GENDER VS. PERSONALITY: THE ROLE OF MASCULINITY IN EXPLAINING COGNITIVE STYLE

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Gender vs. personality: The role of masculinity in explaining cognitive style

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ABSTRACT

Cognitive style (reflective vs. intuitive) as measured with cognitive reflection tests (CRTs) is an important driver of financial decision-making and the rationality of individual behavior. Prior studies explain CRT score differences by gender, stipulating that women are more intuitive and less reflective than men. Recent work, however, raises doubts about such gender differences, suggesting that CRT score differences stem from gender-related role and personality instead. Accordingly, using survey data from 504 Belgian respondents, we examine which of these two individual difference factors better explains CRT scores. The results indicate that, on average, women indeed have a lower reflective cognitive style and a higher intuitive cognitive style. However, this effect is not only explained by gender per se, but also by self-perceived gender role and personality, that is, perceived masculinity. Indeed, perceived masculinity moderates the effect of gender, so that masculine females have higher reflective and lower intuitive CRT scores.

1. Introduction and theoretical background

Cognitive reflection relates to individuals' thinking style and can be defined as "the ability or disposition to resist reporting the response that first comes to mind" (Frederick, 2005: 35). Cognitive reflection is related to other cognitive, numerical, and decision-making skills (Oechssler et al., 2009; Cokely and Kelley, 2009; Thompson and Markovits, 2021) as well as the ability and skill to effectively monitor and correct impulsive behavior, which is necessary for making well-calibrated decisions (Primi et al., 2018). Cognitive style (reflective vs. intuitive) and cognitive abilities are traditionally measured with Cognitive Reflection Tests (CRTs) (Frederick, 2005; Toplak et al., 2014). Indeed, CRTs have become a popular measure of individual differences (Travers et al., 2016) and account for cognitive capacity and styles beyond simple numeracy (Byrd and Conway, 2019). CRTs include mathematical problems that are framed in such a way that respondents are prone to provide a quick and intuitive, but incorrect, answer. Multiple studies in economics and psychology have used CRTs to explain decision-making and biases (Brañas-Garza et al., 2019), suggesting that more reflective people can avoid the influence of certain anchors (Meub and Proeger, 2016). CRT performance explains time and risk preferences (Oechssler et al., 2009; Campara et al., 2021; Bottasso et al., 2022); money withdrawals in times of uncertainty (Kiss et al., 2016, 2022); the ability to discern fake from truthful financial information (Kienzler et al., 2022); and financial self-management in general (Isler et al., 2022). For financial experts, CRT scores are linked to their professional performance and decision-making, including risk-taking (Razen et al., 2020), perception of graphical financial information (Cardoso et al., 2018) and trading behavior in asset markets (Breaban and Noussair, 2015; Powell and Shestakova, 2016). Hence, it is important to be able to account for and explain differences amongst individuals in cognitive style.

Starting from the seminal work of Frederick (2005), various studies document gender differences in CRT performance, providing evidence that, on average, women are more intuitive and less reflective than men (e.g., Bernard et al., 1990; Campitelli and Gerrans, 2014; Cueva et al., 2016; de La Bruslerie, 2015). A recent meta-analysis by Brañas-Garza et al. (2019) confirmed a significant and negative correlation between female gender and the number of correct CRT answers. Oftentimes, the belief of being less reflective is internalized by women, who thus expect themselves to be less able to perform in numerical-related fields, such as economics (Ballard and Johnson, 2005). Gender differences have been reported in financial literacy (Potrich et al., 2018, 2015), risk tolerance

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Table 1
Measurement description and percentage of correct answers to CRT questions. Panel A presents the percentage of correct and incorrect answers, for every CRT question, split up between men and women. The category of incorrect answers is further divided into those that are intuitive, and other incorrect answers. Panel B presents the percentage of answers for CRT reflective and CRT intuitive scores for the total sample, as well as split up between men and women.

Panel A: Percentage of correct and incorrect answers depending on gender

Variable name	Question wording	Percentage of correct answers		Percentage of incorrect answers			
				Percentage of intuitive answers		Percentage of other incorrect answers	
		Men	Women	Men	Women	Men	Women
CRT-3 (Frederick, 2005)	1. A rose and a tulip costs €13. The rose costs €10 more than the tulip. How much does the tulip cost? (in €)	33.6 %	19.8 %	58.4 %	71.1 %	8 %	9.1 %
	2. It takes 5 cooks 5 minutes to make 5 cakes. How long would it take 20 cooks to make 20 cakes? (in minutes)	52.3 %	42.1 %	39.3 %	43.8 %	8.4 %	14.1 %
	3. In a bay, there is an oil spill. Every day, the oil spill doubles in size. If it takes 24 days for the oil spill to spread to the whole bay, how long would it take the oil spill to cover half the bay? (in days)	43.5 %	24.8 %	42.4 %	55.4 %	14.1 %	19.8 %
CRT-4 (Toplak et al., 2014)	1. If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? (in days)	39.3 %	20.2 %	20.2 %	27.7 %	40.5 %	52.1 %
	2. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class?	27.1 %	17.4 %	32.4 %	29.3 %	40.5 %	53.3 %
	3. A man buys a pig for €60, sells it for €70, buys it back for €80, and sells it finally for €90. How much has he made? (in €)	38.9 %	29.3 %	9.2 %	14.9 %	51.9 %	55.8 %
	4. Simon decided to invest €8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50 %. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75 %. At this point, Simon has: a. broken even in the stock market b. is ahead of where he began c. has lost money	62.6 %	36.4 %	30.5 %	42.6 %	6.9 %	21 %
CRT+ (Thomson and Oppenheimer, 2016)	1. If you're running a race and you pass the person in second place, what place are you in?	70.6 %	52.5 %	26.7 %	44.6 %	2.7 %	2.9 %
	2. A farmer had 15 sheep and all but 8 died. How many are left?	76 %	62 %	19.1 %	33.1 %	4.9 %	4.9 %

