most distant countries from Brazil are mainly WEIRD countries such as France, the Netherlands and Great Britain; with all dimensions considered, the most distant countries, by far, are still the WEIRD nations of Norway and Sweden (Muthukrishna et al., 2020), as seen in Appendix 1.

Measures and procedure.

The variables in this correlational design are: declared theism (BiG100), the first dependent variable, as used by Gervais et al. (2018), ranging from 0 to 100; cognitive style (CRT), originally formulated by Frederick (2005), 0 to 3; credibility-enhancing displays exposure scale (CREDs), formulated by Lanman and Buhrmester (2017), 7 to 49, original Chronbach's $\alpha = .92$; guessed average theism of classmates (BiG100g) – asked immediately after BiG100 (questions 17 and 18 of the questionnaire); differential theism (dBiG100): the difference between declared theism and guessed average theism of classmates (calculated as BiG100 - BiG100g); and the error in guessing the average theism of colleagues (eBiG100g, calculated as BiG100g - avg BiG100). Since gender was a reliable covariate in previous studies, the female gender (GenFem) is also controlled for in tests of H1.1 and H1.2. All variables are treated as continuous. They were collected after classes with a paper questionnaire.

The CREDs exposure scale was translated to Portuguese, back-translated to English, and then approved by an expert. In a confirmatory factor analysis of the translated scale, all items had parameter estimates equal or above .687 in the single factor structure. The full scale had high reliability, with Chronbach's $\alpha = .86$. The confirmatory factor analysis of translated CRT had all items with parameter estimates equal or above .791 in the single factor structure. The full scale had acceptable reliability, with Chronbach's $\alpha = .73$.

Data analysis and open science material.

All three hypotheses are original, so an introductory graphic description of interaction effects as predicted by the concurrent models may be instructive. I provide such a description for H1.3, where a bigger error was predicted when CRT interacts with social identity. In a cartesian plan of (y) eBiG100g vs. (x) CREDs, our proxy for

social identity, the purely cognitive model of theism would predict flat (i.e., $b_{CREDs} = 0$) and parallel (i.e., $b_{CRTxCREDs} = 0$) lines for each CRT level, with more analytic lines approaching eBiG100g = 0, since analytical individuals would err less. The offset between lines would be the effect of CRT. The social-cognitive model initially predicts a somewhat flatter line for intuitive students (i.e., $b_{CREDs|CRT=0} \cong 0$), which would use a more naïve/common-sense guessing of BiG100g across all levels of CREDs; but it also predicts that, at extreme levels of CREDs, analytical areligious students (e.g., CREDs = 7) will use a motivated guessing of average theism – making the identity-affirming declaration that average BiG100 is higher than the common-sense guess –, thus shooting eBiG100g relatively upwards. In a similar mechanic but probably much more pronounced effect than in the areligious– an inconspicuous identity (Schiavone & Gervais, 2017) –, the social-cognitive model predicts that analytical hyper-religious students (e.g., CREDS = 49) will guess average theism as lower than the common-sense guess, shooting eBiG100g relatively downwards. As a result, more analytic lines should have negative slope increments – in other words, a negative interaction is predicted.

Four-step hierarchical multiple regressions are used to test the three hypotheses of interaction. The name of each step/model begins with the letter "M" suffixed by its step number and the first letter of the dependent variable – i.e., M1d is the first model for testing dBiG100, M2B the second model for testing BiG100 and so on. First models (M1s) test the exclusive effect of CRT – so, representing the purely cognitive model; M2s test the exclusive effect of CREDs; M3s test the merely combined model, with no interaction; and M4s test the moderation of CRT on CREDs – thus, the social-cognitive model. I report standardized coefficients (betas) as effect sizes for all four models in each test. Since betas are expected to be largely inflated by multicollinearity in moderation regressions, for the final models in each test (M4d, M4B and M4e) I also

report semi-partial correlations, which equals inflation-corrected betas (Disabato, 2016). I confront these effect sizes against the empirically derived thresholds proposed by Lovakov and Agadullina (2017): correlation coefficients of .10, .25, and .40 as small, medium, and large effects. Robust bootstrap coefficients and p-values for final models are provided with bias-corrected and accelerated (BCa) 95% confidence intervals.

The complete paper questionnaire (in Brazilian Portuguese), SPSS data, and syntaxes are available at https://osf.io/fa6jt/, along with data and code to generate the figures in R.

Results

As zero-order robust correlations, CRT was negatively correlated to BiG100, r = -.34, 95% CI [-.48, -.18] BCa, p < .001, and CREDs was positively correlated, r = .31, 95% CI [.19, .42] BCa, p < .001. CRT and CREDs presented a non-significant negative correlation, r = -.10, 95% CI [-.23, .03] BCa, p = .158. GenFem was negatively correlated to both CRT, r = -.19, 95% CI [-.30, -.06] BCa, p = .006, and CREDs, r = -.14, 95% CI [-.27, -.01] BCa, p = .036.

The results of the hierarchical multiple regressions to test H1.1 are summarized in Table 1. In the moderation test with dBiG100 as dependent variable (M4d), a significant coefficient was found for the main predictor CRT x CREDs, b = .645 [-.005, 1.551] BCa, p = .030, for CRT, b = -24.863 [-51.823, -5.194] BCa, p = .024, and for GenFem, b = 7.793 [.366, 14.424] BCa, p = .022. A marginally significant coefficient was found for CREDs, b = .419 [-.034, .897] BCa, p = .052. The test of the moderating effect achieved a statistical power of .75.

Table 1

Multiple regression standardized coefficients (and semi-partial correlations, in brackets) for predictive models of differential theism (dBiG100) using CRT, CREDs, and an interaction factor (CRT x CREDs).

Predictor	M1d	M2d	M3d	M4d
CRT	-.145*		-.114*	-.708 [-.197]**
CREDs		.254***	.239***	.139 [.118]*
CRT x CREDs				.616 [.173]**
GenFem	.108	.167**	.145*	.136 [.132]*
Intercept (non-stand.)	17.778^{+++}	-10.832	-7.216	3.390
N	213	213	213	213
R^2	.038	.081	.094	.123
Adj. R^2	.029	.072	.080	.107

Significance levels, also applied to semi-partial correlations (in brackets):
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

As predicted by the social-cognitive model of theism for H1.1, the relationship between CREDs and dBiG100 was positively moderated by CRT in our sample. A simple slopes graph for extreme values of CRT (Figure 3) shows that intuitive individuals did not differentially declare their theism across values of CREDs, while analytical individuals did. Analytical areligious students, especially, judged their colleagues markedly more theist than themselves.

