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Thinking fast, thinking badly

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HIGHLIGHTS

- We test for the construct validity of the cognitive reflection test.
- Response times indicate that incorrect answers are quicker than correct answers.
- Impulsive subjects complete the test quicker than reflective subjects.
- Our data suggest that intuitive and incorrect answers should be treated differently.

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ABSTRACT

We test for the construct validity of the cognitive reflection test (CRT) by eliciting response times. We find that incorrect answers to the CRT are quicker than correct answers. At the individual level, we classify subjects into impulsive and reflective, depending on whether they choose the incorrect intuitive answer or the correct answer the majority of the time. We show that impulsive subjects complete the test quicker than reflective subjects.

1. Introduction

Dual-system models of human thinking differentiate two cognitive processes: a type 1-system that is *fast*, automatic and non-conscious, and a type 2-system that is *slow*, controlled and conscious (Kahneman, 2011; Stanovich and West, 2000). Economists have recently become interested in the relation between these two cognitive processes and decision-making. The cognitive reflection test (CRT) introduced by Frederick (2005) has emerged as a popular tool to identify which way of thinking subjects use. The test consists of three questions that have "*an intuitive answer [that] does spring quickly to mind (…) but this "impulsive" answer is wrong. Anyone who reflects upon it for even a moment would recognize [the correct answer]*" (Frederick, 2005, pp. 26–27).

While scores in the CRT have been related to risk preferences or behavioral biases (Frederick, 2005; Oechssler et al., 2009; Bergman et al., 2010; Hoppe and Kusterer, 2011; Cheung et al., 2014; Brañas-Garza et al., 2012; Andersson et al., 2016), we are not aware of any paper that directly tests the implicit assumption that the CRT measures the tendency to override an intuitive and spontaneous response that is incorrect and to engage in further reflection that leads to giving the correct response. More precisely, we lack evidence about the construct validity of the CRT showing that quick responses to the CRT are likely to be incorrect, while correct answers take longer. Our paper is an attempt to fill out this gap.

2. Data

Hard-copy invitation letters were sent out to a random sample of the Danish population aged between 18 and 80. A total of 2,347 subjects logged on to our webpage and participated (average age = 46.7, SD = 14.3; 1,209 males and 1,138 females). The experiment

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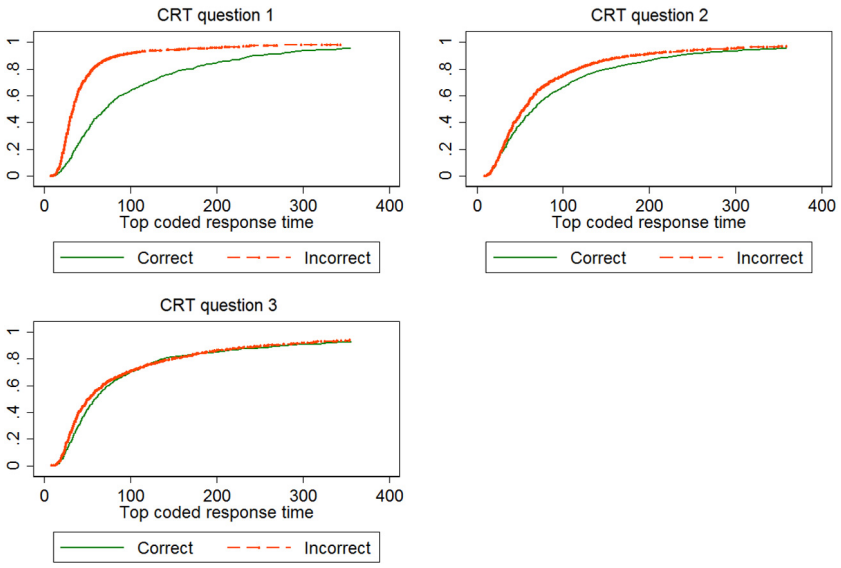

Fig. 1. Cumulative response times to each question.

