

# Right-wing ideology and numeracy: A perception of greater ability, but poorer performance

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## Abstract

Right-wing ideology and cognitive ability, including objective numeracy, have been found to relate negatively. Although objective and subjective numeracy correlate positively, it is unclear whether subjective numeracy relates to political ideology in the same way. Replicating and extending previous research, across two samples of American adults ( $n= 455, 406$ ), those who performed worse on objective numeracy tasks scored higher on right-wing authoritarianism (RWA) and social dominance orientation (SDO), and they self-identified as more conservative on general, social, and economic continua. Controlling for objective numeracy, subjective numeracy related positively to measures of right-wing ideologies. In other words, those who strongly (vs. weakly) endorsed right-wing ideologies believed they are good with numbers yet performed worse on numeracy tasks. We discuss implications for the opposing direction of associations between ideology with objective versus subjective numeracy and similarities with literature on overconfidence.

Keywords: cognitive reflection, overconfidence, political ideology, numeracy, right-wing authoritarianism, social dominance orientation

## 1 Introduction

The ideological divide between left and right in the U.S. has expanded rapidly since the early 2000s (PEW, 2017). The gap between Democrats and Republicans on 10 political values, for instance, grew from 15 points in 1994 and 17 points in 2004 to 36 points in 2017. The political divide in 2017 was substantially larger than gaps in values based on demographic variables such as race (14 points), age (10 points), or gender (7 points). In the midst of this growing divide, social scientists have intensified their study of psychological factors connected to political ideology. One such factor is cognitive ability, with researchers sometimes documenting a negative association with right-wing political ideology (Onraet, van Hiel, Dhont, Hodson, Schittekatte & De Pauw, 2015; van Hiel et al., 2010). This body of literature has largely overlooked numeracy. Objective numeracy is the “*ability* [emphasis added] to store, represent and process mathematical operations” (Peters, 2012). Subjective numeracy instead reflects self-evaluations of numerical ability and general comfort with numbers. Objective and subjective numeracy correlate positively (Fagerlin, et al., 2007; Zikmund-Fisher, et al., 2007), but, they do not always predict the same outcomes (e.g., Miron-Shatz, Hanoch, Doniger, Omer, Ozanne, 2014). Moreover, belief in ability does not correspond to

ability (Oskamp, 1965). The present research investigates two research questions: 1) whether objective and subjective numeracy differentially relate to various indices of political ideology; and, 2) whether relations between numeracy and ideology are dependent on the measure of political ideology.

Numeracy is implicated in decision making in many domains. For example, a large body of data shows an association between numeracy and financial decision-making (Lusardi & Mitchell, 2014), such as retirement planning (Lusardi & Mitchell, 2011) and investing (von Gaudecker, 2015). Support for pressing political issues, such as health insurance (Barnes, Hanoch & Rice, 2015) have also been tied to numeracy. Links between numeracy and political ideology would present the possibility that decisions tied to numeracy might also be ideologically driven. There are indications, though limited, that political attitudes are associated with financial literacy (i.e., narrower form of numeracy) (Bucher-Koenen & Lusardi, 2011), and others have reported differences in financial literacy across political orientation (in France) (Arrondel, Debbich & Savignac, 2013). As a first step, we focus on the association between numeracy and ideology.

### 1.1 Political Ideology

There is a variety of ways to measure political ideology (Morgan & Wisneski, 2017), most commonly with a self-identification continuum from ‘extremely liberal’ to ‘extremely conservative’. Across time and place, researchers have typically found that political, social, and cultural values, attitudes, and ideology are best conceptualised with

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two dimensions (Duckitt, 2001 Table III). One dimension typically corresponds to social or cultural content. Right-wing authoritarianism (RWA), or beliefs that people should yield to legitimate authorities, conform to established social norms and customs, and that norm violators should be penalised (Altemeyer, 1998), is one measure that taps the socio-cultural dimension in the ideology domain (Duckitt, 2001; Jost et al., 2003). A second dimension corresponds to status, competition or economic content (Choma, Ashton & Hafer, 2010; Duckitt, 2001). Social dominance orientation (SDO), or preferences for hierarchical intergroup relationships (i.e., anti-egalitarianism, or SDO-E) and the belief in dominance of some groups over others (i.e., group dominance, or SDO-D; Ho et al., 2015; Sidanius & Pratto, 1999; Pratto et al., 1994), corresponds to this status or competition dimension in the ideology domain (Duckitt, 2001; Jost et al., 2003). Here, we measured the two dimensions with RWA and SDO, respectively. We also asked about social and economic political self-identification from “extremely liberal” to “extremely conservative”. These should also correspond to the two dimensions, respectively.