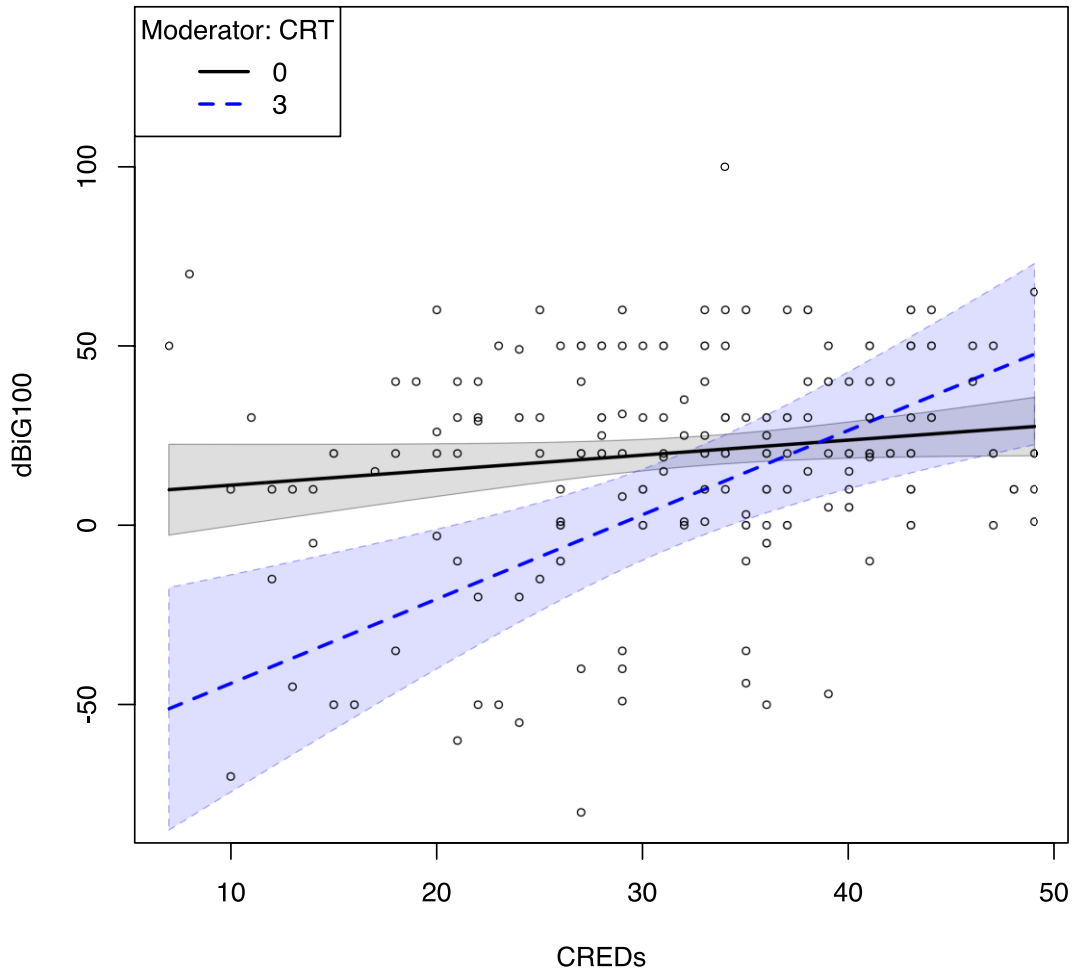

Figure 3. Simple slopes with 95% confidence intervals for the interaction of social identity (CREDs) and cognitive style (CRT) on differential theism (dBiG100) at extreme values of the moderator (intuitive vs. analytic cognitive style).

The results of the hierarchical regression to test H1.2 are summarized in Table 2. In the moderation test with BiG100 as dependent variable (M4B), a significant coefficient was found for CREDs, b = .732 [.361, 1.150] BCa, p < .001, and for GenFem, b = 5.866 [.268, 11.173] BCa, p = .023, but neither for the main predictor CRT x CREDs, b = .138 [-.462, .978] BCa, p = .322, nor for CRT, b = -13.276 [-38.692, 3.690] BCa, p = .118.

Table 2

Multiple regression standardized coefficients (and semi-partial correlations, in brackets) for predictive models of declared belief in God (BiG100) using CRT, CREDs, and an interaction factor (CRT x CREDs).

Predictor	M1B	M2B	M3B	M4B
CRT	-.326***		-.289***	-.437 [-.119]*
CREDs		.334***	.299***	.274 [.234]**
CRT x CREDs				.153 [.042]
GenFem	.070	.175**	.118*	.116 [.112]*
Intercept (non-stand.)	91.243^{+++}	55.571^{+++}	63.603^{+++}	65.898^{+++}
N	215	215	215	215
R^2	.120	.126	.206	.207
Adj. R^2	.111	.118	.194	.192

Significance levels, also applied to semi-partial correlations (in brackets):
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

There was no evidence that the relationship between CREDs and BiG100 was positively moderated by CRT in our sample.

The results of the hierarchical regression to test H1.3 are summarized in Table 3. In the moderation test with eBiG100g as dependent variable (M4e), a significant coefficient was found for the main predictor CRT x CREDs, b = -.499 [-.813, -.223] BCa, p = .001, and for CRT, b = 16.364 [4.329, 29.600] BCa, p = .002, but not for CREDs, b = .136 [-.180, .478] BCa, p = .207. The test of the moderating effect achieved a statistical power of .86.

Table 3

Multiple regression standardized coefficients (and semi-partial correlations, in brackets) for predictive models of error in guessed theism (eBiG100g) using CRT, CREDs, and an interaction factor (CRT x CREDs).

Predictor	M1e	M2e	M3e	M4e
CRT	.017		.012	.706 [.198]**
CREDs		-.049	-.047	.068 [.059]
CRT x CREDs				-.721 [-.203]**
Intercept (non-stand.)	-18.853^{+++}	-15.549^{++}	-15.734^{++}	-23.567^{+++}
N	215	215	215	215
R^2	.000	.002	.002	.044
Adj. R^2	-.004	-.002	-.007	.030

Significance levels, also applied to semi-partial correlations (in brackets):
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

As predicted by the social-cognitive model of theism for H1.3, and now contrarily to purely cognitive predictions, CRT negatively moderated the relationship between CREDs and eBiG100g. A simple slopes graph for extreme values of CRT (Figure 4) shows that the accuracy of intuitive individuals does not vary across values of CREDs: they all guessed the average to be around 20 points less than it really is. However, analytical individuals' accuracy does vary: both areligious and religious analytical students seem biased relative to the predicted naïve/common-sense guess made by intuitive students. Moderately areligious analytical students were the closest to the correct guess – the line eBiG100g = 0 –, and the extremely areligious were more accurate than the extremely religious ones.