consisted of two incentivized parts, a public good game (see Thöni et al., 2012; Fosgaard et al., 2014) and a risk elicitation task (see Andersson et al., 2016). The incentivized part was followed by a questionnaire, which included the CRT (Frederick, 2005), as well as basic socio-economic questions, the Big Five personality test and a 20-item cognitive ability test similar to a Raven's progressive matrices test (henceforth referred to as the cognitive ability test).[1]

3. Results

3.1. Correct answers and response times

Fig. 1 depicts the cumulative response times for subjects that gave correct and incorrect answers to each question (see Section A3 in the Online Appendix for more detailed descriptive statistics).[2] We find that subjects who provided the correct answer devoted more time to each question ($p < 0.001$).[3]

Fig. 1 also reveals that the difference in speed between correct and incorrect answers differs across questions. The difference is particularly striking in question 1, and much less pronounced in question 3. It could be that the first question has a more salient intuitive answer, or perhaps subjects figure out after the first question that they need to think longer since these are tricky if not trick questions.[4] Both explanations are consistent with our data since mean response times are increasing with questions (see Section A3 of the Online Appendix). As a robustness check, we collected additional data using an alternative measure of cognitive reflection (Toplak et al., 2014) with randomized and non-randomized questions to test for possible order effects (see Section 4 below). Overall, we do not find evidence of order effects, suggesting that the different patterns observed across questions is likely not due to the order of presentation, but rather due to characteristics of the questions.[5]

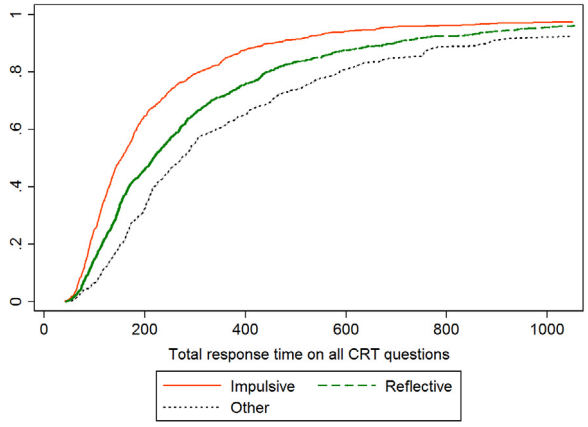

Fig. 2. Cumulative response times of impulsive, reflective and other subjects.

3.2. Intuitive but incorrect answers and response time

Our previous findings support the hypothesis that fast responses are associated with incorrect answers, and vice versa for slow responses. While "impulsive" subjects are frequently defined as those who perform poorly in the CRT, subjects who provide the intuitive (wrong) answer might be treated differently than those who simply provided any incorrect answer (Noussair et al., 2014; Cueva et al., 2015; Ponti and Rodriguez-Lara, 2015). We follow Cueva et al. (2015) and use the iCRT index which adds up the number of intuitive answers, iCRT∈{0,1,2,3}. We then define *Impulsive subjects* as those who scored two or more in the iCRT (39% of the sample) and *Reflective subjects* as those who provided two or more correct answers in the CRT (49% of the sample). The remaining 12% are classified as *Other*.

Fig. 2 displays the cumulative response time distributions for the three types of subjects. We find that Impulsive subjects are

[1] More information about the details of the questionnaire, the recruitment procedures and the sample composition is presented in Sections A1 and A2 of the Online Appendix.

[2] Response times of more than 360 s have been excluded since data contains outliers due to people taking a break or being interrupted. The choice of cut off is not important for any of our results.

[3] Unless otherwise noted, we use the Mann–Whitney and Kolmogorov–Smirnov tests.

[4] These arguments also relate to the "sequence effect" in Brañas-Garza et al. (2015). They report that subjects score better when questions are presented in the standard order, and the smallest (largest) proportion of correct answers is usually observed in question 1 (question 3).

[5] For further details, see Section A6 on the Online Appendix.