Panel B: Percentage of answers for CRT reflective and CRT intuitive scores

	Total	Men	Women
Correct reflective answers for the combined set of 9 CRT questions	0–9.1 %	0–5.7 %	0–12.8 %
	1–12.9 %	1–6.9 %	1–19.4 %
	2–13.9 %	2–13.4 %	2–14.5 %
	3–14.7 %	3–13 %	3–16.5 %
	4–13.1 %	4–15.6 %	4–10.3 %
	5–10.3 %	5–11.1 %	5–9.5 %
	6–9.1 %	6–9.5 %	6–8.7 %
	7–6.5 %	7–9.5 %	7–3.3 %
	8–5.2 %	8–8 %	8–2.1 %
	9–5.2 %	9–7.3 %	9–2.9 %
Intuitive answers to the combined set of 9 CRT questions	0–10.5 %	0–14.9 %	0–5.8 %
	1–11.5 %	1–16 %	1–6.6 %
	2–15.9 %	2–14.5 %	2–17.4 %
	3–18.3 %	3–18.3 %	3–18.2 %
	4–17.1 %	4–14.9 %	4–19.4 %
	5–13.7 %	5–11.5 %	5–16.1 %
	6–9.1 %	6–8 %	6–10.3 %
	7–2.8 %	7–1.9 %	7–3.7 %
	8–1 %		8–2.1 %
	9–0.1 %		9–0.4 %

(Hermansson and Jonsson, 2021), and even credit decision-making among bank managers (Bacha and Azouzi, 2019). Indeed, gender and cognitive abilities measured with CRTs are important factors to control for in many financial behaviors, including time preference (de La Bruslerie, 2015) and impulsive money management (Kiss et al., 2022).

Although CRT gender differences have been widely studied, little is known about the *nature* of these differences (Zhang et al., 2016; Byrd and Conway, 2019; Bao et al., 2021). Indeed, gender differences are generally over-estimated in the existing literature (Nelson, 2016) and recent work argues that gender differences in CRTs "remain debatable" (Bao et al., 2022: 1), since gender is a noisy variable that is related to many other personal and situational characteristics. Thus, recent research shows that gender-related personality (perceived masculinity) can be a better predictor of certain individual differences such as occupational focus than gender itself (Svedholm-Häkkinen et al., 2018), but this notion has not been leveraged to explain differences in individuals' CRT performance. Yet, there is reason to believe that gender roles such as perceived masculinity will help explain differences in CRT performance, given past research finding that females with a more masculine personality type perform better in intelligence tests than those with a more feminine personality type (Bernard et al., 1990).

Our study contributes to the CRT and gender role literature by investigating the effect of gender vs. gender-related personality (Bao et al., 2022). We replicate the female gender effect while showing that the gender-related personality effect dominates when accounting for both effects. Most importantly, we find that perceived masculinity

moderates the gender effect on CRT performance, so that masculine females have higher reflective and lower intuitive CRT scores. In doing so, we add to the literature on male and female brain type (Svedholm-Häkkinen et al., 2018). Furthermore, better understanding how to increase women's reflective style can empower them in many areas of daily life (e.g., gaining access to microfinance (Rankin, 2002)).

2. Methodology

2.1. Data collection

We recruited $N = 506$ Belgian respondents using an online Qualtrics panel, a well-accepted source of individual cognitive and behavioral data (e.g., Razen et al., 2020). We chose Belgium as the context for our study as it scores almost exactly midway (i.e., 54/100) on masculinity according to Hofstede Insights (2022), which should make our results generalizable across cultures. All respondents confirmed their informed consent to participate in our survey. Qualtrics established quotas to approach as close as possible national statistics in terms of age and gender. Platform filters excluded participants who provided speedy answers. The Qualtrics platform' quality checks were supplemented by additional attention and data quality filters of our own to ensure sufficient data quality, as suggested by the literature (Belliveau and Yakovenko, 2022). In particular, we excluded and recollected those who provided straight-line responses, failed attention checks, and did not differentiate reversed items. We further excluded $n = 2$ respondents who did not report their gender, resulting in a final sample of $N = 504$. While existing literature posits that financial incentives are not effective in improving CRT score (Brañas-Garza et al., 2019), the €5 payment for providing a valid questionnaire response and the Qualtrics platform sanction of being excluded from future surveys when providing an invalid response were arguably sufficient motives for respondents to focus on CRT questions and engage in reflection. Conversely, Qualtrics respondents might be seen as comparatively novice (Douglas et al., 2023) and tend to respond more slowly (Smith et al., 2016), which aligns with our objective to have naïve respondents who do not routinely respond to CRT or similar questions, in order to prevent hypothesis-guessing to affect our results.