## 1.2 Right-Wing Ideology and Cognitive Ability

There is a large body of literature examining the association between cognitive ability and political ideology. Meta-analytic results indicate that cognitive ability relates negatively to social conservatism or authoritarianism (Onraet et al., 2015; van Hiel et al., 2010), with stronger correlations emerging with RWA ( $r = -.30$ ) compared to social conservatism ( $r = -.13$ ). Only a handful of studies have examined the association between cognitive ability and SDO (see Onraet et al., 2010 and van Hiel et al., 2015 for a similar conclusion; for exceptions, see Choma & Hanoch, 2017; Choma, Hodson, Hoffarth, Charlesford & Hafer, 2014; Heaven et al., 2011). Some research has identified a negative association, similar to that of RWA: Heaven et al. (2011) reported a weak correlation between SDO and verbal intelligence among adolescents, and Choma and Hanoch (2017) found that higher SDO correlated with lower cognitive ability in a sample of American adults. In both studies, the correlations were weaker between cognitive ability and SDO (vs. with RWA). In contrast, Choma et al. (2014) reported that cognitive ability was *unrelated* to SDO in a sample of Canadian university students. Thus, whereas the limited work on cognitive ability and SDO has produced mixed findings, cognitive ability consistently relates to higher (vs. lower) social conservatism or RWA.

To our knowledge, only one study has singled out numerical ability compared to other types of cognitive ability (for a similar observation see Onraet et al., 2015): Heaven et al. (2011) found a negative association between lower verbal and numerical ability with RWA. Numerical ability also

related to lower SDO. Relatedly, Choma et al. (2014) examined arithmetic reasoning and similarly reported a negative correlation with RWA ( $r = -.20$ ); however, they did not find a significant association with SDO.

## 1.3 Numeracy, the Cognitive Reflection Test, and Political Ideology

One of the more common indices of numeracy is the objective numeracy scale (Lipkus, Samsa & Rimer, 2001). Another widely known measure containing numeracy items is the cognitive reflection test (CRT; Frederick, 2005). The CRT is intended as a measure of reflective ability or thinking, however, it also taps numerical ability (Campitelli & Gerrans, 2014; Del Missier, Mantyla & Bruin, 2012; Pennycook & Ross, 2016; Szaszi et al., 2017). More specifically, some researchers maintain that CRT scores calculated as the number of correct responses, for the original CRT, assess numeracy (Sinayev & Peters, 2015; Thomson & Oppenheimer, 2016; Welsh, Burns & Delfabbro, 2013). Others have observed that the CRT items without lures perform similarly to CRT items with lures (e.g., Baron, Scott, Fincher, & Metz, 2015).

Some studies have examined the association between political ideology and the CRT. In this literature, political ideology has tended to be represented as self-identification as politically conservative (vs. liberal) or general conservatism. Weak negative correlations (Deppe et al., 2015; Iyer et al., 2012; Pennycook et al., 2012, Study 1; Yilmaz & Saribay, 2016, 2018, Study 2) or null associations have been reported (Deppe et al., 2015, Studies 1 and 4; Kahan, 2013; Pennycook et al., 2012, Study 2; Piazza & Sousa, 2014; Yilmaz & Saribay, 2017; 2018, Study 1) (see also Jost, Sterling & Stern, 2017 for meta-analytic results; see also Saribay & Yilmaz, 2017). Some researchers have examined relations between social or economic political identification or attitudes and the CRT. The findings are mixed, though the results overall suggest that higher social conservatism relates to lower CRT scores (Deppe et al., 2015; Yilmaz & Saribay, 2016, Study 2, 2018; but see Deppe et al., 2015, Study 4; Yilmaz & Saribay, 2017), whereas economic conservatism might be essentially uncorrelated with the CRT (Deppe et al., 2015; Yilmaz & Saribay, 2016, 2017), or positively correlated (Baron, 2015; Deppe et al., 2015). Researchers have yet to explore relations between RWA and SDO with the CRT. However, Yilmaz and Saribay (2016, 2018) created measures of ideology combining some items from the RWA and SDO scales; though not definitive, several individual items from both measures correlated with CRT (Appendix B, Table A1 of Yilmaz & Saribay, 2016).

### 1.4 Subjective Numeracy

Researchers have also developed measures of subjective numeracy to assess perceived numerical ability and general comfort with numbers. As might be expected, the subjective numeracy scale (SNS; Fagerlin et al., 2007; Zikmund-Fisher et al., 2007) shows moderate to strong correlations with objective numeracy (e.g., +.36 to +.68; Fagerlin et al., 2007; Galesic, Garcia-Retamero, 2010; Miron-Shatz, Hanoch, Doniger, Omer & Ozanne, 2014; Rolison, Wood, Hanoch & Liu, 2013), indicating that people are capable of gauging their ability. Therefore, it is possible that subjective numeracy will relate to right-wing ideology in the same way it does to objective numeracy: negatively. However, other research presents the possibility that it could relate in the opposite direction. Of particular relevance, De Keersmaecker, Onraet, Lepouttre and Roets (2017) reported a *positive* association between *perceived* intelligence and SDO, raising the possibility that subjective and objective numeracy have unique variance relevant to right- versus left-wing ideology.

