The Impact of Religiosity and Gender on Reflective and Intuitive Thinking – The Case of Poland

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Abstract:

Purpose: Cognitive styles are preferred modes of intellectual functioning that meet individual human needs. Among the most important, cognitive psychology includes impulsivity and reflexivity, which are revealed during cognitive problem solving. In this study, we examine the relationship between the tendency to think impulsively or reflectively and gender and declared religiosity.

Methodology: In this study, we will use the Cognitive Reflective Test (CRT), a simple and widely used tool examining inclination for impulsive or reflective thinking. A total of 511 Polish participants (students on master's studies in economic major) completed two types of CRT tests (3- and 7-question versions). Results were analyzed using descriptive statistics, tau-Kendall correlation, Student's t-test, and Mann-Whitney test.

Findings: Results indicated that highly religious Polish survey respondents scored lower on the CRT compared to non-religious and that men scored higher on the CRT than women. Additionally, the CRT7 being less publicly known produced more impulsive (fewer correct answers) scores than the CRT3 version among both men and women.

Practical Implications: The results provide information that female and highly religious Poles surveyed in our study display an impulsive cognitive style, while male and low religious think more reflectively.

Originality/value: The results contribute to the diversity of research on the relationship between cognitive style and religiosity or gender by using tests of Polish survey respondents.

Keywords: reflective and intuitive thinking, cognitive reflection test (CRT), religiosity, gender.

JEL classification: C91, D81, J16, Z12

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1. Introduction

When approaching any problem, our brains have available various computational mechanisms for dealing with the situation. These mechanisms embody a trade-off, well described in contemporary dual process theory (Evans and Stanovich, 2013).

Dual process theories assume that thought can arise as a result of two different processes. The first process (System 1) is automatic, fast and unconscious while the second one (System 2) is relatively slow, controlled and computationally expensive (Kahneman, 2011). In cognitive psychology, automatic processes are typically characterized in terms of four operating conditions: (1) they are elicited unintentionally; (2) they require little amounts of cognitive resources; (3) they cannot be stopped voluntarily; and (4) they occur outside of conscious awareness. In contrast, controlled processes are characterized as those that (1) are initiated intentionally; (2) require considerable amounts of cognitive resources; (3) can be stopped voluntarily; and (4) operate within conscious awareness (Moors and De Houwer, 2006).

The trade-off between System 1 and System 2 processing is one between power and expense. System 2 processing enables us to solve a wide range of novel problems, and solve them with great accuracy. However, this power comes with a cost. System 2 processing takes up a great deal of attention, tends to be slow, tends to interfere with other thoughts and actions that we are carrying out, and requires great concentration that is often experienced as aversive. In contrast, System 1 processes are low in computational power but have the advantage that they are low in cost.

Humans are cognitive misers because their basic tendency is to default to System 1 processing mechanisms of low computational expense. Using less computational capacity for one task means that there is more left over for another task if they both must be completed simultaneously. This would seem to be adaptive. Nevertheless, this strong bias to default to the simplest cognitive mechanism - to be a cognitive miser - means that humans are often less than rational.

The reflective and impulsive approach was investigated by Tversky and Kahneman (1974) in the domain of behavioral economy. Due to bounded rationality introduced by Simon (1957), we are unable to make decisions rationally. The capacity of the human mind is too small in relation to the problems encountered to be solved objectively and rationally. The amount of information that the human brain processes in one second is too much for us to consciously reflect. It turns out that the processing of cognitive information is conducted by two systems, where the first one operates quickly, automatically, and intuitively without requiring a lot of time or efforts and the second one requires us to engage in effortful, demanding, and reflective mental activities, and it is slower, more deliberate, and analytic (Frederick, 2005). The two systems divide the tasks, minimizing effort and optimizing efficiency. Most of the things we think, do start from System 1, but when difficulties arise, System 2 takes over.