2.2. Sample description

The final sample was almost equally distributed between men ($n = 262$) and women ($n = 242$). It was also fairly equally distributed between French-speaking Walloons ($n = 256$) and Dutch-speaking Flemings ($n = 248$). We translated the questionnaire into French and Flemish accordingly since foreign language can bias responses to CRTs (Costa et al., 2014; Białek et al., 2020). Respondents completed the questionnaire in their mother tongue by selecting their preferred language. The average age was 45.13 years (SD = 15.8). The majority of the respondents attended secondary school (54.22 percent); while 25.5 percent held a Bachelor's degree; and 19.3 percent had a Master's degree. Only a minor proportion of the sample does not hold a secondary school diploma (0.98 percent). Appendix 1 provides details on the sample's profile in terms of respondents' age, education, and region of residence and its correspondence to the national statistics of the Belgian population in that regard. It shows that our sample is close to the Belgian population in terms of gender representation and region of residence, while it is slightly older and more educated in terms of upper secondary education. Table 1 provides descriptive statistics on respondents' CRT scores.

2.3. Measurement scales

Table 2 provides details on all measurement scales and confirms their reliability. Below, we discuss our key measures (CRT and perceived gender role) as well as the control variables.

2.3.1. CRT

For a comprehensive assessment of individuals' cognitive style and abilities (Weiss et al., 2021), we combined three CRT items from Frederick (2005), four from Toplak et al. (2014), and two from Thomson and Oppenheimer (2016). For our analysis, we summed the correct answers that relate to a reflective cognitive style as well as formally incorrect answers that correspond to an intuitive cognitive style (Raoelison et al., 2020), and computed a score from 0 to 1 relating to the fraction of correct reflective or intuitive answers, respectively.

2.3.2. Perceived gender role

To measure perceived gender role (masculinity), we used items from Howard and Fox (2020), in which respondents attribute their appearance and behavior as either more masculine or feminine.

2.3.3. Control variables

We accounted for variables previously related to CRT performance: numeracy[1] (Zhang et al., 2016), self-esteem[2] (Francis and James, 1996), and response time[3] (Stankov and Roberts, 1997). Numeracy is measured as per Lusardi and Mitchell (2007). Self-esteem is measured with Rosenberg's (1965) Self-Esteem Scale. Response time is the natural log of the time in seconds to answer the CRT. We also controlled for age, education, and region of residence (Brañas-Garza et al., 2019; Campitelli and Gerrans, 2014).

2.4. Common method variance (CMV)

We applied procedural and statistical measures to address the risk of CMV bias affecting our results (Craighead et al., 2011). First, we included reverse-scored items. Second, we performed Harman's single-factor test (Podsakoff et al., 2003), and a marker variable test with a theoretically unrelated question (Simmering et al., 2015). None of the tests suggest that CMV bias is a concern.

3. Results

First, we checked zero-order correlations between the key variables (Table 3). Consistent with our expectations, reflective and intuitive CRT scores are highly negatively correlated (coef. = −0.824, p <.001). Also, as expected, having a reflective cognitive style is negatively related to female gender (coef. = −0.274, p <.001) and positively related to perceived masculinity (coef. = 0.280, p <.000).

Further, we checked for the main effects of gender on CRT scores. The results are presented in Fig. 1 and show that men have a significantly higher (p <.001) reflective CSR score, while women have a significantly higher (p <.001) intuitive CRT score.

3.1. Regression analysis

We ran a series of hierarchical linear regressions[4] for intuitive

[1] Numeracy ranges from 0 correct answers to 3 out of 3 correct answers (for men: M = 2.28, SD = 0.79; for women: M = 1.96, SD = 0.88; total: M = 2.13, SD = 0.85).

[2] Self-esteem ranges from 1.10 to 7 (for men: M = 4.95, SD = 0.92; for women: M = 4.78, SD = 1.16; total: M = 4.87, SD = 1.04).

[3] The natural log for response time ranges from 1.79 to 3.54 (for men: M = 2.58, SD = 0.25; for women M = 2.56, SD = 0.27; total: M = 2.57, SD = 0.26). Response time is initially expressed in seconds (for men: M = 458.27, SD = 336.43; for women M = 470.32, SD = 423.11; total: M = 464.06, SD = 380.19).

[4] OLS regressions rely on the homoscedasticity or constant variance assumption being fulfilled. To confirm that this assumption is fulfilled, we performed a bootstrapped Breusch-Pagan Test (Cribari-Neto and Zarkos, 1999) for the effect of gender on the correct CRT score and intuitive CRT score. The test results show no evidence of heteroscedasticity.

Table 2
Measurement description and reliability of key variables and controls. Table 2 presents the description of measurement instruments, including the wording of scale items and the corresponding question, the mean and standard deviation of the item and the total scale (for the men, women, and the total sample), as well as factor loadings, Cronbach's Alpha, Composite Reliability, and Average Variance Extracted.