No previous research has directly investigated associations between subjective numeracy and political ideology; therefore, we were agnostic about the direction of the link. Post hoc, research on overconfidence could help explain possible positive associations between right-wing ideology and subjective numeracy. In samples of American adults, Eriksson and Funcke (2012) found that Republicans perceived themselves (and their political group) as more competent than did Democrats, and in a later study (2015) showed that the effect size for perceiving oneself and their political group as above average in competence was higher among Republicans than Democrats. Others observed that individuals who self-identify as conservative or Republican are overconfident (Ortoleva & Snowberg, 2015a, 2015b). This literature could help inform positive associations between right-wing ideology and subjective numeracy, to the extent that the parts of subjective numeracy unique from objective numeracy might be conceptually similar to overconfidence. Importantly, we did not at first analyse the data with this connection in mind; however, this literature can, in retrospect, help interpret the findings.

Moreover, RWA and SDO are associated with traits and attitudes reflecting beliefs that they or their group is better than others are. Those higher in RWA, for instance, are self-righteous (Altemeyer, 1998), and those higher in SDO are narcissistic, patriotic, culturally elitist, nationalistic, and chauvinistic (Ho et al, 2015; Hodson, Hogg & MacInnis, 2009; Pratto et al., 1994). RWA and SDO are two of the strongest individual difference predictors of prejudice; that is, beliefs that the ingroup is better than outgroups (Altemeyer, 1998; Duckitt, 2001; Duckitt & Sibley, 2017). As noted earlier, although there is theoretical and empirical grounding for expecting a positive association between

TABLE 1: Sample characteristics.

|                        | Sample 1<br>N = 455 | Sample 2<br>N = 406 |
|------------------------|---------------------|---------------------|
| Age – Mean (SD)        | 33.1 (13.3)         | 38.4 (13.1)         |
| Gender                 | 255 F, 197 M        | 221 F, 185 M        |
| Political orientation: |                     |                     |
| Generally              | 4.03 (2.10)         | 4.41 (2.39)         |
| Economically           | 4.53 (2.19)         | 4.66 (2.49)         |
| Socially               | 3.65 (2.25)         | 4.12 (2.54)         |
| Ethnic background:     |                     |                     |
| Chinese                | 17                  | 13                  |
| South Asian            | 11                  | 4                   |
| African-American       | 41                  | 22                  |
| Arab/West Asian        | 3                   | 1                   |
| Filipino               | 9                   | 2                   |
| South East Asian       | 7                   | 7                   |
| Latin American         | 27                  | 14                  |
| Japanese               | 2                   | 1                   |
| Korean                 | 7                   | 0                   |
| Aboriginal             | 9                   | 2                   |
| White                  | 345                 | 335                 |
| Other                  | 9                   | 4                   |
| Education:             |                     |                     |
| <High School           | 6                   | 4                   |
| High School graduate   | 83                  | 58                  |
| Some College           | 189                 | 138                 |
| College degree         | 136                 | 158                 |
| Master’s degree        | 32                  | 41                  |
| Doctoral degree        | 6                   | 7                   |
| Annual income:         |                     |                     |
| <\$15,000              | 79                  | 47                  |
| \$15,001 - \$30,000    | 99                  | 91                  |
| \$30,001 - \$45,000    | 84                  | 73                  |
| \$45,001 - \$60,000    | 75                  | 67                  |
| \$60,001 - \$75,000    | 39                  | 50                  |
| \$75,001 - \$100,000   | 45                  | 40                  |
| Over \$100,000         | 29                  | 38                  |

subjective numeracy and right-wing ideology, in light of the paucity of previous work, the current research was exploratory and no directional hypothesis was proposed.

## 2 The Present Research

We investigate two research questions. First, we studied whether objective and subjective numeracy differentially relate to various indices of political ideology. Given previous research, it is reasonable to expect objective numeracy to relate negatively to right-wing ideologies and conservative identification. However, it is unclear how or whether subjective numeracy will relate to political ideology; consequently, our examination of a possible link is exploratory. Second, we investigate whether relations between numeracy and ideology are dependent on the measure of political ideology. In particular, given previous research reviewed earlier, it is reasonable to expect that objective numeracy will relate negatively with RWA or self-identification as socially conservative; however, it is unclear whether objective numeracy will relate to SDO or self-identification as economically conservative. We explored the research questions in two samples of American adults.