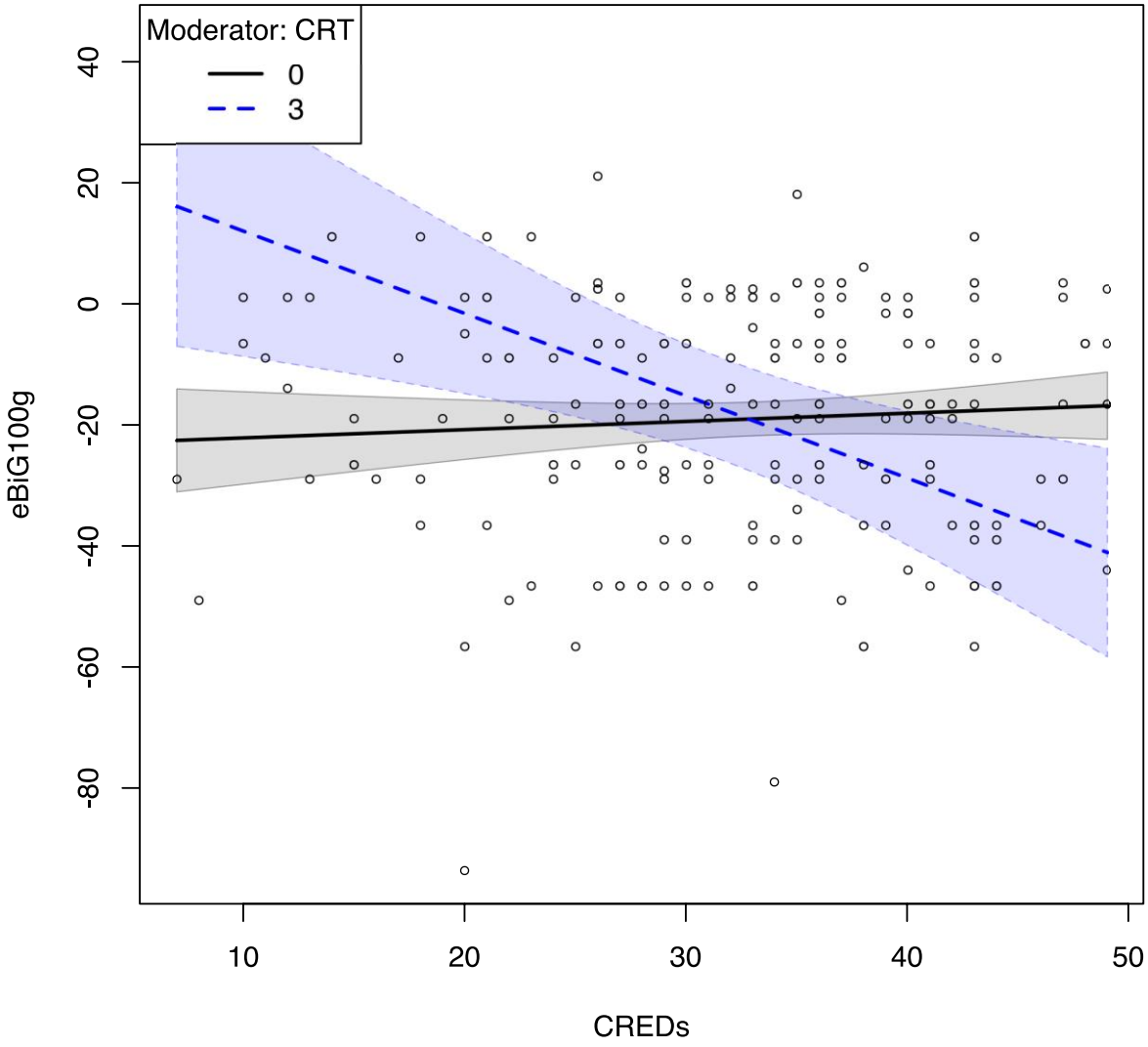

Figure 4. Simple slopes with 95% confidence intervals for the interaction of social identity (CREDs) and cognitive style (CRT) on the error in guessing average theism (eBiG100g) at extreme values of the moderator (intuitive vs. analytic cognitive style).

Discussion

Results indicate a small-to-medium effect size for our main predictor of differential theism, the interaction factor. While a less pronounced effect was expected for areligious students than for those religious (Schiavone & Gervais, 2017), a possible explanation for the divergent finding is that the prevalence of high levels of theism in

the sample made this latent identity threat more salient to areligious students. Another interesting observation is that the analytic atheism effect – the effect of CRT – increases from initial to final models. The purely cognitive model (M1d) and the merely combined model (M3d) miss a crucial predictor, resulting in biased estimators for CRT. In other words, the analytic atheism effect seems to be underestimated in the purely cognitive model of theism, being not only compatible with but also stronger in the social-cognitive model.

There is no evidence that the relationship between social identity and theism is positively moderated by analytic cognitive style in our sample. As Brazilians are highly religious, both low dispersion and ceiling effect (especially) in the dependent variable may have been detrimental to this test.

Results again indicate a small-to-medium effect size for our main predictor of error in guessed theism, the interaction factor, with a significant negative coefficient that is coherent with the social-cognitive model, which assumes that identity-protective reasoning bias theism declaration. The analytic atheism effect considerably increases from initial to final models. Once more, the purely cognitive model (M1e) and the merely combined model (M3e) miss a key predictor, resulting in biased estimators for CRT. In fact, we only have a functional predictive model – with a positive adjusted R^2 – when the interaction factor is added, allowing CRT to show its expected oppositional effect. This positive coefficient of CRT is precisely what puts analytical areligious students better at guessing the real average theism than their analytical religious colleagues, as seen in Figure 4.

The interaction on BiG100 proposed in H1.2 – the most parsimonious hypothesis derived from the social-cognitive model – may have been tested exploratorily before, since CRT and (especially) CREDs are becoming the gold

standard variables in predicting individual differences in theism. Indeed, Gervais (2015, p. 315) comments in a footnote about a failed exploratory test with endorsement of evolution as dependent variable, and, in a recent pre-print, Gervais et al. (2019) report that a small interaction effect between cultural learning (CREDs) and cognitive style (CRT) in predicting disbelief was found in a nationally representative sample of USA adults (N = 1,417).

The approaches developed to evaluate these interactions in H1.1 and H1.3 may help to overcome the ceiling problems likely found in American samples that may have prevented this moderation effect from emerging. Our indirect method may allow a test of the hypothesis that the negative correlation between CRT and theism observed by Gervais et al. (2018) in a British college student sample was caused by identity-affirming theism declarations.

In this study, I assumed the variables did measure what they intend to measure. In Study 2, I stress test this assumption, while trying to replicate the interactions found before.

Study 2: Convergent Validity of the Social-Cognitive Model

Study 2 has two specific objectives, the most immediate being to replicate Study 1, but I also seek to evaluate the consistency of the relationships previously found using convergent validity measures.

A convergent validity evaluation of CRT is necessary, firstly and foremost, because there is no validation study (of our knowledge) for any Brazilian Portuguese translation. Since analytic atheism postulates that analytic cognitive style allows individuals to suppress intuitive predispositions to supernatural belief and even religious socialization, it is crucial to test if our translation of CRT correlates with the well-established Need for Cognition (NFC) scale, advanced as a measure of someone's "tendency to engage in and enjoy thinking" (Cacioppo & Petty, 1982). The original test proposed by Frederick (2005) found a correlation of .22 with NFC, but a more recent study yielded a moderate-to-strong correlation of .28 (Pennycook et al., 2016).

Our model treats CREDs as a proxy for (a)religious identity, due to its association with doctrinal religiosity (Whitehouse & Lanman, 2014) and group identification (Wen et al., 2016). Therefore, the exposure to religious CREDS should correlate with measures of internalized religious commitment and coalitional mentality. The intrinsic religiosity subscale (Durel_i) of the Duke University Religion Index (Koenig & Büssing, 2010) is a well-established measure of the degree of personal religious commitment that was already translated into Brazilian Portuguese (Lucchetti et al., 2012), so I chose it as proxy for internalized religious commitment. The binding subscale of the Moral Foundations Questionnaire (Graham et al., 2011; Graham & Haidt, 2010) was theoretically conceived to subsume coalitional morality, so its Brazilian Translation (Silvino et al., 2016) is used as the other variable for the convergent validity test of CREDs.

The study hypotheses are: the relationship between the exposure to CREDs and differential theism is moderated by cognitive style (H2.1); the relationship between the exposure to CREDs and declared theism is moderated by cognitive style (H2.2); the relationship between the exposure to CREDs and error in guessing average theism is moderated by cognitive style (H2.3); there is a strong positive correlation between cognitive style and need for cognition (H2.4); there is at least a moderate negative correlation between the exposure to CREDs and intrinsic religiosity (H2.5) – negative because the higher the Durel_i, the lower the religiosity; there is at least a moderate positive correlation between the exposure to CREDs and binding moral foundations (H2.6).

Method

Participants.

Participants were University of Brasilia undergraduate students (N = 88; 66 female; mean age 22.1, SD = 5.6; mean theism = 68.1, SD = 37.3) who volunteered to participate through indications from professors and Facebook group invitations. Those recruited by professors earned bonus points in their courses.

Measures and procedure.

The main variables, in addition to those already presented in Study 1 (BiG100, dBiG100, eBiG100g, CREDs, CRT and GemFem), are: the Need for Cognition Scale (NFC_s) score (short form) (Cacioppo et al., 1984), comprised of 18 questions in a five-point Likert scale, original Chronbach's $\alpha = .90$; the intrinsic factor (Durel_i) of the Duke Religion Index in Brazilian Portuguese (Lucchetti et al., 2012), the sum of three questions in a five-point Likert scale, in which 1 indicates high religiosity and 5 low religiosity, original Chronbach's $\alpha = .76$; and the "binding" factor (MFQ_bind - ingroup, authority, and purity) score of the Moral Foundations Questionnaire in

Brazilian Portuguese (Silvino et al., 2016), original Chronbach's $\alpha = .87$. Since gender was a consistent covariate in previous studies, female gender (GenFem) is also controlled for in tests of H2.1 and H2.2. All variables are treated as continuous. They were collected asynchronously with a digital questionnaire.

