COMMENTARY

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Susceptibility to violent extremism and cognitive rigidity: Registered replication, corroboration and open questions for criminological research and practice

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Abstract

Does cognitive inflexibility predict vulnerability to violent extremism? Schumann, Salman, Clemmow, and Gill (2021) conducted a registered direct replication of Zmigrod, Rentfrow, and Robbins' (2019, *Frontiers in Psychology*, 10, 989) studies on the relationship between neuropsychologically assessed cognitive inflexibility and extremist attitudes. Replicating the original study, Schumann et al. (2021) demonstrated that cognitive inflexibility on the Remote Associates Test was related to individuals' willingness to fight and die for their ideological group (Bayes Factor = 58.7). In a further corroboration, the study found that individuals who indicated they would self-sacrifice in a trolley-dilemma paradigm were more psychologically rigid on the Remote Associates Test than those who opted for self-preservation (Bayes Factor = 402.3). A mini meta-analysis with the original study revealed a significant negative correlation between cognitive flexibility and violent extremist behaviour intentions, thereby supporting the conclusions of the original study by Zmigrod and colleagues (2019). Nevertheless, the replication study highlighted moderators of the effect sizes of the reported relationships and revealed subtleties in the theoretical relationships between cognitive style and tendencies towards extremist attitudes. Follow-up analyses with Bayesian statistics demonstrated that—corroborating the original study—cognitive inflexibility on both the Remote Associates Test (Bayes Factor = 7.2)

and the Wisconsin Card Sorting Test (Bayes Factor = 2.3) are linked to individuals' willingness to fight for an ideological cause. However, the replication study revealed that these effects are specific to individuals who endorse ideological self-sacrifice. Furthermore, deviating from the original study, Schumann and colleagues found that cognitive flexibility on the Wisconsin Card Sorting Test may in fact positively predict willingness to die for a group under some conditions. This suggests that flexibility may be a double-edged sword when it comes to ideological conversion. These insights indicate that a fine-grained examination of risk sub-profiles and interactions among predictors is essential. The findings of the replication also stimulate a discussion of what constitutes a phenomenologically or practically meaningful effect size for psychological and criminological research and practice—and the implications for cognitive methodologies in risk assessment.

KEYWORDS
cognitive rigidity, extremism, interactions, radicalization, vulnerability

EVALUATING THE RELATIONSHIP BETWEEN COGNITIVE INFLEXIBILITY AND VIOLENT TENDENCIES

The notion that a person's ideological convictions may be reflections of their cognitive traits is an old and fascinating hypothesis (Adorno et al., 1950; for reviews see: Jost, 2017; Zmigrod, 2020, 2021, 2022). Theoretically, the link between ideology and cognition suggests that we can map the minds of potential ideologues and extremists using the tools of cognitive science (Zmigrod, 2021; Zmigrod & Goldenberg, 2021). Yet what does this relationship mean for criminological research and practice?

An emerging body of research illustrates that neuropsychological assessments of executive functions, including cognitive rigidity, can reveal who is most susceptible to extreme and dogmatic ideological thinking (Zmigrod et al., 2018, 2020, 2021; Zmigrod, Rentfrow, et al., 2019; Zmigrod, Rentfrow, Zmigrod, et al., 2019; Zmigrod, Zmigrod, et al., 2019). Building on this line of inquiry, Schumann et al. (2021) conducted a registered replication of Zmigrod, Rentfrow, et al. (2019) multi-study investigation of the relationship between neuropsychologically assessed cognitive rigidity and extremist attitudes. By and large, the replication was a success in terms of the replicability of results and the extension of the original study. It expanded the scope of the original investigation, examining over 1300 participants and tested the relationships between cognitive rigidity as measured with the Remote Associates Test and Wisconsin Card Sorting Test and individuals' willingness to fight and die for their ideological group (as in Swann et al., 2014). Deviating from the original study, Schumann et al. (2021) included participants who failed an attention check, used a different software platform for the Wisconsin Card Sorting Test assessment and did not test the Alternative Uses Test measure for cognitive rigidity.[1]

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[1] As a result, for the purposes of this commentary, when relaying and re-analysing the relationships identified by Schumann et al. (2021), there will be a distinction between 'reported' relationships in the replication paper and the relationships 'calculated here', which exclude participants who failed the attention check—as is standard practice and as was performed in the original study.