### 2.1 Method

#### 2.1.1 Participants and Procedure

Samples consisted of American participants who completed a survey on Amazon Mechanical Turk for \$1. The first sample was collected in September of 2012 and the second sample in March of 2016. Participants in both samples (Sample 1,  $n=455$ ; Sample 2,  $n=427$ ) tended to be predominantly white (75.8% and 82.5%), female (56.0% and 54.4%), in their 30s ( $M = 33.1$ ,  $SD = 13.3$ , range = 18–82 and  $M = 38.4$ ,  $SD = 13.1$ , range = 19–76), educated beyond the high-school level, and politically liberal (see Table 1).<sup>1</sup> Participants completed the objective numeracy scale, the cognitive reflection test (CRT), the subjective numeracy scale, and measures of RWA, SDO, and political self-identification.<sup>2</sup>

#### 2.1.2 Measures<sup>3</sup>

**Objective numeracy.** Participants completed two scales. First, they completed the three general numeracy items from the Lipkus et al.'s (2001) Objective Numeracy scale. One item read, "Imagine that we flipped a coin 1,000 times. What is your best guess about how many times the coin would come up heads in 1,000 flips?" Participants who provided the correct answer (here: 500) were given a score of 1.

<sup>1</sup>Sample size requirements are based on a SEM model that we did not depend on for the present analyses.

<sup>2</sup>Sample 1 participants also completed the DOSPRT, which assesses risk taking, risk perception, and perceptions of benefits of risks. These data have not been published. Sample 2 was collected in the midst of Democratic and Republican Party leader debates in the U.S. Therefore, items tapping attitudes toward Trump and cognitive ability were also added. These measures were collected as part of a separate project (Choma & Hanoch, 2017) and therefore are not reported here.

<sup>3</sup>This file provides all measures discussed.

Participants who did not respond correctly received a score of 0. The sum of participants' scores for the three items formed their overall objective numeracy score (Sample 1  $\alpha = .53$ , Sample 2  $\alpha = .59$ ). Second, participants responded to three questions from the Cognitive Reflection Test (CRT; Frederick, 2005). Participants got the answer correct (and received a score of 1) or incorrect (and received a score of 0). One question asked, "If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?" The sum of participants' scores for the three items formed their cognitive reflection score (Sample 1  $\alpha = .76$ , Sample 2  $\alpha = .78$ ). A numeracy score was created by averaging the centered objective numeracy scale and CRT items. Higher scores indicated greater ability (Sample 1  $\alpha = .75$ , Sample 2  $\alpha = .78$ ).<sup>4</sup> We named this variable *objective numeracy composite* in Tables 2 and 3 to distinguish from the objective numeracy scale.

**Subjective numeracy.** To assess participants' perceived numerical ability, participants completed the first four items of the Subjective Numeracy Scale (SNS) (Fagerlin et al., 2007). Items were on scales from 1 (*not at all good*) to 6 (*extremely good*). As an example item is, "How good are you at working with fractions?" Subjective numeracy was measured by averaging the scores on all 4 items. Larger-than-average SNS scores suggested that participants perceived themselves to be mathematically skilled (Sample 1  $\alpha = .92$ , Sample 2  $\alpha = .92$ ).

**Right-wing ideology.** Participants completed a 12-item version of the RWA scale (Altemeyer, 1996). The response scale relied on Likert-type answers from 1 (*strongly disagree*) to 7 (*strongly agree*). Scores were created by averaging the 12 items. Higher RWA scores indicated agreeing more strongly with right-wing authoritarian principles (Sample 1  $\alpha = .93$ , Sample 2  $\alpha = .94$ ). The 16-item version of the SDO6 scale (Pratto et al., 1994) was also administered to participants. Participants responded on a 7-point response scale ranging from 1 (*do not agree at all*) to 7 (*strongly agree*). Scores were created by averaging the 16 items. Higher scores indicated a stronger social dominance orientation (Sample 1  $\alpha = .93$ , Sample 2  $\alpha = .95$ ). Because the RWA and SDO scales are worded strongly, data skew to lower numbers, violating assumptions of normality.

**Political self-identification.** Participants indicated their self-identified political orientation with three items assessing the degree to which they were politically liberal/conservative

<sup>4</sup>We combined the CRT and objective numeracy items for two reasons. First, the reliability of each scale on its own, especially the objective numeracy scale, was low – likely because of the small number of items. Combining the six items resulted in acceptable alpha reliability. Second, previous research (e.g., Baron et al., 2015) indicates that the CRT in part, taps numeracy. A factor analysis of the six items supports a single factor.