Scale/Variable and Items		Mean (SD)		Mean (SD)	Factor loading	α	CR	AVE
		Men	Women	Total sample				
Perceived gender role (masculinity) (Howard and Fox, 2020)	*From 1 = "Very feminine" to 7 = "Very masculine"*							
Total scale		**5.71 (1.01)**	**2.75 (1.10)**	**4.29 (1.81)**		**.971**	**.976**	**.874**
1. I consider myself as…		5.76 (1.22)	2.66 (1.26)	4.27 (1.99)	.945			
2. Ideally, I would like to be…		5.79 (1.25)	2.33 (1.19	4.13 (2.12)	.940			
3. Traditionally, my interests would be considered as…		5.53 (1.31)	3.02 (1.34)	4.33 (1.82)	.910			
4. Traditionally, my attitudes and beliefs would be considered as…		5.50 (1.25)	2.97 (1.32)	4.28 (1.80)	.929			
5. Traditionally, my behavior would be considered as…		5.67 (1.16)	2.96 (1.35)	4.37 (1.85)	.946			
6. Traditionally, my outer appearance would be considered as…		6.02 (1.08)	2.60 (1.24)	4.37 (2.06)	.940			
Explicit self-esteem (Rosenberg, 1965)	*To which extent do you agree with the following statements. From 1 = "Completely disagree" to 7 = "Completely agree."*							
Total scale		**4.95 (0.92)**	**4.78 (1.16)**	**4.87 (1.04)**		**.886**	**.790**	**.327**
1. On the whole, I am satisfied with myself.		5.26 (1.13)	5.08 (1.35)	5.18 (1.24)	.349			
2. At times I think I am no good at all. (R)		4.57 (1.51)	4.21 (1.79)	4.40 (1.66)	.770			
3. I feel that I have a number of good qualities.		5.34 (1.09)	5.30 (1.09)	5.32 (1.09)	.100			
4. I am able to do things as well as most other people.		5.19 (1.20)	5.17 (1.30)	5.18 (1.25)	.150			
5. I feel I do not have much to be proud of. (R)		5.04 (1.50)	5.00 (1.67)	5.02 (1.59)	.605			
6. I certainly feel useless at times. (R)		4.43 (1.71)	4.31 (1.90)	4.37 (1.80)	.811			
7. I feel that I am a person of worth, at least on an equal plane with others.		5.17 (1.24)	5.24 (1.28)	5.20 (1.26)	.183			
8. I wish I could have more respect for myself. (R)		4.11 (1.55)	3.76 (1.80)	3.94 (1.68)	.787			
9. All in all, I am inclined to feel that I am a failure. (R)		5.18 (1.64)	5.01 (1.80)	5.10 (1.74)	.756			
10. I take a positive attitude toward myself.		5.24 (1.17)	4.76 (1.54)	5.01 (1.38)	.530			
Response time	*Time taken to respond to the nine CRT questions in seconds*	470 (423)	458 (336)	464 (380)	N/A	N/A	N/A	N/A
Numeracy (Lusardi and Mitchell, 2007)								
1. If the chance of getting a disease is 10%, how many people out of 1,000 would be expected to get the disease?		89.3% of sample answered correctly	85.1% of sample answered correctly	87.3% of sample answered correctly	N/A	N/A	N/A	N/A
2. If 5 people all have the winning numbers in the lottery and the prize is two million Euro, how much will each of them get?		83.2% of sample answered correctly	74.4% of sample answered correctly	79% of sample answered correctly				
3. Let's say you have €200 in a savings account. The account earns 10% interest per year. How much would you have in the account at the end of two years?		55.3% of sample answered correctly	36.8% of sample answered correctly	46.4% of sample answered correctly				

Notes. SD = Standard Deviation. α = Cronbach's alpha. CR = Composite Reliability. AVE = Average Variance Extracted. N/A = not applicable as numeracy is a formative instead of a reflective measure.

(Table 4) and reflective cognitive styles (Table 5). We found a significant positive association of female gender with an intuitive CRT score (coef. = 0.842, p <.001), and a significant negative association with a reflective CRT score (coef. = −1.393, p <.001) (Model 1). The higher R^2 for Model 1 in Table 5 versus Table 4 shows that gender better explains heterogeneity across reflective than intuitive CRT scores. After accounting for perceived masculinity (Model 2), the gender effect became insignificant for explaining CRT scores, while perceived masculinity had a significant positive association with a reflective CRT score (coef. = 0.236, p <.050). Importantly, perceived masculinity added explanatory power in terms of explaining CRT performance. Furthermore, the interaction effect of female gender and perceived masculinity (Model 3) was significant and negative for the intuitive CRT score (coef. = −0.457, p <.010). This interaction effect remained significant when including control variables. When introducing gender and masculinity as an interaction variable for the reflective CRT score, gender regained some significant explanatory power, but the interaction effect of female gender and perceived masculinity was never significant at any conventional levels.

Additional insights are provided by a "floodlight" analysis (Spiller et al., 2013), defining Johnson-Neyman significance thresholds for different values of perceived masculinity (Fig. 2). This analysis indicated that the effect of female gender on the intuitive CRT score is positive and significant for lower levels of perceived masculinity until it becomes insignificant at a masculinity level of 3.917. Similarly, the effect of female gender on the reflective CRT score is negative and significant for lower levels of perceived masculinity until it becomes insignificant at a masculinity level of 4.198.