Behavioral economists do state that most of the heuristics and cognitive biases stem form reliance on intuitive thinking. The heuristics can be highly economical and usually effective, but they can also lead to systematic and predictable errors (Tversky and Kahneman, 1974).

The main objective of this study is to show that such factors as gender or religiosity can influence different type of thinking (impulsive or reflective) as measured by cognitive reflection test (CRT).

This paper is organized as follows. The next section presents background information and literature review of cognitive reflection test and the relationship between CRT reported religiosity and gender. The research data and methodology as well as results and experimental evaluation are presented subsequently. The results of our research are concluded and discussed in the last section. The results of this research are a part of a wider work investigating altruistic behavior (examined by experimental tool – the Dictator Game) in regard to dual processes of thinking (examined by CRT tests) (Staniszewska *et al.,* 2020; Czerwonka *et al.,* 2017).

2. Theoretical Background and Literature Review

2.1 Cognitive Reflection Test

The Cognitive Reflection Test (CRT3) proposed by Frederick (2005) is a 3-item task which measures the extent to which individuals form their judgments intuitively (operate in "System 1"), as opposed to through reflection ("System 2"). A remarkable property of the CRT is that for each item, almost all participants produce either the normatively correct response, or a typical incorrect (i.e., heuristic) response. CRT is composed of three following questions:

1) A bat and a ball cost $1.10 in total. The bat costs a dollar more than the ball. How much does the ball cost?
   (impulsive answer: 10 cents, reflective answer: 5 cents)

2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?
   (impulsive answer: 100 min, reflective answer: 5 min)

3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?
   (impulsive answer: 24 days, reflective answer: 47 days).

Although the correct response is 5 cents, 5 minutes and 47 days many participants give the responses "10 cents", "100 minutes" and "24 days" which seem to pop into mind effortlessly. Cognitive reflection involves the ability to effectively monitor and

correct impulsive response tendencies, and it is related to a wide variety of cognitive and decision-making skills. CTR is therefore designed to measure the tendency to override a predominant response alternative that is incorrect and engage in further reflection that leads to a correct response (Toplak *et al.,* 2011).

Over time, the original CRT 3 proposed by Frederick (2005) became too popular among students and academics, particularly the bat-and-ball problem, which had appeared in books and journals and was a common classroom demonstration. Toplak et al. (2014) introduced a CRT7 as an expanded 7-item task, which proved to be more potent predictor of the rational thinking than the original CRT3. Toplak *et al.* (2014) added the four-items to the original CRT:

4) 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?
   (impulsive answer: 9, reflective answer: 4 days)

5) Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class?
   (impulsive answer: 30, reflective answer: 29 students)

6) 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?
   (impulsive answer: $10, reflective answer: $20)

7) 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
   (impulsive response: b; reflective answer: c, because the value at this point is $7,000).

The seven-item version has become a strong independent predictor of performance on rational thinking tasks after the variance accounted for by cognitive ability and thinking dispositions had been partialled out. The advantages of CRT 7 were among others: stronger reliability due to the longer measure of the test and the greater simplicity of the test[1].

Numerous studies have shown that the CRT predicts susceptibility to decision-making biases and heuristics (Duttle and Inukai 2015; Oechssler *et al.,* 2009; Toplak *et al.,* 2011; 2014), risk-taking behavior (Frederick, 2005; Czerwonka, 2019) and that it is not just a mathematical test but measures something above and beyond general skills, namely cognitive reflection (Campitelli and Gerrans, 2014).

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[1]*The mean probability of answering an item correct on the CRT3 is 0.17, whereas the mean probability of answering an item correct on the CRT4 is 0.24.*

There is also a group of studies that investigate such factors as gender or religiosity that differentiate and explain the obtained results from cognitive reflection test.

2.2 Reflective and Intuitive Thinking and Self-Declared Religiosity

Research regarding relation between CRT scores and self-declared religiosity confirms that believing in God is an intuitive action. People probably believe in God to decrease uncertainty and stress in case of adverse events (Lupfer *et al.,* 1996).