TABLE 2: Means, standard deviations, and correlations.

|        | Sample 1<br>Mean (SD) | 1      | 2      | 3      | 4     | 5      | 6     | 7     | 8     | 9     | Sample 2<br>Mean (SD) |
|--------|-----------------------|--------|--------|--------|-------|--------|-------|-------|-------|-------|-----------------------|
| 1. ONC | 0.00 (0.31)           |        | .84**  | .90**  | .51** | -.29** | -.10* | -.08  | -.11* | -.06  | 0.00 (0.33)           |
| 2. ONS | 1.89 (0.99)           | .83**  |        | .52**  | .48** | -.23** | -.12* | -.09  | -.11* | -.06  | 1.86 (1.01)           |
| 3. CRT | 1.02 (1.16)           | .88**  | .47**  |        | .42** | -.27** | -.06  | -.06  | -.09  | -.04  | 1.43 (1.24)           |
| 4. SN  | 4.07 (1.43)           | .43**  | .40**  | .33**  |       | -.05   | .04   | .09   | .07   | .07   | 4.09 (1.38)           |
| 5. RWA | 2.96 (1.42)           | -.33** | -.31** | -.27** | -.02  |        | .48** | .64** | .71** | .47** | 3.06 (1.57)           |
| 6. SDO | 2.52 (1.19)           | -.11*  | -.09*  | -.11*  | .07   | .50**  |       | .44** | .42** | .42** | 2.47 (1.43)           |
| 7. GEN | 4.07 (2.00)           | -.10*  | -.10*  | -.07   | .04   | .54**  | .40** |       | .91** | .85** | 4.39 (2.33)           |
| 8. SOC | 3.67 (2.26)           | -.20** | -.17** | -.17** | .00   | .63**  | .43** | .82** |       | .72** | 4.12 (2.54)           |
| 9. ECO | 4.52 (2.19)           | -.04   | -.06   | -.02   | .07   | .38**  | .38** | .81** | .64** |       | 4.66 (2.49)           |

Note. Sample 1 (n=455) correlations are below the diagonal and Sample 2 (n=406) correlations are above the diagonal. ONC = objective numeracy composite, ONS = objective numeracy scale, CRT = cognitive reflection task, SN = subjective numeracy, RWA = right wing authoritarianism, SDO = social dominance orientation, GEN=general conservative identity, SOC = social conservative identity, ECO = economic conservative identity. \*  $p < .05$ . \*\*  $p < .001$ .

in general, for economic issues, and for social issues (Skitka et al., 2002). Participants indicated their response using a scale ranging from 1 (*extremely liberal*) to 9 (*extremely conservative*).

### 2.2 Sample 1 Results

Data were analyzed using R (R Core Team, 2018) with the assistance of the psych package (Revelle, 2018) and JASP (JASP Team, 2018). Means, standard deviations, and correlations of Sample 1 variables are shown in Table 2 (below the diagonal). The objective numeracy composite score and objective numeracy scale correlated negatively with RWA, SDO, general conservative identity, and identification as socially conservative (vs. liberal). Correlations between CRT and ideology showed the same pattern, except that the correlation with general political orientation was not significant. Therefore, objective numeracy relates negatively with right-wing ideology (with the exception of economic conservatism).

Subjective numeracy did not correlate significantly with any of the ideology variables. However, the zero-order correlations do not provide the most accurate assessment of this potential relationship. To evaluate whether subjective numeracy relates to right-wing political ideology, we ran five regression analyses, one for each of the political ideology variables, with objective numeracy composite and subjective numeracy entered as simultaneous predictors. These regressions allowed us to examine the association between subjective numeracy and ideology somewhat independently of objective numeracy. This is necessary because of the likely causal effect of objective numeracy on subjective nu-

meracy. In other words, the regression analyses allowed us to examine the parts of subjective numeracy that might relate to ideology, that are not due to an association with objective numeracy. Missing values were deleted listwise for the single item political self-identification measures. Results, with standardized coefficients, are reported in Table 3.

Similar to objective numeracy, subjective numeracy was significantly (or almost significantly) associated with measures of right-wing ideology. However, the relation was in the opposite direction: subjective numeracy related positively to right-wing or conservative ideology. Specifically, greater subjective numeracy related to higher RWA, higher SDO, self-identification as socially conservative (vs. liberal), and self-identification as economically conservative (vs. liberal). Results in Table 3 also show, as do the correlations in Table 2, that objective numeracy related negatively to right-wing or conservative ideology (with the exception of economic conservative identity).