The CREDs exposure scale was translated to Portuguese, back-translated to English an evaluated by an expert, and then used in Study 1 with high reliability ($\alpha = .86$). There were some doubts, though, in the application for translated questions 5 and 7, so I used slightly different versions of both in Study 2. In confirmatory factor analysis, all items of this translation of the CREDs exposure scale had parameter estimates equal or above .443 in the single factor structure. The full new scale had higher reliability, with Chronbach's $\alpha = .89$.

The confirmatory factor analysis of CRT had all items with parameter estimates equal or above 1.0 in the single factor structure. The full scale had acceptable reliability, with Chronbach's $\alpha = .73$.

In the confirmatory factor analysis of NFC_s, NFC_s07 showed a parameter estimate of only .081, but all other 17 items had them equal or above .478 in the single factor structure. The full scale had high reliability, with Chronbach's $\alpha = .85$. The exclusion of NFC_s07 would result in a scale with Chronbach's $\alpha = .86$, a negligible increase, so the full scale was retained.

All three items of the intrinsic subscale of the Duke Religion Index had parameter estimates equal or above 1.0 in the single factor structure in the confirmatory factor analysis. The full subscale had excellent reliability, with Chronbach's $\alpha = .92$. It is important to clarify that in the Portuguese version of Durel (Lucchetti et al., 2012, p. 581), responses to each item (such as "In my life, I experience the presence of the

Divine"), range from 1 ("Definitely true of me") to 5 ("Definitely not true"), thus the inverted correlation expected for H2.5.

In a confirmatory factor analysis of the binding scale from Moral Foundations Questionnaire, MFQ30 ("It is more important to be a team player than to express oneself") showed a parameter estimate of -.460, but all other 17 items had them equal or above .369 in the single factor structure. The full scale had high reliability, with Chronbach's α = .81. The exclusion of MFQ30 resulted in a scale with Chronbach's α = .83. Despite the small increase, I retained only 17 items in MFQ_bind, because the ingroup subscale had Chronbach's α improved (.32 to .47) after the exclusion.

Data analysis and open science material.

For H2.1, H2.2, and H2.3, the same procedure and reports from Study 1 are used. For H2.4, H2.5, H2.6, non-parametric Kendall's tau (τ) one-tailed tests are used, with bias-corrected and accelerated (BCa) 95% confidence intervals also reported. Kendall's tau, instead of Spearman's coefficient, is the test of choice when a large number of tied ranks is expected (Field, 2013). Just as it is done to other effect sizes, these correlations are confronted against the empirically derived thresholds proposed by Lovakov and Agadullina (2017): coefficients of .10, .25, and .40 as weak, moderate, and strong correlations. The digital questionnaire (in Brazilian Portuguese) and SPSS data are available at https://osf.io/fa6jt/.

Results

The results of the hierarchical multiple regressions to test H2.1 are summarized in Table 4. In the moderation test with dBiG100 as dependent variable (M4d), a significant coefficient was found only for CREDs, b = 1.198 [-.061, 2.456] BCa, p = .031. The coefficient for our main predictor CRT x CREDs was not significant, b = .111 [-.680, .901] BCa, p = .391, nor for CRT, b = -4.267 [-28.803, 20.268] BCa, p = .365.

Table 4

Multiple regression standardized coefficients (and semi-partial correlations, in brackets) for predictive models of differential theism (dBiG100) using CRT, CREDs, and an interaction factor (CRT x CREDs).

Predictor	M1d	M2d	M3d	M4d
CRT	-.008		-.027	-.112 [-.036]
CREDs		.298**	.300**	.273 [.196]*
CRT x CREDs				.094 [.029]
GenFem	.164	.094	.089	.081 [.075]
Intercept (non-stand.)	.793	-31.369^{+}	-29.875	-25.818
N	88	88	88	88
R^2	.027	.111	.112	.113
Adj. R^2	.005	.080	.090	.070

Significance levels, also applied to semi-partial correlations (in brackets):
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

The moderation found in Study 1 H1.1 was not replicated in the test of H2.1. There was no evidence that the relationship between CREDs and differential theism was moderated by CRT. The much smaller and less heterogeneous sample may have been detrimental to the statistical power of this test since the interaction effect found in Study 1 was only small-to-medium.

The results of the hierarchical regression to test H2.2 are summarized in Table 5. In the moderation test with BiG100 as dependent variable (M4B), a significant coefficient was found only for CREDs, b = 1.017 [-.130, 2.046] BCa, p = .026, but again not for the main predictor CRT x CREDs, b = .108 [-.539, .754] BCa, p = .371, nor for CRT, b = -3.325 [-23.385, 16.735] BCa, p = .371. As in Study 1 (H1.2), there was no evidence that the relationship between CREDs and declared theism was moderated by CRT.

Table 5

Multiple regression standardized coefficients (and semi-partial correlations, in brackets) for predictive models of declared belief in God (BiG100) using CRT, CREDs, and an interaction factor (CRT x CREDs).

Predictor	M1B	M2B	M3B	M4B
CRT	.014		-.005	-.106 [-.034]
CREDs		.312**	.312**	.281 [.201]*
CRT x CREDs				.111 [.034]
GenFem	.191*	.114	.112	.104 [.096]
Intercept (non-stand.)	55.318^{+++}	28.705^{++}	28.943^{+}	32.898^{+}
N	88	88	88	88
R^2	.036	.127	.127	.128
Adj. R^2	.013	.107	.096	.086

Significance levels, also applied to semi-partial correlations (in brackets):
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

The results of the hierarchical regression to test H2.3 are summarized in Table 6. In the moderation test with eBiG100g as dependent variable (M4e), no significant coefficient was found for the main predictor CRT x CREDs, b = .001 [-.344, .346] BCa, p = .498, nor for CRT, b = .804 [-9.749, 11.356] BCa, p = .440, or for CREDs, b = -.181 [-.747, .385] BCa, p = .527.

Table 6

Multiple regression standardized coefficients (and semi-partial correlations, in brackets) for predictive models of error in guessed theism (eBiG100g) using CRT, CREDs, and an interaction factor (CRT x CREDs).

Predictor	M1e	M2e	M3e	M4e
CRT	.050		.051	.049 [.016]
CREDs		-.095	-.096	-.096 [-0.69]

CRT x CREDs				.002 [.001]
Intercept (non-stand.)	-14.169^{+++}	-8.084	-9.089	-9.057
N	88	88	88	88
R^2	.002	.009	.012	.012
Adj. R^2	-.009	-.003	-.012	-.024

Significance levels, also applied to semi-partial correlations (in brackets):
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

The moderation found in Study 1 H1.3 was not replicated in the test of H2.3. There was no evidence that the relationship between CREDs and accuracy in guessing average theism was moderated by CRT. Again, the much smaller and less heterogeneous sample may have been detrimental to the statistical power of this test, since the interaction effect found in Study 1 was only small-to-medium.

There was a significant weak-to-moderate positive correlation between CRT and NFC_s, τ = .135, 95% BCa CI [-.021, .285], p = .050. Exploratorily for each item in the NFC short-form, I found significant weak-to-moderate positive correlations between CRT and NFC_s13 (“I prefer my life to be filled with puzzles that I must solve”), τ = .239, 95% BCa CI [.070, .396], p = .004, and NFC_s15 (“I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought”), τ = .148, 95% BCa CI [-.019, .312], p = .048.