In line with the original study, the findings revealed a small significant correlation between performance on the Remote Associates Test and willingness to fight and die for an ideological group (reported Spearman's $r = -.08$, $p < .001$; calculated here without attention-check failing participants: $N = 1369$, Pearson's $r = -.104$ [−0.156, −0.052], $p = .0001$, Bayes Factor = 58.719; Spearman's rho = −.092 [−0.144, −0.039], $p = .0007$; Kendall's Tau $B = -.066$ [−0.101, −0.031], $p = .0007$, Bayes Factor = 30.167). The Bayes Factors indicate that there is 'very strong' evidence for the alternative hypothesis that RAT and willingness to fight and die are correlated.[2]

Furthermore, the pattern of results in Schumann and colleagues' investigation corroborated the original finding that cognitive inflexibility on the Remote Associates Test was linked to greater conviction in one's decision to self-sacrifice in an intergroup trolley-dilemma scenario (reported Spearman's rho = −.09, $p = .053$; Pearson's $r = -.097$, $p = .047$). When participants who failed the attention check are excluded, and age and gender are controlled for,[3] the correlation between RAT accuracy and certainty in the choice to self-sacrifice is more pronounced and achieves statistical significance across all parameters ($N = 416$, Pearson's $r = -.104$, $p = .034$, Spearman's rho = −.102, $p = .038$, Kendall's Tau $B = -.069$, $p = .035$).

The replication study also identified a novel finding: individuals who chose to self-sacrifice on an intergroup trolley-dilemma scenario were more cognitively rigid on the Remote Associates Test than individuals who opted to save themselves and sacrifice other members of their ideological group[4] (calculated here: Cohen's $d = .248$ [0.132, 0.363], $p = .00003$, Bayes Factor = 402.278; Mann–Whitney = 225,139, rank-biserial correlation = .136 [0.070, 0.200], $p = .0006$, Bayes Factor = 14.813, whereby H1 = significant differences between the groups, H0 = no significant differences between the groups).

The results were less clear with regards to the Wisconsin Card Sorting Test, with some null results. Consequently, I conducted a follow-up analysis of Schumann et al.' (2021) data and found notable instances of corroboration of the original study as well as discrepancies and novel results, including null findings and moderated relationships. The exploratory and follow-up analyses remained true to the approach of the original study and the replication study, which split participants into those who would sacrifice their lives for the ideological group and those who would save themselves and sacrifice ideological group members instead. As a result, while these follow-up analyses offer a fine-grained analysis, they do so in keeping with the preregistration of the replication study.

EXPLORATORY AND FOLLOW-UP ANALYSES WITH BAYESIAN STATISTICS

As illustrated in the original and replication studies, it is fruitful to focus on individuals willing to sacrifice their lives for an ideological group; this group of people is presumably most susceptible to extremist ideologies demanding self-sacrifice and harm. Examining the dataset that excludes participants who failed the attention check, I followed up on Schumann and colleagues' analyses.

Focusing on the subgroup which opted for self-sacrifice, there was a significant negative correlation between cognitive flexibility on the Remote Associates Test and willingness to fight ($N = 416$, Pearson's $r = -.125$, $p = 0011$, Spearman's rho = −.114, $p = .020$, Kendall's Tau $B = -.082$, $p = .021$), which was even

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[2]These Bayes Factors were calculated using the most basic assumption that, for the alternative hypothesis H1, the RAT and willingness to fight and die are 'correlated', as opposed to the null hypothesis H0 that there is no correlation. Given that the preregistration hypothesized that the two variables will be negatively correlated, it is possible to calculate the Bayes Factors for the alternative hypothesis that the variables are not simply 'correlated' but in fact 'correlated negatively'. When the alternative hypothesis is that RAT and willingness to fight and die are correlated negatively, the Bayes Factors are BF = 117.431 for the Pearson's correlation (indicating 'decisive' evidence in favour of the alternative hypothesis) and BF = 60.326 for the Kendall's tau correlation (indicating 'very strong' evidence in favour of the alternative hypothesis).

[3]The original study outlined the need to check the relationships when controlling for demographic variables.

[4]The task reads: 'You have the opportunity to jump from a bridge into the trolley's path and save all 5 British people. Would you: (a) let the trolley crush the 5 British people and save your own life, OR (b) save the 5 British people and sacrifice your own life?'

more pronounced when controlling for age and gender (Pearson's $r = -.161$, $p = .001$, Spearman's rho $= -.133$, $p = .007$, Kendall's Tau $B = -.090$, $p = .006$). Moreover, corroborating the original study, there was a significant negative correlation between cognitive flexibility on the Wisconsin Card Sorting Test and willingness to fight in the parametric measures[5] ($N = 416$, Pearson's $r = -.126$, $p = .010$, Spearman's rho $= -.071$, $p = .149$, Kendall's Tau $B = -.049$, $p = .162$; including age and gender: Pearson's $r = -.131$, $p = .008$).