The differential effect of masculinity on men and women was confirmed by an additional analysis. Comparing the results presented in Table 6 for women and Table 7 for men, we found that masculinity is

Table 3
Zero-order correlations between the main variables of interest. Table 3 presents zero-order correlations between the main variables of interest, namely the score for CRT reflective and intuitive answers, gender, and perceived masculinity.

Variables	1	2	3	4
1. CRT reflective	-			
2. CRT intuitive	−0.824***	-		
3. Gender (0 = male; 1 = female)	−0.274***	0.215***	-	
4. Perceived masculinity	0.280***	−0.220***	−0.813***	-

Notes. N = 504. *** p <.001.

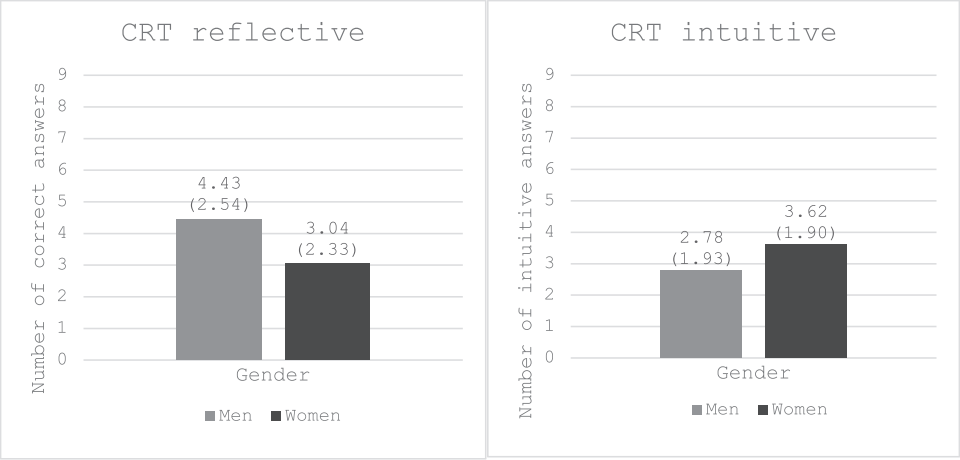

Fig. 1. Gender difference in CRT scores. **Notes.** Scores are shown as the number of correct (intuitive) answers from 0 to 9 for the CRT reflective (intuitive). Values on top of the bars refer to Means (Standard Deviations). The grey tab represents Men; the black tab represents Women.

Table 4

Gender, perceived masculinity, and intuitive cognitive style. Table 4 presents results from OLS regressions of gender on intuitive CRT score. Model 1 includes the main effect of gender only, Model 2 additionally considers the effect of perceived masculinity, Model 3 furthermore adds the moderation effect of gender and perceived masculinity, while Model 4 finally also considers all control variables, including socio-demographic factors (i.e., age, education, and region of residence), psychographic factors (i.e., numeracy, self-esteem), and response-related factors (i.e., response time). Gender is a binary variable set to one for women. Age is expressed in number of years. Masculinity is measured using the perceived gender role scale of Howard and Fox (2020) detailed in Table 2. Education is a 3-level ordinal variable referring to completed secondary school, Bachelor's degree, and Master's degree. Region is a binary variable set to one for French-speaking Walloons. Numeracy is measured using the Big 3 of Lusardi and Mitchell (2007) detailed in Table 2. Self-esteem is measured with Rosenberg's (1965) Self-Esteem Scale detailed in Table 2. Response time refers to the natural log of the time in seconds to answer the CRT.

Variables	Model (1) CRT_intuitive ***B(SE)***	Model (2)$^{\Delta}$ CRT_intuitive ***B(SE)***	Model (3) CRT_intuitive ***B(SE)***	Model (4) CRT_intuitive ***B(SE)***
Intercept	2.782*** (0.118)	3.612*** (0.475)	2.255*** (0.670)	7.111*** (1.014)
Gender (0 = male; 1 = female)	0.842*** (0.171)	0.412 (0.293)	2.374** (0.747)	2.138** (0.709)
Masculinity		−0.145 (0.081)	0.092 (0.116)	0.097 (0.110)
Gender*Masculinity			−0.457** (0.160)	−0.376* (153)
Age				0.013* (0.005)
Education				−0.358*** (0.082)
Region (0 = Flanders; 1 = Wallonia)				−0.370* (0.160)
Numeracy				−0.331*** (0.099)
Self-esteem				0.003 (0.081)
Response time (ln)				−1.549*** (0.315)
R^2	0.046	0.052	0.067	0.196
F	F(1,502) = 24.261***	F(2,501) = 13.809***	F(3,500) = 12.050***	F(9,494) = 13.382***
ΔR^2		0.006	0.015	0.129
ΔF		F(1,501) = 3.249	F(1,500) = 8.138**	F(6,494) = 13.168***

Notes. *B* = unstandardized regression coefficient. *SE* = standard error. *** p <.001. ** p <.010. * p <.050. $^{\Delta}$ VIF values in Model (2) are below 3, indicating that multicollinearity is not an issue.

indeed positively related to the reflective CRT score and negatively related to the intuitive CRT score, but only for women. These effects are visualized in graphs (Appendix 2), showing that in line with the regression results, men's CRT scores are less impacted by perceived masculinity than women's, whose reflective CRT score peaks for higher levels of masculinity.