There was a significant moderate-to-strong negative correlation between CREDs and Durel_i, τ = -.297, 95% BCa CI [-.432, -.153], p < .001. Exploratorily for each of the three items, the strongest positive correlation is between CREDs and Durel5 (“I try hard to carry my religion over into all other dealings in life”), τ = -.373, 95% BCa CI [-.501, -.241], p < .001.

There was a significant weak-to-moderate positive correlation between CREDs and MFQ_bind, τ = .208, 95% BCa CI [.067, .348], p = .003. Exploratorily for each of

the three subscales of MFQ_bind (ingroup, authority and purity), I found a significant weak-to-moderate positive correlation between CREDs and ingroup, $\tau = .148$, 95% BCa CI [.006, .286], $p = .025$, and a significant moderate positive correlation between CREDs and purity, $\tau = .251$, 95% BCa CI [.110, .394], $p < .001$.

Discussion

The first objective of the study resulted in the moderating effects found in Study 1 not being replicated in the test of H2.1, H2.2, and H2.3. The much smaller and less heterogeneous sample may have been detrimental to the replication since the main effects found in Study 1 were never large. An alternative that should not be ruled out is that the combined sample from two heterogeneous institutions used in Study 1 was the real source of the interactions found. A high-powered study with a random sample should be the next step in the replication effort. It is important to note that the coarseness of the moderating variable – CRT, with only 4 discrete possible values –, may also impact power (Kang & Waller, 2005). Indeed, Gervais et al. (2019) chose to use a nine-item CRT scale in their recent moderation study.

Nevertheless, the exposure to CREDs is a consistent predictor of theism and differential theism in all models, with moderate-to-strong semi-partial correlations of about .30. CRT has never a significant coefficient, not even in predicting accuracy, what again points to problems of sample size and scale coarseness.

As for the second objective of the study, convergent validity evaluation, the positive correlation between CRT and need for cognition is not strong as predicted, but weak-to-moderate – similar to the original validation study (Frederick, 2005). Again, the coarseness of the CRT scale may have been detrimental to power, but it may be the case that I was just too optimistic in hypothesizing. Considering the robust correlation

with “I prefer my life to be filled with puzzles that I must solve”, though, I conclude that CRT has an acceptable convergence with need for cognition.

Evaluating the convergent validity of CREDs and measures akin to religious identity, the moderate-to-strong negative correlation between CREDs and intrinsic religiosity is greater than predicted. The strong correlation with “I try hard to carry my religion over into all other dealings in life” seems coherent with the hypothesis of a bias that facilitates the cultural transmission of religion through credible displays of belief. There is also a weak-to-moderate positive correlation between CREDs and MFQ_bind, but weaker than predicted. The authority subscale did not correlate at all, while ingroup and (especially) purity had robust correlations. I conclude that CREDs has an acceptable convergence with binding moral foundations. More generally, the exposure to CREDs seems a reliable proxy for (a)religious identities.

To further probe the model I have developed to predict theism (differential, declared, and guessed as average), overcoming limitations intrinsic to correlational designs and some others found in these two studies, I designed an experiment to test the moderating hypotheses and, more specifically, the supposed identity-affirming mechanics of (a)theism declaration in analytical individuals.

Study 3: Experimental Test of the Social-Cognitive Model

Study 3 has two specific objectives, the most immediate being to replicate Study 1 in a different country, for an evaluation of the external validity and the cross-cultural equivalence of the social-cognitive model. But I also seek to assess, through an experimental manipulation, the consistency of the interactions found and, most of all, the supposition of the model of an identity-affirming declaration of theism in analytical individuals.

In Study 1, we asked participants how much they believed in God or gods and, next, how much they guessed the average theism would be in a reference group. According to our model, this order of questions elicits identity-protective reasoning in more analytical participants, making them respond to the second question – about the average theism – in an identity-affirming way, biased according to their (a)religious identity. Since there is a floor (0) and a ceiling (100) in our BiG100 variable, analytical participants with extreme responses can use the following question about the average as an extended canvas, where they may express their religious identity as more markedly divergent by biasing the guessed average theism. If the order of the questions is inverted, we hypothesize that analytical participants with extreme responses would be bounded in the second question by floor and ceiling in BiG100, preventing the so-called extended canvas effect.

Therefore, the order of those two questions is randomized in this study, to assess whether the interactions found in Study 1 (for differential theism and accuracy in guessing average theism) are attributable to motivated reasoning. If it is true that intervention order elicits identity-affirming declarations of differential theism in analytical (a)religious individuals, we should be able to detect an interaction. For

coherence with previous studies and consistency evaluation, I test if the mechanism also works for declared theism itself.

So, my first hypothesis is of a positive moderated moderation between the exposure to CREDs, cognitive style, and order in determining differential theism (H3.1) – positive because I expect to see steeper lines for more analytical participants in the intervention condition. I also test the same three-way interaction in predicting declared theism (H3.2). Lastly, I hypothesize that the three-way interaction factor is negatively related to guessed average theism (H3.3); since it is not possible to calculate real accuracy in this national sample, I use the guess of average theism of classmates as a proxy of accuracy.

Method

Participants.

Participants were current undergraduate students living in the USA (N = 203; 101 female; mean theism = 49.4, SD = 39.6; mean CRT = 1.3, SD = 1.2; mean CREDs = 24.8, 11.2) enrolled through Prolific, an online service for recruiting payed respondents. They were randomly assigned to either control (N = 106; 44 female; mean theism = 47.5, SD = 38.3; mean CRT = 1.4, SD = 1.2; mean CREDs = 25.0, 10.9) or experimental condition (N = 97; 57 female; mean theism = 51.4, SD = 40.9; mean CRT = 1.3, SD = 1.2; mean CREDs = 24.6, 11.7).

The desired sample size was 395 participants, a number indicated by a power analysis supposing a small effect size ($f^2 = .02$) for the three-way interaction factor and the level of significance ($p = .05$) and power ($1-\beta = .80$) expected for the moderation test. Due to time constraints, data collection had to be interrupted with 203 respondents, bringing expected statistical power down to only .52.

Measures and procedure.

The variables are some of those already presented in Study 1 and 2: BiG100, BiG100g, dBiG100 (calculated), CRT, CREDs, and GenFem. A binary variable named Order distinguishes control (0: BiG100g → BiG100) from intervention (1: BiG100 → BiG100g) groups. All variables are treated as continuous. They were collected asynchronously through a digital questionnaire.

In a confirmatory factor analysis of the CREDs Exposure Scale, all items had parameter estimates equal or above .935 in the single factor structure. The full scale had high reliability, with Chronbach's $\alpha = .93$. The confirmatory factor analysis of CRT had all items with parameter estimates equal or above .977 in the single factor structure. The full scale had acceptable reliability, with Chronbach's $\alpha = .75$.

Data analysis and open science material.

Four-step hierarchical multiple regressions are used to test the three hypotheses of interaction. The name of each step/model begins with the letter "M" suffixed by its step number and the first (or last, for BiG100g) letter of the dependent variable – i.e., M1d is the first model for testing dBiG100, M2B the second model for testing BiG100, M3g is the third model for testing BiG100g and so on. First models (M1s) test the exclusive effect of CRT; M2s test the exclusive effect of CREDs; M3s test the merely combined model of CRT, CREDs, and Order, with no interaction; M4s test the full three-way interaction model. I report semi-partial correlations as effect sizes, confronting them against the empirically derived thresholds proposed by Lovakov and Agadullina (2017): correlation coefficients of .10, .25, and .40 as small, medium, and large effects. Robust bootstrap coefficients and p-values for M4s are provided with bias-corrected and accelerated (BCa) 95% CIs. Tests of conditional interactions on order, provided by PROCESS (Hayes, 2017), are reported for additional information about

different interactions in control vs. intervention group. The digital questionnaire (in English) and SPSS data are available at https://osf.io/fa6jt/.