A large literature indicates that the tendency to think analytically (as measured by CRT) is negatively related to religious belief (Gervais and Norenzayan, 2012; Pennycook *et al.,* 2012).

Research by Shenhav *et al.* (2011) proves that intuitive thinking determines faith. Approximately 88% of people in the world declared believing in God and Gods (Zuckerman, 2007). Shenhav *et al.* (2011) tested 822 Americans showed that people who gave more intuitive answers in CRT were confident believers which means that were more involved in religion practices. This effect was not mediated by education level, income, political orientation, or other demographic variables and held when cognitive ability (IQ) and aspects of personality were controlled.

The relationship between different types of religiosity and analytic cognitive style has been also investigated in a non-Western sample by Bahçekapili and Yilmaz (2017). It was found that CRT showed a significant negative correlation between intrinsic and extrinsic religiosity but showed a positive correlation with Quest religiosity, that measures a need for cognition in religious issues rather than religiosity *per se[2]*.

Yonker *et al.* (2016) suggest that individual differences in religiosity are important and there might be different relationships between different religiosity measures and the tendency to think analytically.

There is, therefore, a general problem in the literature on conclusion whether it is the intuitive mindset that is increasing religious belief or the reflective mindset that is decreasing it. Moreover, almost all the data on the relation of analytical thought and religiosity come from American participants, therefore, whether analytical thinking is related to religious belief in e.g., European samples, is not clear.

2.3 Reflective and Intuitive Thinking and Gender

Papers on CRT and gender revelas that women are more impulsive then men. Frederick (2005) presents results of CRT research where man achieve on average more reflective results then women. Gender differences may accure due to on average

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[2]*Quest religiosity includes statements about questioning, rethinking, and belief change, which are the characteristics strongly related to analytic thinking tendency.*

higher cognitive abilities of men and intuitive abilities of women and aversion to risk (Eckel and Grossman, 1998). Results were confirmed by other studies (Campitelli and Gerrans, 2014; Cueva *et al.,* 2016; Pennycook *et al.,* 2016). Campitelli and Gerrans (2014) showed that women struggled with inhibiting the intuitive response, especially in the case of the "bat and ball" problem. An analogous relation between gender and performance on the original CRT was found by Sinayev and Peters (2015) with American adults, by Ring, Neyse, David-Barett, and Schmidt (2016), who tested German undergraduate students, and by Albaity, Rahman, and Shahidul (2014) whose study involved Malaysian adults from different ethnic groups.

Oechssler, Roider, and Schmitz (2009) got on average 2.2 for men and 1.7 for women in CRT 3 test. Similar results got Duttle and Inukai (2015) on sample of German and Japaneese students.

Gender differences were also found in the case of extended versions of the cognitive reflection test. Toplak *et al.* (2014) showed that Canadian male students obtained higher scores than female students, not only on the original CRT, but also on four new items. In a study of Primi, Morsanyi, Chiesi, Donati, and Hamilton (2015) Italian and British male students, attending the senior year of high school and undergraduate university courses outperformed females on the original CRT, but also did better in the case of a long form of the CRT (CRT7), which included three new items.

To sum up the studies that investigated gender differences on the CRT have found that males perform better than females on every single question, and that females are more likely to answer none of the questions correctly (i.e., they are more likely to show very low levels of cognitive reflection), while males are more likely to answer all three questions correctly (i.e., to exhibit very high levels of cognitive reflection). What is interesting, Branas-Garza, Kujal, and Lenkei (2015) prove that gender differences persist even when controlling for test characteristics (e.g., monetary incentives, computerized administration, student samples, and positioning of the experiment).