The original study and preregistration included hierarchical linear regressions, and so I computed hierarchical linear regressions for the self-sacrificial participants in the sample. Specifically, I conducted a series of hierarchical linear regressions with willingness to fight as the outcome measure, and the first step including the demographic variables age, gender and educational attainment. When Remote Associates Test performance was included in the second step, it was a significant negative predictor of willingness to fight (beta $= -0.132$, $t = -2.782$, $p = .006$). An equivalent hierarchical Bayesian linear regression showed that, given the data, the probability of including RAT accuracy as a predictor variable of willingness to fight is 87.7% and that the associated Bayes Factor—which indicates the evidential strength in favour of the hypothesized relationship, in contrast to the null hypothesis H0 of no relationship—is 7.158, which is classified as 'substantial' or 'moderate' evidential strength in favour of the RAT as a predictor of willingness to fight, beyond age, gender and educational attainment. In other words, the data are 7.158 times more likely to support a model with the RAT as a predictor than the null model with only demographic variables.

Similarly, a hierarchical linear regression which included Wisconsin Card Sorting Test performance in the second step found WCST flexibility to be a significant negative predictor of willingness to fight to protect one's ideological group (beta $= -0.107$, $t = -2.309$, $p = .021$). An equivalent hierarchical Bayesian linear regression showed that, given the data, the probability of including WCST accuracy as a predictor variable of willingness to fight is 69.6% and that the associated Bayes Factor is 2.294 which is classified as 'anecdotal or 'weak' evidential strength in favour of the WCST as a predictor of willingness to fight, beyond age, gender and educational attainment.

These results were only evident in individuals who chose to self-sacrifice for their ideological groups. The findings did not emerge when examining the individuals who shunned ideological self-sacrifice in the name of self-preservation—indicating that concentrating on individuals who endorse ideological self-sacrifice is a valuable analytical and theoretical approach. The large dataset collected by Schumann and colleagues confers the statistical power to explore such nuanced relationships and highlights the importance of large sample sizes for empirical exploration, corroboration, refutation and confirmation.

One insight from the replication study is that the willingness to die scale has quite separable psychological correlates to the willingness to fight scale. Unlike the original study, Schumann and colleagues found that the Wisconsin Card Sorting Test was positively related to willingness to die (reported Spearman's rho $= .07$, $p < .05$; calculated here without attention-failing participants: Spearman's rho $= .072$, $p = .004$, Pearson's $r = .050$, $p = .033$, Bayes Factor $= 0.184$, Kendall's Tau $B = 0.054$, $p = .004$, Bayes Factor $= 3.032$). This correlation was indeed corroborated by—and accentuated in—follow-up analysis of the self-sacrificial subgroup ($N = 416$, Pearson's $r = .108$, $p = .027$, Bayes Factor $= 0.695$; Spearman's rho $= .135$, $p = .006$; Kendall's Tau $B = .098$, $p = .006$, Bayes Factor $= 5.626$).[6] There was no significant relationship between willingness to die and the Remote Associates Test ($N = 416$, Pearson's $r = -.061$, Bayes Factor $= 0.133$, $p = .214$, Spearman's rho $= -.059$, $p = .230$, Kendall's Tau $B = -.043$, $p = .239$, Bayes Factor $= .152$), and Bayesian analyses suggested strong evidence for the null hypothesis H0 that there is no relationship. Perhaps the use of additional cognitive flexibility tasks will elucidate this paradox. If corroborated, this finding

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[5]It is difficult to infer from the data why the non-parametric tests differ from the parametric tests here and which one would be easier to interpret (Mircioiu & Atkinson, 2017). Triangulation of methods is therefore helpful.

[6]Note the difference in Bayes Factor sizes between the parametric and non-parametric calculations. The reasons for this discrepancy are unclear and may be linked to skewed distributions.

might suggest that some form of flexibility or behavioural adaptability may be required for ideological conversion. The original study (Zmigrod, Rentfrow, et al., 2019) pointed out a distinction between types of mental flexibility: while the WCST involves reactive adaptability to changing rules, the RAT involves generative semantic flexibility. In terms of future theory building, perhaps this distinction will prove to be essential for delineating which kind of rigidity facilitates susceptibility to different forms of extremist acts and ideation.