Results

GenFem was never significant, so I have dropped it from all specifications. The results of the hierarchical multiple regressions to test H3.1 are summarized in Table 7.

Table 7

Multiple regression semi-partial correlations for predictive models of differential theism (dBiG100) using CRT, CREDs, Order, and interaction factors

Predictor	M1d	M2d	M3d	M4d
CRT	-.084		-.046	-.087*
CREDs		.352***	.347***	.105*
Order			.060	.005
CRT x CREDs x Order				.068
2-way interactions	No	No	No	Yes
Intercept (non-standardized)	-.729	-35.899^{+++}	-35.777^{+++}	-20.543
N	203	203	203	203
R^2	.007	.124	.130	.164
Adj. R^2	.002	.120	.117	.134

Significance levels:
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

In the moderation test with dBiG100 as dependent variable (M4d), a significant coefficient was found for CREDs, b = .836 [-.102, 1.663] BCa, p = .028, and for CRT, b = -9.954 [-21.678, 2.174] BCa, p = .045. The coefficient for our main predictor (CRT x CREDs x Order) was not significant, b = .410 [-.321, 1.136] BCa, p = .134, nor for Order, b = 1.503 [-37.930, 41.764] BCa, p = .937.

The test for conditional interactions of CRT x CREDs was non-significant for control, $\theta_{CRTxCREDs \rightarrow dBiG100|Order=0}$ = .199, F(1, 195) = .507, p = .477, but significant for

the intervention condition, $\theta_{CRTxCREDs \rightarrow dBiG100|Order=1} = .609$, $F(1, 195) = 4.681$, $p = .032$, as shown in Figure 5.

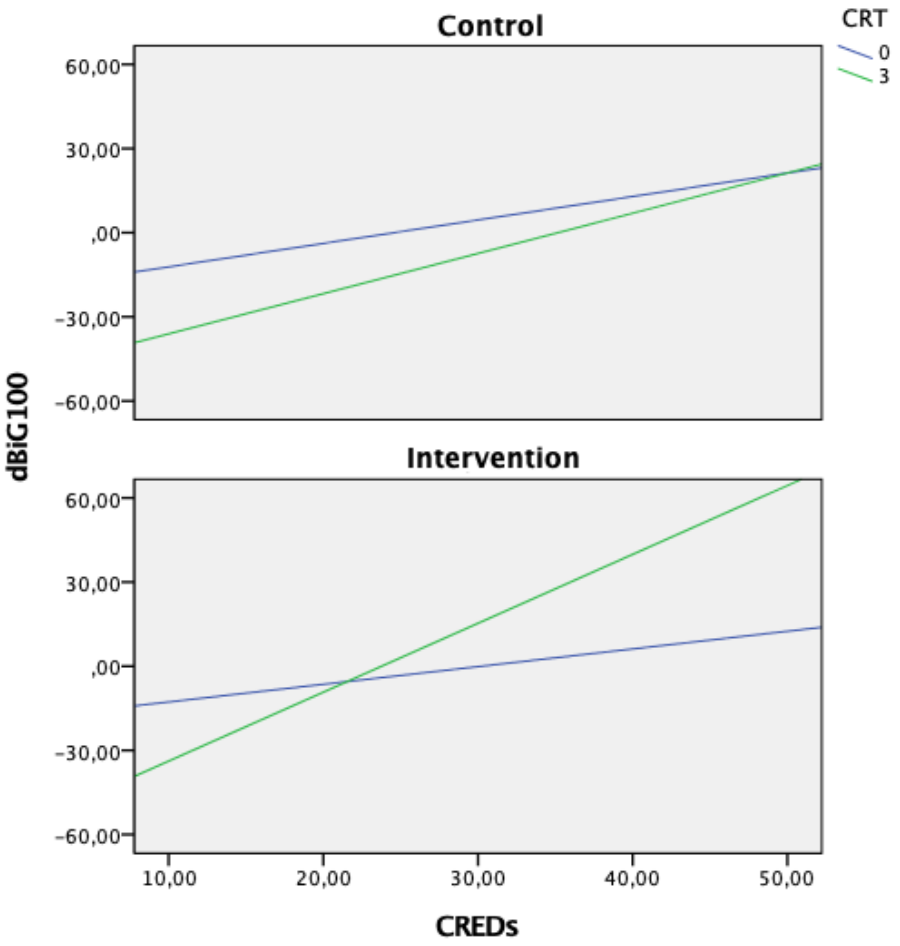

Figure 5. Simple slopes for the interaction of social identity (CREDs) and cognitive style (CRT) on differential theism (dBiG100) at extreme values of the moderator (intuitive vs. analytic cognitive style), in both experimental conditions.

Figure 5 shows that areligious participants presented similar dBiG100 irrespective of experimental condition, whether analytical (around -40) or intuitive (around -15). For their turn, religious participants differed according to experimental condition, with intuitive ones being always close to their guessed average theism and analytical ones being the most divergent of all.

The results of the hierarchical multiple regressions to test H3.2 are summarized in Table 8.

Table 8

Multiple regression semi-partial correlations for predictive models of theism (BiG100) using CRT, CREDs, Order, and interaction factors

Predictor	M1d	M2d	M3d	M4d
CRT	-.094		-.051	-.096*
CREDs		.407***	.400***	.102*
Order			.055	-.001
CRT x CREDs x Order				.043
2-way interactions	No	No	No	Yes
Intercept (non-standardized)	53.481^{+++}	13.863^{+}	14.415	31.842^{+}
N	203	203	203	203
R^2	.009	.165	.171	.199
Adj. R^2	.004	.161	.159	.170

Significance levels:
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

In the moderation test with BiG100 as dependent variable (M4d), a significant coefficient was found for CREDs, b = .795 [-.157, 1.634] BCa, p = .033, and for CRT, b = -10.752 [-21.117, .314] BCa, p = .021. The coefficient for our main predictor (CRT x CREDs x Order) was not significant, b = .254 [-.378, 898] BCa, p = .210, nor for Order, b = -.320 [-37.676, 37.565] BCa, p = .989.

The test for conditional interactions of CRT x CREDs was not significant for control, $\theta_{CRTxCREDs \rightarrow BiG100|Order=0} = .316$, F(1, 195) = 1.386, p = .240, but significant for the intervention condition, $\theta_{CRTxCREDs \rightarrow BiG100|Order=1} = .570$, F(1, 195) = 4.458, p = .036, as depicted in Figure 6.