3. Research Data and Methodology

3.1 Participants

We investigated 6 different courses on undergraduate and postgraduate studies in finance at Warsaw School of Economics (SGH). The courses embraced finance, behavioral finance, financial analysis, banking, derivatives and corporate taxes. 511 surveys were completed in 12 subsequent student groups. After removing the uncompleted surveys, the 378 surveys were analyzed. The sample consisted of 185 (49%) women and 193 (51%) men. The age of the participants ranged from 21 to 24

years old (M = 21.74, SD = 2.33)[3]. As all of the students were Polish, there were no issues with racial/ethnic background or social class in the survey.

Participants completed the CRT 3 and CRT 7 (Toplak *et al.,* 2014) and answered additional two questions regarding gender and religion. Religion was presented as an option from 0 to 10, where 0 meant atheist and 10 strong believer who attends church activities.

3.2 Materials and Procedure

According to their CRT scores, the participants were categorized into impulsive and reflective. Impulsive were ones who scored 0-1 correct answers in CRT3, or who scored 0–3 correct answers in CRT7. Reflective were ones who scored 2-3 correct answers in CRT3 or ones who scored 4–7 correct answers in CRT 7. High scores on CRT tests suggest that a responder uses a more cognitive rather than intuitive method of making decisions. Using the Kahneman (2011) approach, system 1 induces a low score on the CRT while system 2 encourages a more effortful high score on the CRT. After completing the CRT tests, participants answered a 3-item survey about their age, gender, and self-declared religiosity. The attitude to religion item contained 10 Likert-type scales, where 0 meant atheist and 10 meant deeply believing and regularly taking part in church practices. This item did not investigate the particular religion, only the responder's approach to his or her religion[4].

3.3 Hypotheses

Hypothese 1: CRT tests results are correlated with the level of self-declared religiosity. Highly self-declared religious players score generally lower on CRT tests as compared to non-religious players.

Hypothese 2: CRT test results differ between men and women. Men score generally higher in CTR tests than women which means they more often use reflective thinking (operate in System 2) for solving the questions.

4. Research Results

4.1 CRT and Self-Declared Religiosity

In our analysis, we have checked whether the results in the CRT tests were correlated with the level of self-declared religiosity. For this purpose, the tau-Kendall correlation analysis was performed. The results of the analyzes are presented in Table 1.

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[3]*For the whole paper n denotes number of participants; M denotes average; SD denotes standard deviation, and Me denotes median.*
[4]*This study investigates only a self-declaration of the agents' religiosity and not their true behavior.*

Table 1. *Correlation between self declared religiosity and CRT results.*

Sample size N = 378	Level of self-declared religiosity	
CRT3	$\tau = -0.12$	$p = 0.001$
CRT7	$\tau = -0.11$	$p = 0.001$

Note: *τ means Kendall's tau correlation coefficient, p means p-value*
Source: *Own elaboration.*

The analysis showed that the results in CRT tests were negatively correlated with the attitude towards religiosity. This means that people who were declaring themselves as strong believers scored lower on CRT tests. However, the strength of all correlations should be considered as low. The Mann-Whitney U test was performed to check whether the results in the CRT3 and CRT7 tests differed depending on the declared faith. The analysis compared the level of faith in two groups:

1. participants obtaining reflective results in the CRT test,
2. participants obtaining impulsive results in CRT tests.

As the result of the Mann-Whitney U test was statistically significant for both CRT3 (Z = 2.30; p = 0.022; r = 0.24), and CRT 7 (Z = 3.49; p = 0.001; r = 0.18) it should be concluded that the groups differed in terms of the level of faith. The CRT3 impulsive group had a higher level of faith (n = 128; Me = 7.0) than the reflective group (n = 243; Me = 5.0). Same results were obtained from CRT 7. Highly self-declared religious players scored lower on CRT tests (n = 122; Me = 7.5) as compared to non-religious players (n = 256; Me = 5.0). Our results are in line with Shenhav *et al.'s* (2011) study that proved a positive correlation between CRT intuitive scores and belief in God. Participants who gave more intuitive answers in the CRT reported a stronger belief in God (Table 2).