CLUSTERS OF PSYCHOLOGICAL PROFILES, EFFECT SIZES AND EVIDENTIAL STRENGTH, AND CRIMINOLOGICAL THEORY BUILDING

The results indicate that criminological psychology must be attuned to complex interactions and risk sub-profiles in order to develop a comprehensive and predictive framework for understanding radicalization risk (Zmigrod & Goldenberg, 2021). Moderation analyses that identify for whom the relationship between ideological extremism and cognitive flexibility is most pronounced—and for whom it is attenuated or absent—offer clarity on the boundary conditions of the links between extremist tendencies and psychological traits. Therefore, as depicted in both the original study (Zmigrod, Rentfrow, et al., 2019) and its registered replication (Schumann et al., 2021), when we focus on sub-groups of individuals who are ideologically motivated to self-sacrifice, rather those who focus on self-preservation, we can observe strong and substantial relationships between cognitive rigidity and willingness to fight for one's ideological group.

While experimental criminology is traditionally based on randomized controlled trials, which involve comparing multiple interventions, in individual differences research the effect size considerations can be different: 'small' effect sizes are captured by $r = .10$, 'typical' effect sizes by $r = .20$ and 'relatively large' effect sizes by $r = .30$ (Gignac & Szodorai, 2016). Indeed, Funder and Ozer (2019) argue that an effect size $r = .05$ can be considered as *very small* for explanation of single events but potentially consequential in the not-very-long run, an effect size r of .10 indicates an effect that is still *small* at the level of single events but potentially more ultimately consequential, an effect size of .20 indicates an effect of *medium* size that is of some explanatory and practical use even in the short run and therefore even more important' (p. 166). Bearing this in mind, as well as the Bayesian evidential strength analyses conducted here (and with increasing use in criminology; Mac Giolla & Ly, 2020), the effect sizes identified by Schumann et al. (2021) are small—sometimes even medium-sized—but not necessarily inconsequential.

Practically and phenomenologically, what do these results imply for criminological theory and practice? Effect sizes are sometimes best understood in relation to benchmarks (Funder & Ozer, 2019), anchors (Anvari & Lakens, 2021), or other effects that are considered theoretically and practically meaningful. In Schumann et al.' (2021) replication study, the effect sizes of the demographic predictors of age (beta = 0.133) and educational attainment (beta = 0.130) were of equivalent magnitude to the explanatory power of cognitive inflexibility (beta = 0.132) when predicting individuals' willingness to fight for their ideological group. As a result, if criminological research considers age and education as meaningful screening criteria for risk for radicalization (e.g. Bhui et al., 2014) then cognitive rigidity should be considered seriously too. Incorporating cognitive rigidity becomes especially important for criminological practice in light of the high prevalence of disorders of compulsivity and rigidity—especially autism spectrum disorders—among individuals referred to counter-extremism services (Al-Attar, 2020; Woodbury-Smith et al., 2022). Rigidity may be a mediating mechanism between such mental health disorders and participation in extreme ideologies. Hence, in understanding the aetiology of radicalization risk, it is paramount that scholars in public policy and law can evaluate how rigidity—which is a core psychological characteristic of many people with autism—may augment individuals' vulnerability.

'Prediction' is at times a catch-all term for a variety of different scientific and practical exercises. If the aim is to predict a given individual's likelihood of committing ideologically motivated violent acts, then variables such as prior violent history, general aggression, or ideological commitments are

proximal, 'neighbour' variables that are sufficiently similar to the outcome variable itself that they may have high predictive power for risk assessment. Yet such variables do not give us a 'deep' theory or longitudinal account of the characteristics that render a brain susceptible to extremism. If our goal is to understand how a mind comes to be ideologically extreme and receptive to committing extremist acts, then we need to measure distal predictors—such as cognitive traits, environmental factors and their interactions—that offer a window into the phenomenology of ideological immersion and radicalization (Wolfowicz et al., 2020; Zmigrod, under review). Building these deeper, multivariate theories of ideological extremism will ensure that our explanations delve into the antecedents and consequences of engagement with dogmatic ideologies. Without attention to distal cognitive and biological factors, criminological research will struggle to trace the reverberations of violent and prejudiced worldviews to the mind and body—and thereby to imagine how to combat and undo these changes.

AUTHOR CONTRIBUTIONS

Leor Zmigrod: Conceptualization; writing – original draft; writing – review and editing.

CONFLICT OF INTEREST

There are no conflicts of interest to report.

DATA AVAILABILITY STATEMENT

All data analysis scripts used to calculate these results are available on the Open Science Framework through the following link: https://osf.io/azdqh/.

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