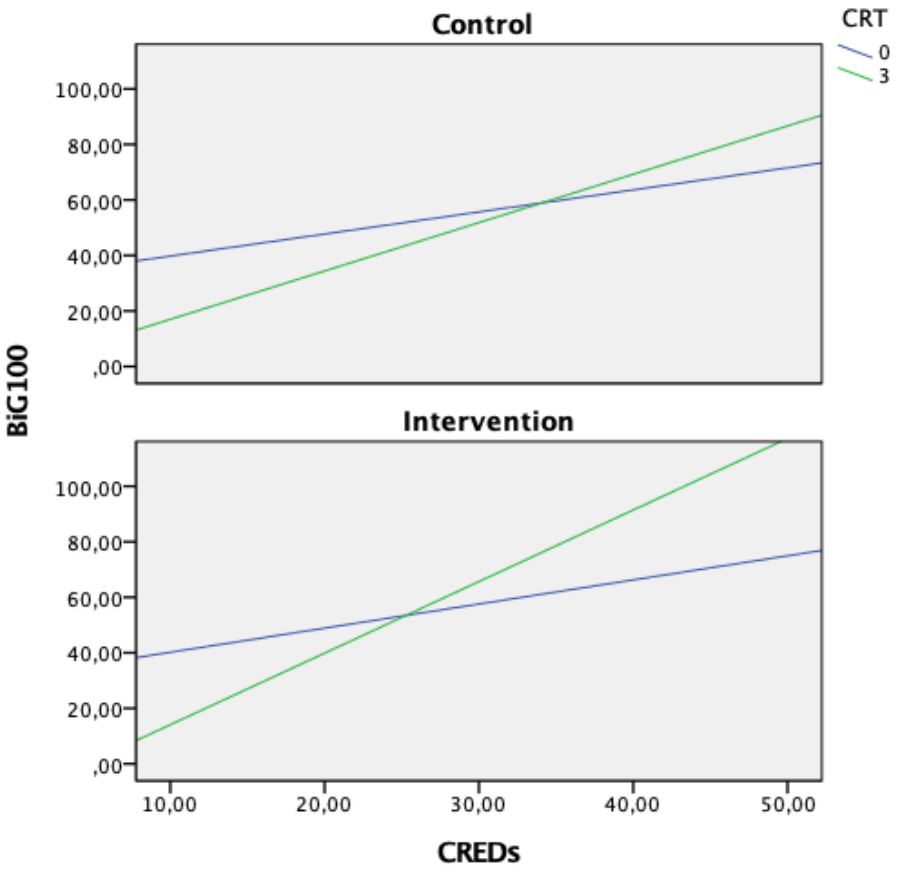

Figure 6. Simple slopes for the interaction of social identity (CREDs) and cognitive style (CRT) on declared theism (BiG100) at extreme values of the moderator (intuitive vs. analytic cognitive style), in both experimental conditions.

Figure 6 shows that, again, only religious participants (i.e., those with high exposure to CREDs, on the extreme right of the graph) differed in declaring theism according to experimental condition, with the intuitive around 70, regardless of the condition, but the analytical going through the ceiling in the intervention group.

The results of the hierarchical multiple regressions to test H3.3 are summarized in Table 9.

Table 9

Multiple regression semi-partial correlations for predictive models of guessed average theism (BiG100g) using CRT, CREDs, Order, and interaction factors

Predictor	M1g	M2g	M3g	M4g
CRT	-.018		-.008	-.015
CREDs		.099	.097	-.011
Order			.013	-.013
CRT x CREDs x Order				-.056
2-way interactions	No	No	No	Yes
Intercept (non-standardized)	54.210^{+++}	49.762^{+++}	50.192^{+++}	52.385^{+++}
N	203	203	203	203
R^2	.000	.010	.010	.034
Adj. R^2	-.005	.005	-.005	-.001

Significance levels:
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

In the moderation test with BiG100g as dependent variable (M4g), the coefficients were not significant for our main predictor (CRT x CREDs x Order), b = -.156 [-.549, .219] BCa, p = .208, nor for Order, b = -1.824 [-19.809, 16.441] BCa, p = .837, for CREDs, b = -.042 [-.488, .396] BCa, p = .860, or for CRT, b = -.799 [-7.519, 5,593] BCa, p = .404.

The test for conditional interactions of CRT x CREDs was not significant for both control, $\theta_{CRTxCREDs \rightarrow BiG100g|Order=0} = .117$, F(1, 195) = .703, p = .403, and intervention condition, $\theta_{CRTxCREDs \rightarrow BiG100g|Order=1} = -.039$, F(1, 195) = .078, p = .780.

Discussion

The hypothesized three-way moderation was not detected in H3.1, H3.2, or H3.3. The low power predicted for the test, with half the sample needed to detect the theorized small effect, surely took its toll.

Despite the low power of the study, the interaction effect between CREDs and CRT found in Study 1 for differential theism was replicated in the intervention group although – importantly – not in the control group. As seen in Figure 5, areligious participants presented similar differential theism irrespective of experimental condition. For their turn, religious participants differed according to experimental condition, with analytical ones being the most divergent of all.

On the declaration of theism, Figure 6 provides a thought-provoking picture. First, irrespective of cognitive style or condition, declared belief grew with CREDs. Indeed, the large effects of CREDs on theism, around .40, were the strongest found in all our specifications. If there is a selected CREDs bias mechanism, it should affect both intuitive and analytical – though it is interesting that the analytical seems more biased.

Then, again, religious participants differed in declaring theism according to experimental condition, with the intuitive stable regardless of the condition, but the analytical going through the ceiling in the intervention group.

It should be pointed out that "analytic atheism" once more slightly increases from the purely cognitive model to the moderated moderation model, also when predicting differential theism. In fact, when the same four-step multiple regressions used in Study 1 are exploratorily applied only to the intervention subsample (N = 97), which had similar treatment of Study 1 and 2 samples, the effect of CRT on theism goes from -.065 to -.176 and of CRT on differential theism from .010 (positive) to -.152 – see M1s vs. M4s in Appendix 2. Such better adjustment indicates that there is synergy, not conflict, between purely cognitive and motivated reasoning accounts of belief.

The proposed "extended canvas" mechanism when guessing average theism is somewhat challenged in this study because BiG100g had no reliable prediction model. Differential theism is calculated as the subtraction of BiG100g from BiG100, so I was

expecting that it correlated with the interaction factor. But our rationale was that the mechanism would be elicited in extreme atheists and theists only, small shares of 13.8% and 22.2% of the sample – so probably rendering an undetectable effect in such an underpowered study.

An exploratory analysis with only those who responded 100 in BiG100 (N = 45), though, do show an interaction between CRT and Order – see Appendix 3 for PROCCESS output and derived simple slopes. In our exploration, while highly theistic participants do not seem to differ in guessed average theism across CRT in the control condition, $\theta_{CRT \rightarrow BiG100g|Order=0}$ = 2.363, t(40) = .732, p = .468, they do in the experimental condition, $\theta_{CRT \rightarrow BiG100g|Order=1}$ = -5,266, t(40) = -1,996, p = .053. In other words, highly analytical theists guess average theism as being 16 points lower, at least – see graphic in Appendix 3, where the difference seems even bigger –, just because it was asked after their personal belief. Maybe they are more accurate, but, then, why highly analytical ones in control condition would not be? Further research on the topic should probe a little more this hypothesized mechanism, maybe with additional questions for extreme respondents of BiG100.

Summarizing, despite this exploratorily found moderation, the source of the discrepancy between experimental conditions on differential theism seems to rely mostly in theism declaration itself. With the finding that analytical individuals differ in theism declarations according to experimental condition, it seems that an identity-affirming declaration of theism occurs even when personal belief is asked as the first (or sole) question – in line with our original model, with our most parsimonious hypotheses and with recent evidence (Gervais et al., 2019). Interestingly, this moderation on theism does not occur when people are previously asked about the average theism. Maybe this order gives all an anchor (Furnham & Boo, 2011); maybe, it prevents identity concerns.

General discussion

The objective of integrating cognitive and motivated reasoning accounts through a social-functionalist modeling of belief has been achieved in this thesis with the social-cognitive model of theism declaration elaborated in the introduction, based on an evolutionary perspective of human cognition and behavior, namely the dual-inheritance theory.

Three empirical studies provided initial evidence of a social-cognitive structuring in theism declarations. Except for the extremely underpowered Study 2, an interaction between cognitive style and religious socialization/identity consistently emerged in the determination of differential theism. It was also present in an exploratory model of declared theism with a small-to-medium effect (Appendix 2), showing that the absence of such interaction in model specifications may be the reason why so many recent studies failed to detect analytic atheism (Farias et al., 2017; Sanchez et al., 2017) – or detected it amidst other seemly contradicting findings (Yilmaz & Isler, 2019). Our results show that, in fact, analytic atheism increases in such moderated models, pointing to a possible synergy between perspectives often seen as irreconcilable.

