

# The Cognitive Reflection Test and Investment Decision

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## Abstract

The Cognitive Reflection Test (CRT), a measure of cognitive reflection, assesses people's capacity and, accordingly, investors' ability to override immediate, reflexive responses in favour of rational answers and decisions. The test is significant in behavioural finance as its questions reveal biases and heuristics, which affect rational investment decisions and choices.

The present research employs a sample of Accounting and Finance students, who represent potential future investors and participants in financial markets, to examine the extent to which the respondents engage in rational thinking when answering the test questions. CRT approach aims to evaluate their ability to avoid impulsive actions and rely less on intuitive decision-making (System 1).

**Keywords:** Cognitive Reflection Test, investment, behavioral, finance

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Date of Submission: 09-10-2024

Date of Acceptance: 19-10-2024

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## I. Introduction

The Cognitive Reflection Test (CRT), a task focused on cognitive reflection, was developed to evaluate a particular cognitive skill. It assesses individuals' capacity to override an intuitive and spontaneous incorrect response ('System 1') in favour of a deliberate and reflective correct response ('System 2') (Frederick, 2005). Introduced by Frederick in 2005, CRT aims to measure the inclination to reject an incorrect answer initially and engage in deeper reflection to arrive at the correct one (Toplak, West, Stanovich, 2011).

## II. Cognitive Reflection Test

According to Kahneman and Frederick (2002), who provided an experimental framework for the cognitive test, cognitive processes can be categorised into two types: answers which are quickly activated with minimal conscious deliberation ('System 1'), and those which are slower and characterised by reflection ('System 2'). 'System 1' processes, which are impulsive and do not require considerable attention, are deprived of intellect, readiness, or motivation, whereas 'System 2' ones encompass mental functions, which demand effort, motivation, concentration, and adherence to specific rules (Stanovich and West, 2000). According to Kahneman (2011), the two systems are not independent of each other and can be typically utilized in daily life, by frequently complementing each other in decision-making processes.

## III. CRT questionnaire

CRT questions, which participants are asked to answer are:

### Question 1:

A bat and a ball cost 1.10€ in total. The bat costs 1.00€ more than the ball. How much does the ball cost?

1. 10€
2. 5€
3. None of the above

### Question 2:

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

1. 100 minutes
2. 5 minutes
3. None of the above

### Question 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?

1. 10 days
2. 24 days

3.47 days

The correct answers are 5€, 5 minutes, and 47 days, respectively.

Although the solutions to the specific questions are easily understandable, obtaining the correct answer often involves suppressing the incorrect one, which comes to mind spontaneously. The specific test aims to determine whether the human brain operates through emotional thinking or pure logic. Montier (2010) draws parallels from Star Trek, contrasting two characters, Dr. McCoy, who embodies human emotion, and Spock, who embodies cold logic. McCoy tends to make decisions emotionally, using psychological shortcuts effortlessly, whereas Spock approaches decisions logically, processing information systematically. Psychologists suggest that people tend to exhibit behaviours similar to McCoy's when they encounter loosely structured and complex problems, incomplete or unclear information and goals, high competition and pressure, and decisions which require interaction with others.

#### **IV. CRT And Behavioural Biases**

Montier (2010) highlights that even when participants answer the Cognitive Reflection Test (CRT) questions correctly, they remain susceptible to various behavioural biases, such as loss aversion, conservatism, and impatience. In addition, individuals commonly exhibit overconfidence, overoptimism, and confirmation bias.

In the context of investment decision-making, people are frequently susceptible to illusions, intuition, and impulsive judgments. Cognitive abilities-attributes play a crucial role in affecting decisions on investment timing, risk-taking behaviour, aversion to ambiguity, anchoring effects, and the endowment effect (to attribute greater value to objects or investments simply because they belong to oneself). Frederick (2005) underscores the fact that investors who perform well on cognitive tests tend to take greater risks and exhibit overconfidence.

Relying on intuitive and impulsive decisions for stock market investments often results in failure; intuitive thinking is not a rational method for selecting stocks. Understanding how the stock market operates reveals that instances of intuition leading to profitable outcomes are typically random events. Sound investment decisions require reflection and an informed approach.

Investment decisions should preferably rely on 'System 2' approaches, encompassing experience, deliberate thought, persistence, and focused attention. The specific approach mirrors the time-consuming and effortful nature of investment processes, whereas 'System 1' ones require no concentrated effort; decisions are made effortlessly based on innate abilities (Kahneman, 2011).

#### **V. The Research**

The research was carried out from 1/03/2023 to 31/03/2023 with a sample of 124 Accounting & Finance undergraduate students (out of a total of 220, thus representing over 56% of the total number of students) at the beginning of the 5th semester of studies when students are required to select their specialist area in Finance.

Overall, 53.2% of the students were aged 18 to 22 years, and 42% were aged 23 to 30 years. The participants had moderate (54%) and minimal (22%) knowledge of stock market processes. In addition, 33% of them expressed a desire to engage in the stock market industry, whereas 15% were completely negative.

#### **VI. Research Results**

As regards the first question of the Cognitive Reflection Test, 65.8% of the participating Accounting and Finance students answered that the ball costs 10€, 8.4% answered "none of the above," whereas only 25.8% gave the correct answer that the ball costs 5€. Accordingly, 74.2% of the students provided incorrect answers to a question that they later acknowledged as simple when the correct answers were presented in class.

As to the second question of the Cognitive Reflection Test, which involves the number of machines making widgets, 45% of the students answered 100 minutes, and 15.8% "None of the above". The correct answer, which was 5 minutes, was given by only 39.2%, thus implying that 60.8% of the respondents made an incorrect, irrational choice/decision.

Finally, with regard to the third question, only 35.8% of the students answered correctly, 47 days, whereas 64.2% in total provided incorrect answers (61.7% answered 24 days and 2.5% "I don't know/I don't answer").

During lectures, when the correct answers were discussed, all 120 participating students had the opportunity to realise how simple and easy each question was.

The analysis of results demonstrated that most students acted under System 1, answering on impulse rather than further analysing the questions or relying on reflection, thereby not engaging in cognitive functions, which implies System 2. They were susceptible to impulsive thinking and emotions, which hindered their ability to think rationally and make sound judgments. Impatience, rushed responses, effortless judgment, and low motivation to provide accurate answers (if the correct answers had counted towards their grades, they might have paid more attention and spent more time on the questions), anxiety about correctness, and time constraints all contributed to irrational decision-making.

## VII. Conclusions

The present research employing the cognitive reflection test demonstrated anomalies in human behaviour, particularly among potential investors and investment advisors, and, accordingly, among investors and those involved in investment activities.

The participating Accounting and Finance Students answered impulsively, and their answers lacked focus and attention, giving mostly incorrect answers to easy and simple questions, as they later realised. They predominantly operated under System 1, making quick and reckless decisions, which led to inaccurate and irrational results. Considering that the research respondents are potential investors and financial executives, the significance of the research is particularly significant.

To avoid irrational behaviour, it is vital that investors make informed decisions relying on reflection, attention, and experience. Awareness of both System 1 and System 2 of the specific test can prevent irrational answers given to similar or related questions in the future, promoting rationality through second thoughts, focused attention, concentration, and expertise.

Overall, the significance of Cognitive Reflection tests in behavioural finance is profound as they contribute to revealing biases and heuristics, which affect rational decision-making in investment processes.

Investors achieve profits through rationality, deliberate decision-making, and analytical thinking (System 2), avoiding intuitive and impulsive incorrect answers (System 1).

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