Given that the various CRT items differ in difficulty, we examined the robustness of the results by exploring the factorial structure of the CRT scores (Otero et al., 2022). To do so, we ran Principal Component Analysis and combined the questions that fall on the same component. All reflective CRT scores fall on the same Principal Component, and, therefore, no supplementary test is warranted. Intuitive scores, however, fall on three different Principal Components. These findings are consistent with CRT not being particularly accurate to measure intuitive cognitive style (Blacksmith et al., 2018). We ran robustness checks for every Principal Component of intuitive CRT score and validated our findings for gender and masculinity effects as presented in Appendix 3. Supplementary robustness checks using fractional logit models are presented in Appendix 4.[5]

4. Discussion

Consistent with prior studies, we found that, on average, men are indeed more reflective, while women are more intuitive (Brañas-Garza et al., 2019). While some studies use CRT to explain gender differences in social preferences (e.g., Espín et al., 2021), we provide evidence that

[5] Because our dependent variables are bounded, the use of OLS models might not be optimal. Hence, we also estimated fractional logit models that are econometrically more appropriate for dependent variables taking on values ranging from zero to one. We obtained qualitatively similar results for our main variables of interest in these alternative models.

Table 5
Gender, perceived masculinity, and reflective cognitive style. Table 5 presents results from OLS regressions of gender on reflective CRT score. Model 1 includes the main effect of gender only, Model 2 additionally considers the effect of perceived masculinity, Model 3 furthermore adds the moderation effect of gender and perceived masculinity, while Model 4 finally also considers all control variables, including socio-demographic factors (i.e., age, education, and region of residence), psychographic factors (i.e., numeracy, self-esteem), and response-related factors (i.e., response time). Gender is a binary variable set to one for women. Age is expressed in number of years. Masculinity is measured using the perceived gender role scale of Howard and Fox (2020) detailed in Table 2. Education is a 3-level ordinal variable referring to completed secondary school, Bachelor's degree, and Master's degree. Region is a binary variable set to one for French-speaking Walloons. Numeracy is measured using the Big 3 of Lusardi and Mitchell (2007) detailed in Table 2. Self-esteem is measured with Rosenberg's (1965) Self-Esteem Scale detailed in Table 2. Response time refers to the natural log of the time in seconds to answer the CRT.

Variables	Model (1) CRT_reflective ***B(SE)***	Model (2)$^{\Delta}$ CRT_reflective ***B(SE)***	Model (3) CRT_reflective ***B(SE)***	Model (4) CRT_reflective ***B(SE)***
Intercept	4.439*** (0.151)	3.089*** (0.606)	4.251***(0.858)	−4.835*** (1.200)
Gender (0 = male; 1 = female)	−1.393*** (0.218)	−0.695 (0.373)	−2.374* (0.956)	−2.128** (0.816)
Masculinity		0.236* (0.103)	0.033 (0.148)	−0.017 (0.126)
Gender*Masculinity			0.391 (0.205)	0.329 (0.176)
Age				−0.027*** (0.006)
Education				0.447*** (0.094)
Region (0 = Flanders; 1 = Wallonia)				0.406* (0.184)
Numeracy				0.981*** (0.114)
Self-esteem				0.151 (0.093)
Response time (ln)				2.442*** (0.362)
R^2	0.075	0.085	0.092	0.366
F	F(1,502) = 40.835***	F(2,501) = 23.239***	F(3,500) = 16.787***	F(9,494) = 31.725***
ΔR^2		0.010	0.007	0.275
ΔF		F(1,501) = 5.294*	F(1,500) = 3.638†	F(6,494) = 35.699***

Notes. *B* = unstandardized regression coefficient. *SE* = standard error. *** p <.001. ** p <.010. * p <.050. † p <.100. $^{\Delta}$ VIF values in Model (2) are below 3, indicating that multicollinearity is not an issue.