In line with demands for more diversity in psychological inquiry, our first two studies used samples from Brazil, a country of much interest in ritual studies (Dengah II, 2017; Legare & Souza, 2012; Newson et al., 2018; Soler, 2012) and that, despite the westernization of its welthier urban strata, still presents significant cultural distance from most WEIRD nations (see Appendix 1). Indeed, transcultural validity concerns surfaced thoughout our studies. Religious analytical participants seemed more biased in the US, but in Brazil, areligious ones seemed so. Perhaps culture can moderate the structuring of an areligious social identity, in contrast to what Schiavone and Gervais (2017) saw as a systematic pattern of atheist discretion (in WEIRD?). Additional transcultural inquiry is also needed to test the CREDs bias hypothesis, because Brazilian

intuitive participants displayed an unexpected insensitivity to religious CREDs exposure, an observation that undermines the case for a selected mechanism. Since CREDs theory seems to be gaining attention among philosophy and theology authors in Brazil (e.g., De Luca-Noronha, 2018; Porcher, 2018), social and psychological research should follow.

Many other research questions arose from the studies or persist: could a conversion variable increase the fitness of the social-cognitive model? Could the CREDs exposure scale – a personal account of parental religious commitment – be improved with objective retrospective data or, even better, longitudinal studies on individual religious development? How could other empirical approaches (e.g., cognitive manipulations and neuroscience) help to falsify the CREDs bias hypothesis? Could CREDs theory be applied in the booming studies of other beliefs contingent on socialization, such as moral values (e.g., Reynolds et al., 2020) and political ideologies (e.g., Burger et al., 2020), for cross-context validity? How would other constructs associated with debiasing – such as actively open-minded thinking (Baron, 2019; Haran et al., 2013) and science curiosity (Kahan et al., 2017) – interact with CREDs and integrate the model? A recent theory states the alternative account that similar biases are just rational, for some more than others (Baron & Jost, 2019), and coherent pre-published evidence contends that human belief is only "Bayesian, not biased" (Tappin et al., 2019). How could these concurrent (and, for now, irreconcilable) perspectives be contrasted, with a minimum collaboration from the two sides of the aisle?

Summarizing, the present research can be seen as (soft) evidence that, when a person is asked about her/his belief in God or gods, the answer changes with cognitive styles: from a naïve declaration of belief, for the intuitive, to a rationalization on inherited identity, for the analytical. If this is true, common knowledge of it could someday make us perceive our differences over religion – and maybe politics and even

soccer – in a less judgmental way.

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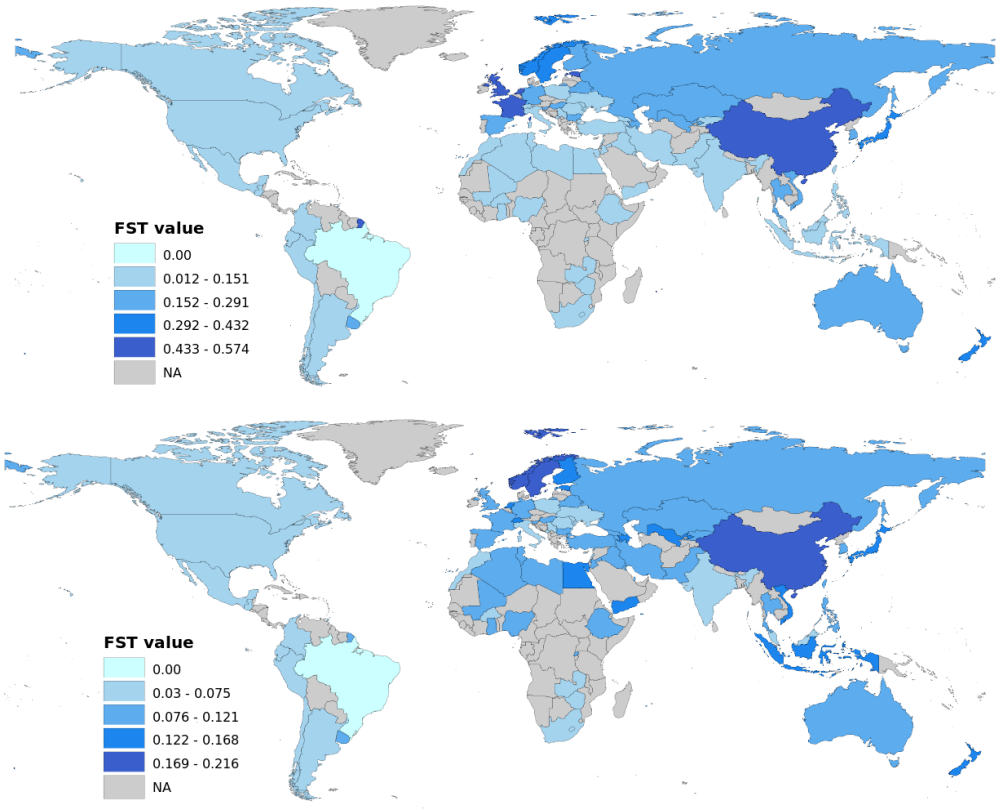
Appendix 1



Cultural distance from Brazil on religious belief (top) and on all dimensions (down).

Source: http://culturaldistance.com (Muthukrishna et al., 2020)

Appendix 2

Multiple regression semi-partial correlations for predictive models of differential theism (dBiG100) using CRT, CREDs, and an interaction factor for the intervention group of Study 3.

Predictor	M1d	M2d	M3d	M4d
CRT	.010		.057	-.152
CREDs		.371***	.375***	.116
CRT x CREDs				.192*
Intercept (non-stand.)	-2.622	-35.898^{+++}	-39.182^{++}	-19.040
N	97	97	97	97
R^2	.000	.138	.141	.178
Adj. R^2	-.010	.129	.123	.152

Significance levels:
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

Multiple regression semi-partial correlations for predictive models of declared theism (BiG100) using CRT, CREDs, and an interaction factor for the intervention group of Study 3.

Predictor	M1B	M2B	M3B	M4B
CRT	-.065		-.007	-.176*
CREDs		.454***	.450***	.168*
CRT x CREDs				.190*
GenFem				
Intercept (non-stand.)	54.185^{+++}	12.265	12.673	31.521*
N	97	97	97	97
R^2	.004	.206	.206	.242
Adj. R^2	-.006	.198	.189	.218

Significance levels:
* p<0.05, ** p<0.01, *** p<0.001 (1-tailed)
$^{+}$ p<0.05, $^{++}$ p<0.01, $^{+++}$ p<0.001 (2-tailed)

Appendix 3

```
************** PROCESS Procedure for SPSS Version 3.3 ******************
          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3
**************************************************************************
Model  : 1
    Y  : BiG100g
    X  : CRT
    W  : Order

Covariates:
 CREDs

Sample
Size:  45
**************************************************************************
OUTCOME VARIABLE:
 BiG100g

Model Summary
          R       R-sq        MSE          F        df1        df2          p
       ,453       ,206    275,658      2,588      4,000     40,000       ,051

Model
              coeff         se          t          p       LLCI       ULCI
constant     53,456      9,858      5,423       ,000     33,532     73,380
CRT           2,363      3,227       ,732       ,468     -4,159      8,886
Order        -1,406      7,220      -,195       ,847    -15,998     13,186
Int_1        -7,630      4,177     -1,826       ,075    -16,073       ,813
CREDs          ,356       ,254      1,400       ,169       -,158      ,869

Product terms key:
 Int_1    :        CRT      x        Order

Test(s) of highest order unconditional interaction(s):
       R2-chng           F         df1         df2           p
X*W       ,066       3,336       1,000      40,000       ,075 (halved for 1-tail = ,037)
----------
    Focal predict: CRT      (X)
          Mod var: Order    (W)

Conditional effects of the focal predictor at values of the moderator(s):

      Order      Effect         se          t          p       LLCI       ULCI
       ,000      2,363      3,227       ,732       ,468     -4,159      8,886
      1,000     -5,266      2,639     -1,996       ,053    -10,599       ,067
```