Table 2. *Self - declared religiosity in division for impulsive and reflective participants.*

CRT 3	Self - declared religiosity						
	Impulsive		Reflective		Mann-Whitney U test		
	n	*Me*	*n*	*Me*	*Z*	*p*	*r*
	128	7.0	250	5.0	2.30	0.022	0.24
CRT 7	Self - declared religiosity						
	Impulsive		Reflective		Mann-Whitney U test		
	n	*Me*	*n*	*Me*	*Z*	*p*	*r*
	122	7.5	256	5.0	3.49	< 0.001	0.18

Source: *Own elaboration.*

4.2 CRT and Gender

In our sample, women received lower scores in the CRT 7 test, answering an average of 3.79 questions correctly while men answered 4.84 correctly out of 7 questions (Table 3).

Table 3. *CRT results depending on gender*

Type of CRT test	Women n = 185		Men n = 193		t-Student test for independent groups			
	Av	*SD*	*Av*	*SD*	*t*	*df*	*p*	*r*
CRT3	1.60	1.15	2.11	0.99	-4.65	362.3	<0,001	0.24
CRT7	3.79	2.08	4.84	1.77	-5.27	361.3	<0,001	0.27

Source: *Own elaboration.*

The obtained results indicate that there were statistically significant differences in both two tests. Males scored higher on CRT than females. However, the differences had low-strength effects.

We analyzed the correlation between the results in CRT3 test and gender. The Pearson chi-square test was used for this purpose. As the test result was statistically significant [$\chi2$ (df = 1) = 15.69; p <0.001; ϕ = 0.20] it should be stated that the variables are related to each other. Men obtained more reflective results in both CRT3 and CRT7 tests than women. At the same time CRT7 gave more impulsive results for the whole sample (35% from CRT 3 vs 41% from CRT7). The summary of the analysis is presented in the following Table 4.

Table 4. *Results of CRT3 and CRT 7 for impulsive and reflective participants*

	Impulsive & (share in total impulsive)	Reflective & (share in total reflective)	Total
CRT3			
Woman	85 (62%)	101 (41%)	185
Man	50 (38%)	143 (59%)	193
Total	135 (100%)	244 (100%)	378
CRT7			
Woman	102 (65%)	83 (38%)	185
Man	57 (35%)	136 (18%)	193
Total	155 (100%)	219 (100%)	378

Source: *Own elaboration.*

5. Discussion and Conclusions

The results of our study generally confirm the previous research. We show that the tendency to think analytically (as measured by CRT) is negatively related to religious belief (Gervais and Norenzayan, 2012; Pennycook *et al.,* 2012). Highly self-declared religious players score generally lower on CRT tests as compared to non-religious players. Moreover, we show that results of CRT differ between men and women, where men score generally higher in CTR tests than women.

The findings we present here contribute to the diversity of sampling in the field. All of the previous findings we know of in the literature are based on data collected from American university students. Thus, using samples from Polish students, this research contributes to the study of the cognitive style – religious and gender relationship.

Additionally, in our study we we implemented two versions of CRT tests (CRT3 and CRT7) to check if well-known 3 questions version gives similar or different results than less popular 7 questions version. It appeared in both versions that stronger believers (women and men) are more impulsive. In longer version of CRT the whole sample appeared to be more impulsive than in short test. This is probably because CRT 7 is less known to players. Ones who knew reflective, "correct" answers in CRT3 acted more impulsive in CRT7.

It has to be noted, however, that the CRT used in this study and in the majority of previous studies has some limitations. For example, it has been criticized because of having become familiar to most participants (Haigh, 2016; Stieger and Reips, 2016) and being based on numeracy (Sinayev and Peters, 2015). Although familiarity might not be an issue in Polish samples, the possibility that the CRT measures numeracy skills in particular and not high-effort thinking, in general, might be a limitation of this study.

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