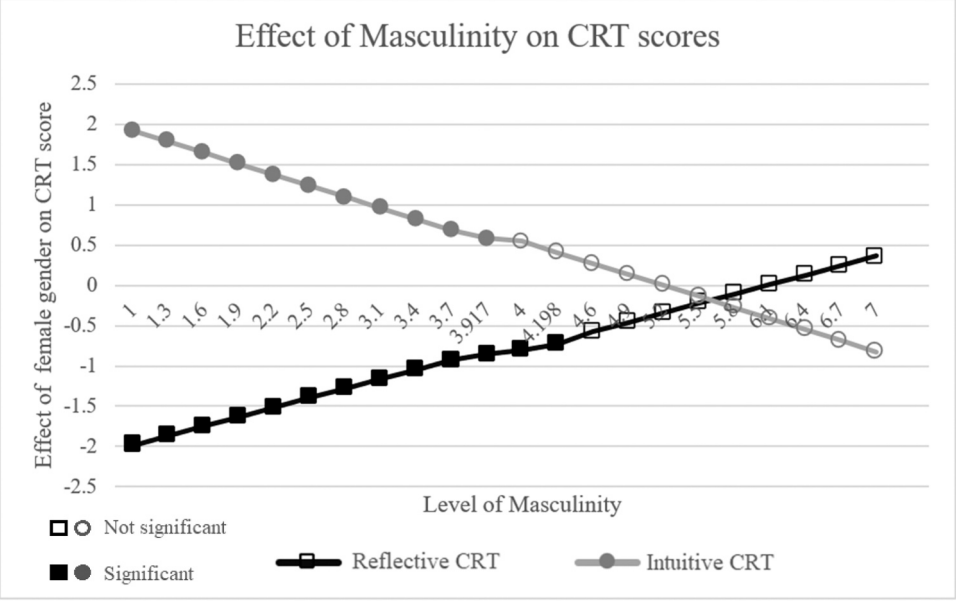

Fig. 2. Floodlight Analysis: Johnson–Neyman Scatter Plot. **Notes.** The black circles represent reflective CRT scores; the grey cubes represent intuitive CRT scores. Non-filled circles and cubes are non-significant. The values of the lines (vertical axis) correspond to the effect of the female gender on the CRT score at different levels of masculinity (horizontal axis). Thus, the graph allows to see the effect of gender (female) on CRT score (reflective and intuitive) for different values of the moderator (masculinity). Moderator value defining Johnson-Neyman significance regions is 4.198 for reflective CRT score, 49.4 % below, 51.6 % above; the moderator value defining Johnson-Neyman significance regions for intuitive CRT score is 3.917, 43.2 % below, 56.7 % above.

heterogeneity in CRT performance is explained by perceived masculinity beyond gender per se. Furthermore, perceived masculinity moderates the previously documented gender effect, with more masculine females answering in a more reflective and less intuitive way. Consistent with Bao et al. (2022), our findings suggest that gender is a noisy measure, which might not properly reflect how people actually feel about themselves and behave in daily life. Indeed, our results confirm the previously identified problems related to relying on gender-related stereotypes when assessing individuals' cognitive style and CRT performance (Grieve et al., 2019). Considering other explanatory factors, such as personality or self-assessment feelings (Primi et al., 2018), can indeed alleviate the gender effect. Therefore, in addition to empowering women with lower education and income levels (Potrich et al., 2018), it is important to address this self-perception gap with educational programs, since reflective cognitive capacities can be trained (Boissin et al., 2021). Furthermore, we found that response time is positively related to the reflective CRT score and negatively related to the intuitive CRT score. While some studies had found that more time spent answering to CRT only marginally leads to a better reflective CRT score and less intuitive answers (Stupple et al., 2017), our results indicate that people

Table 6
Perceived masculinity and cognitive style for women. Table 6 presents results from OLS regressions for reflective cognitive style with the control variables only (Model 1) and with perceived masculinity (Model 2); and for intuitive cognitive style with the control variables only (Model 3) and with perceived masculinity (Model 4) for women only. Age is expressed in number of years. Education is a 3-level ordinal variable referring to completed secondary school, Bachelor's degree, and Master's degree. Region is a binary variable set to one for French-speaking Walloons. Numeracy is measured using the Big 3 of Lusardi and Mitchell (2007) detailed in Table 2. Self-esteem is measured with Rosenberg's (1965) Self-Esteem Scale detailed in Table 2. Response time refers to the natural log of the time in seconds to answer the CRT. Masculinity is measured using the perceived gender role scale of Howard and Fox (2020) detailed in Table 2.

Variables	Model (1) CRT_reflective ***B(SE)***	Model (2)$^{\Delta}$ CRT_reflective ***B(SE)***	Model (3) CRT_intuitive ***B(SE)***	Model (4)$^{\Delta}$ CRT_intuitive ***B(SE)***
Intercept	−5.092***(1.192)	−5.946***(1.219)	7.285***(1.148)	8.061***(1.175)
Age	−0.034***(0.008)	−0.032***(0.008)	0.020*(0.008)	0.018*(0.008)
Education	0.578***(0.109)	0.572***(0.107)	−0.432***(0.105)	−0.426***(0.103)
Region (0 = Flanders; 1 = Wallonia)	0.488*(0.236)	0.354 (0.239)	−0.465*(0.228)	−0.343 (0.230)
Numeracy	0.944***(0.139)	0.926***(0.137)	−0.179 (0.134)	−0.162 (0.132)
Self-esteem	0.042 (0.110)	0.086 (0.109)	0.086 (0.105)	0.046 (0.105)
Response time (ln)	2.445***(0.435)	2.385***(0.430)	−1.394***(0.418)	−1.339***(0.414)
Masculinity		0.297**(0.111)		−0.270*(0.107)
R^2	0.400	0.418	0.163	0.185
F	F(6,235) = 26.118***	F(7,234) = 24.008***	F(6,235) = 7.605***	F(7,234) = 7.585***
ΔR^2		0.018		0.022
ΔF		F(1,234) = 7.210***		F(1,234) = 6.415*

Notes. *B* = unstandardized regression coefficient. *SE* = standard error. *** p <.001. ** p <.010. * p <.050. $^{\Delta}$ VIF values in Model (2) and Model (4) are below 3, indicating that multicollinearity is not an issue.