### 2.3 Sample 1 Discussion

The results from Sample 1 show that performing worse on objective numeracy items is associated with right-wing ideology or conservative political identity (with the exception of economic conservative identity) in our sample. These findings mirror other work reporting a link between right-wing ideology and lower cognitive ability (Onraet et al., 2015) and lower scores on the CRT (Deppe et al., 2015; Iyer et al. 2012; Pennycook et al., 2012, Study 1; Yilmaz & Saribay, 2016, 2018, Study 2). Similar to previous research, moderate relations with the social dimension (e.g., RWA), and weak or non-significant relations with the economic or status

TABLE 3: Regression results of composite objective numeracy and subjective numeracy predicting political ideology

|                 | RWA                 |     |       | SDO                |     |       | General Political Orientation |     |       | Social Conservative Identity |     |       | Econ. Conservative Identity |     |       |
|-----------------|---------------------|-----|-------|--------------------|-----|-------|-------------------------------|-----|-------|------------------------------|-----|-------|-----------------------------|-----|-------|
|                 | $\beta$             | SE  | $p$   | $\beta$            | SE  | $p$   | $\beta$                       | SE  | $p$   | $\beta$                      | SE  | $p$   | $\beta$                     | SE  | $p$   |
| Sample 1        |                     |     |       |                    |     |       |                               |     |       |                              |     |       |                             |     |       |
| Intercept       |                     | .21 | <.001 |                    | .18 | <.001 |                               | .33 | <.001 |                              | .35 | <.001 |                             | .34 | <.001 |
| ONC             | -.39                | .22 | <.001 | -.18               | .20 | <.001 | -.14                          | .35 | .006  | -.24                         | .37 | <.001 | -.09                        | .37 | .097  |
| SN              | .15                 | .05 | .002  | .15                | .04 | .004  | .10                           | .08 | .059  | .10                          | .08 | .050  | .10                         | .08 | .047  |
| <i>F</i> -test  | $F(2, 451) = 32.08$ |     |       | $F(2, 451) = 7.14$ |     |       | $F(2, 449) = 4.11$            |     |       | $F(2, 447) = 10.96$          |     |       | $F(2, 449) = 2.40$          |     |       |
| <i>p</i> -value | <.001               |     |       | <.001              |     |       | .017                          |     |       | <.001                        |     |       | .092                        |     |       |
| $R^2$           | .125                |     |       | .031               |     |       | .018                          |     |       | .047                         |     |       | .011                        |     |       |
| Sample 2        |                     |     |       |                    |     |       |                               |     |       |                              |     |       |                             |     |       |
| Intercept       |                     | .27 | <.001 |                    | .25 | <.001 |                               | .42 | <.001 |                              | .45 | <.001 |                             | .44 | <.001 |
| ONC             | -.37                | .26 | <.001 | -.16               | .25 | .005  | -.18                          | .42 | .002  | -.20                         | .44 | <.001 | -.12                        | .44 | .031  |
| SN              | .14                 | .06 | .010  | .12                | .06 | .039  | .18                           | .10 | .002  | .17                          | .10 | .003  | .13                         | .10 | .020  |
| <i>F</i> -test  | $F(2, 403) = 22.82$ |     |       | $F(2, 403) = 4.18$ |     |       | $F(2, 403) = 6.38$            |     |       | $F(2, 403) = 7.13$           |     |       | $F(2, 403) = 3.37$          |     |       |
| <i>p</i> -value | <.001               |     |       | .016               |     |       | .002                          |     |       | <.001                        |     |       | .035                        |     |       |
| $R^2$           | .102                |     |       | .020               |     |       | .031                          |     |       | .034                         |     |       | .016                        |     |       |

Notes: ONC = objective numeracy composite, SN = subjective numeracy, RWA = Right-wing authoritarianism, SDO = Social dominance orientation, RWA = right wing authoritarianism, SDO = social dominance orientation. Objective numeracy composite is the average of the centered items from the objective numeracy and cognitive reflection scales.  $\beta$  values are standardized estimates.

dimension emerged (Deppe et al., 2015; Yilmaz & Saribay, 2016, Study 2, 2018, but see Deppe et al., 2018, Study 4; Yilmaz & Saribay, 2017), including with SDO (Choma & Hanoch, 2017; Choma et al., 2014; Heaven et al., 2011).

Despite a positive association between objective numeracy and subjective numeracy, both in the present sample and prior works (Fagerlin et al., 2007; Galesic and Garcia-Retamero, 2010; Miron-Shatz et al., 2014; Rolison et al., 2013), subjective numeracy significantly related positively to right-wing ideology, when accounting for objective numeracy. Specifically, participants who appraised themselves as being good with numbers were higher in RWA and SDO, and self-identified as socially or economically conservative (the effects for general conservative identify were not statistically significant), once objective numeracy was controlled for.<sup>5</sup> Of note, all of the associations were weak. This positive link, alongside a negative association with ability, echoes findings on overconfidence showing that Republicans and conservatives believe they are more competent or better performing (Eriksson & Funcke, 2012, 2015; Ortoleva & Snow-

berg, 2015a, 2015b), similarly to the research documenting a link between perceived intelligence and higher SDO (De Keersmaecker et al., 2017). This interpretation is post hoc; given this, and the fact that our examination of subjective numeracy and ideology was exploratory, it was particularly important that we test the same research questions and evaluate the replicability of the findings of Sample 1 in a second sample.