Table 7
Perceived masculinity and cognitive style for men. Table 7 presents results from OLS regressions for reflective cognitive style with the control variables only (Model 1) and with perceived masculinity (Model 2) and for intuitive cognitive style with the control variables only (Model 3) and with perceived masculinity (Model 4) for men only. Age is expressed in number of years. Education is a 3-level ordinal variable referring to completed secondary school, Bachelor's degree, and Master's degree. Region is a binary variable set to one for French-speaking Walloons. Numeracy is measured using the Big 3 of Lusardi and Mitchell (2007) detailed in Table 2. Self-esteem is measured with Rosenberg's (1965) Self-Esteem Scale detailed in Table 2. Response time refers to the natural log of the time in seconds to answer the CRT. Masculinity is measured using the perceived gender role scale of Howard and Fox (2020) detailed in Table 2.

Variables	Model (1) CRT_reflective ***B(SE)***	Model (2)$^{\Delta}$ CRT_reflective ***B(SE)***	Model (3) CRT_intuitive ***B(SE)***	Model (4)$^{\Delta}$ CRT_intuitive ***B(SE)***
Intercept	−5.052***(1.552)	−4.836**(1.668)	8.732***(1.248)	8.202***(1.339)
Age	−0.023*(0.009)	−0.023*(0.009)	0.009 (0.007)	0.010 (0.007)
Education	0.260 (0.163)	0.251 (0.165)	−0.257*(0.131)	−0.236 (0.132)
Region (0 = Flanders; 1 = Wallonia)	0.471 (0.278)	0.473 (0.278)	−0.384 (0.223)	−0.388 (0.223)
Numeracy	1.067***(0.185)	1.067***(0.185)	−0.538***(0.149)	−0.539***(0.149)
Self-esteem	0.235 (0.154)	0.245 (0.157)	−0.044 (0.124)	−0.067 (0.126)
Response time (ln)	2.432***(0.601)	2.453***(0.605)	−1.673***(0.484)	−1.724***(0.486)
Masculinity		−0.050 (0.141)		0.123 (0.113)
R^2	0.246	0.246	0.152	0.156
F	F(6,255) = 13.874***	F(7,254) = 11.869***	F(6,255) = 7.627***	F(7,254) = 6.712***
ΔR^2		0.000		0.004
ΔF		F(1,254) = 0.127		F(1,254) = 1.187

Notes. *B* = unstandardized regression coefficient. *SE* = standard error. *** p <.001. ** p <.010. * p <.050. $^{\Delta}$ VIF values in Model (2) and Model (4) are below 3, indicating that multicollinearity is not an issue.

might need to allocate sufficient time to engage in elaborative thinking (Baron et al., 2015; Campitelli and Gerrans, 2014).

Since correlation does not imply causality, the relationship between gender and personality should be taken with parsimony. We cannot rule out that women report themselves to be more masculine when they are thinking and behaving more reflectively and rationally. Thus, it is not always a natural predisposition or relation to one's psychological and hormonal profile (Cueva et al., 2016), but a habit and skill of being reflective, which is classified as a masculine personality trait (Sent and van Staveren, 2019). Therefore, it is important to understand what behaviors are perceived by women as more masculine and whether that perception leads to a more reflective thinking style. Reflective CRT score should not be mistaken for a measure of cognitive ability (Levy, 2023). Hence, studies should consider other measures of reflectiveness, especially for intuitive thinking, as our robustness analyses show that CRT score does not fully capture the intuitive thinking style. While we combined several CRT scales for a more comprehensive measure, other methods with potentially better psychometric properties should be tested as well (Primi et al., 2016). We encourage future studies on cognitive reflection to examine the generalizability of our findings to other countries and regions, as well as other data sources, and to also include further gender-related self-perceptions. Despite the appropriateness of our sample in this regard as previously mentioned, future studies should address the possibility that respondents are familiar with the CRT and similar questions or are not motivated to engage in rational thinking. Meta-analyses indicated that financial incentivization is not significant in improving CRT scores (Brañas-Garza et al., 2019). Future studies should therefore also test whether social incentives (e.g., reputation when score is made public) or ego-related motivations (e.g., improving one's score or scoring better than the average) can affect respondents' motivation and CRT performance.

Finally, we would like to note that intuitive thinking per se is sometimes necessary and can even be beneficial in some circumstances, especially when individuals face complex situations that demand fast responses (Patton, 2003). In such cases, however, intuition is not built on an emotional or non-considering response, but often stems from experience and focused learning (Patton, 2003). While the CRT is an appropriate measure for individuals' cognitive-reflective style, it cannot

fully capture the intuitive thinking style (Pennycook et al., 2016). More appropriate instruments to measure reliance on intuition are, for example, the Faith in Intuition scale (Epstein et al., 1996). It should also be noted that intuition is a complex concept that comprises multiple dimensions, of which only holistic intuition was found to be associated with thinking styles (Dennin et al., 2022).

CRediT authorship contribution statement

Daria Plotkina: Writing – original draft, Methodology, Formal analysis, Conceptualization. **Arvid O.I. Hoffmann:** Writing – original draft, Methodology, Formal analysis, Conceptualization. **Patrick Roger:** Writing – review & editing, Formal analysis, Conceptualization. **Catherine D'Hondt:** Writing – review & editing, Methodology, Formal analysis.

Use of generative AI and AI-assisted technologies

None

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Data statement

Available upon request

Declarations of interest

None.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.jbef.2024.100995.

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