### 2.4 Sample 2 Results

Means, standard deviations, and correlations with 95% confidence intervals of the Sample 2 variables are shown in Table 2 (above the diagonal). Consistent with the Sample 1 findings, the objective numeracy composite and objective numeracy scale scores correlated negatively with RWA, SDO, and identification as socially conservative (vs. liberal). In contrast, the correlation with general political orientation was not significant in Sample 2. Similar to Sample 1, the correlation with economic political identification was also not significant. CRT correlated significantly only with lower RWA. As in Sample 1, subjective numeracy did not correlate significantly with any of the ideology variables. However, as explained earlier, the zero-order correlations do not pro-

<sup>5</sup>Note that we cannot fully control for objective numeracy because we measure it with error, but better measurement would only increase the coefficient for subjective numeracy in the model.

vide a good test of whether subjective numeracy relates to political ideology because of the possible influence of its relation with objective numeracy. Instead, we again ran five regression analyses on each political ideology variable, with objective numeracy composite and subjective numeracy entered as simultaneous predictors. Results, with standardized predictors, are reported in Table 3. The findings mirrored those of Sample 1: once objective numeracy composite was accounted for, higher subjective numeracy was significantly associated with all of the indices of right-wing ideology.

## 2.5 Sample 2 Discussion

Those who performed worse on objective numeracy tests were higher in RWA, SDO, or identified as socially conservative (vs. liberal). This pattern of findings replicates the findings of Sample 1 and is in line with previous research documenting a negative association between cognitive ability and right-wing ideology (Choma & Hanoch, 2017; Onraet et al., 2015). Unlike Sample 1, general political orientation did not relate to any of the objective numeracy variables. Furthermore, Sample 2 results are in line with a pattern across studies documenting moderate associations between cognitive ability and the social-cultural dimension of ideology, and weak associations with the economic or status dimension (Choma et al., 2014; Deppe et al., 2015; Yilmaz & Saribay, 2016, Study 2, 2018, but see Deppe et al., 2018, Study 4; Yilmaz & Saribay, 2017). Also replicating Sample 1 findings, subjective numeracy did not correlate with the political ideology measures at the zero-order level. However, accounting for objective numeracy revealed positive links between subjective numeracy and all the indices of right-wing ideology. These findings replicate those of Sample 2, with the only difference being one almost-significant effect of subjective numeracy in Sample 1 ( $p=.059$ ).

## 3 General Discussion

The present research confirms existing work documenting a link between cognitive ability and right-wing ideology and also finds that subjective numeracy is tied to various indices of political ideology. Specifically, in line with previous research reporting a negative link between cognitive ability and right-wing or conservative political ideology (Onraet et al., 2015; van Hiel et al., 2010), those who performed worse on objective numeracy tasks were higher in right-wing ideology or identified as socially conservative. However, the relation with identification as economically conservative was significant only in Sample 1, and general political orientation was not significant in either sample. Moreover, in both samples, RWA, similar to other measures of the social-cultural dimension of political ideology, related negatively to the CRT (for similar results see Deppe et al., 2015; Yilmaz & Saribay,

2016, Study 2, 2018; see also Yilmaz & Saribay, 2016, Appendix B, Table A1).

Very few studies have considered the association between cognitive ability with SDO (for exceptions see Choma & Hanoch, 2017; Choma et al., 2014; Heaven et al., 2011). In both samples, performing worse on the numeracy tests correlated at best weakly with SDO, much like the weak and inconsistent associations between economic conservatism and the CRT (Deppe et al., 2015; Yilmaz & Saribay, 2016, 2017). The inclusion or exclusion of libertarians can account for this inconsistency for economic conservatism; specifically, the association is weaker and non-significant when libertarians are removed (Yilmaz, Saribay & Iyer, in press). Therefore, at a minimum, existing evidence suggests that any link between SDO or the economic dimension of ideology and cognitive ability is tenuous.

Despite a negative relation between right-wing ideology and objective numeracy, and a positive relation between objective and subjective numeracy – both in previous and current research – the association between subjective numeracy and ideology was not negative. That is, the unique part of subjective numeracy that is separate from objective numeracy captures something relevant to political ideology. In both samples, individuals who scored higher on subjective numeracy were higher in right-wing ideologies and identified as politically conservative (with the exception of general conservative identity in Sample 1), when controlling for objective numeracy. In other words, peoples' *beliefs* about their ability, beyond effects of their *actual* ability, accompanied endorsement of right-wing ideologies and self-placement as politically conservative. These findings present the possibility that, on average, those who are right- or conservative- (vs. left or liberal) leaning might overestimate their numerical abilities, despite performing no better or somewhat worse than their left-leaning counterparts.

This positive association, though not predicted a priori, is consistent with other recent research. As noted earlier, De Keersmaecker et al. (2017) showed that those who rated themselves as more intelligent than the average person in their country were more likely to endorse SDO. Also, as described earlier, a handful of studies show that American participants who identify as Republican or political conservatives perceive themselves (and their political group) as more competent than others and Democrats, and are overconfident (at least since 1980 and during non-election years) (Eriksson & Funcke, 2012, 2015; Ortoleva & Snowbert, 2015a, 2015b). Again, our examination of the link between subjective numeracy and political ideology was exploratory. However, the positive associations replicate in two separate samples, and correspond to findings in other research areas.

Interpreting the current findings with an overconfidence lens raises the possibility that that some outcomes of overconfidence could be further affected by or connected to political affinity. In general, being overconfident can contribute

to grave real-world outcomes including war, entrepreneurial failure, litigation (Moore & Healy, 2008), and believing that you are accurate in clinical assessments when you are not (Oskamp, 1965). Plous (1993) observed, “No problem in judgment and decision making is more prevalent and more potentially catastrophic than overconfidence” (p. 217, as cited by Moore & Healy, 2008). Interestingly, overconfidence is linked to greater likelihood of voting (Ortoleva & Snowberg, 2015), thus, possibly, influencing how elections are won (or lost). Being overconfident about numbers could influence politicians’ financial planning, estimates for resources required for national defense, managing climate change or natural disasters, or public health insurance. Finally, overconfidence is associated with lower actively open-minded thinking (AOT) (see Baron, 2019), and right-wing ideologies are associated with closed (vs. open) cognitive styles (van Hiel et al., 2010) and overconfidence. Therefore, it is possible that those higher in right-wing ideologies will also be lower in AOT. Given the implications of AOT for fostering healthy democracies (Baron, 2019), future research might explore this possibility more directly.

Broadly, the current research joins a large body of literature studying psychological underpinnings of political ideology (e.g., Duckitt, 2001; Duckitt & Sibley, 2017; Jost et al., 2003), including cognitive ability and cognitive style variables (Jost, Sterling & Stern, 2018; Onraet et al., 2015; van Hiel et al., 2010). There is ongoing debate in political psychology about the presence or absence of ideological asymmetry versus symmetry for a host of variables traditionally linked with right-wing or conservative ideologies. For example, Ditto et al. (2019) recently argued, drawing on meta-analytic results, that ideological bias is symmetrical. Contesting this position, Baron and Jost (2019) questioned the methodology used by Ditto and colleagues (2019) and reviewed other meta-analytic results showing asymmetry.

One strength of the present study, in the midst of this broader debate, is the reliance on non-political measures of numeracy. At a basic level, being good with numbers relates negatively to right-wing or conservative ideology, and belief that one is good with numbers, relative to one’s ability, relates positively. This basic finding does not negate the possibility that political issues or domains could affect this association. Indeed, positive links with risk-taking have been observed with political liberalism as well as conservatism, depending on the domain considered (e.g., Choma, Hanoch, Hodson & Gummerum, 2014), even though liberals tend to be more risk-taking and sensation seeking. Further, even though right-wing ideology relates negatively to generic collective action measures (Wiener & Federico, 2017), right-wing ideologies, including RWA, relate both positively and negatively to domain-specific collective action (Choma, Hodson, Jagayat & Hoffarth, 2019). Exploring possible domain-specific or issue-specific effects of subjective numeracy or overconfidence could inform political

decision-making and opinions more generally.

Some caveats need to be acknowledged. First, our samples comprised primarily White, educated, left-of-centre, US citizens. As such, any generalizations are restricted to this group of individuals. Second, although there is longitudinal data demonstrating the predictive ability of cognitive ability on political orientation (Block & Block, 2001; Heaven et al., 2011), our data were cross-sectional and therefore no firm conclusions can be drawn about causation. Third, the reliability of the objective numeracy scale items and CRT were low on their own, prompting us to combine them. This is likely a result of the few numbers of items used. Finally, considerable research suggests powerful effects of motivation in predicting political ideology (Jost et al., 2003). Related to this point, recent research shows that this motivation effect extends to when and whether individuals use their numeracy skills. Kahan, Peters, Dawson and Slovic (2017), for example, recently reported that even highly numerate individuals selectively use their skills to support ideologically consistent positions. Consequently, the finding that particular ideologies relate to lower or higher cognitive ability does not mean that this relationship transcends all contexts or conditions. Much would be gained by identifying the boundary conditions of when and whether individuals choose to rely on or apply their numerical skills, and the implications of such choices.

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