

Cognitively-Tailored Decisions: An Exploration of Cognitive Reflection, Heuristics, and Time Constraints

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Background

Decision-making is based in part on cognitive reflection, described by “System 1” and “System 2” (Figure 1). This research focuses on the differences between participants’ responses to heuristically-based questions (Figure 3) and takes into account whether each person favors System 1 or System 2. In addition, this research considers how time limits for answering these questions affect the accuracy of the answers of both groups. Applications of this research include tailoring interfaces to users’ cognitive preferences: for example, interfaces for unmanned systems (such as UAV’s). If a user’s cognitive reflection is known, an interface can be tailored to accommodate his or her style of decision-making or to encourage the person to react in a certain way. This research is currently being performed, and data will be collected and analyzed when available.

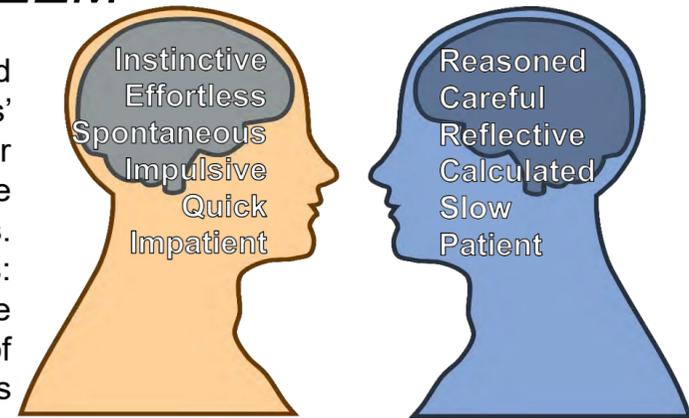


Figure 1: Characteristics of Systems 1 & 2

Experiment

Participants will be given twenty-two, randomly-ordered heuristics questions (Figure 4). Eleven questions will allow a short amount of time to read and answer (either 45 or 60 seconds), while the other eleven will allow a longer amount of time (165 or 180 seconds). The questions in each set of eleven are similar to those of the other set. Afterwards, each participant will be given the three-item Cognitive Reflection Test (Figure 2) with no time limit.

Hypothesis

Overall, a System 2 person will answer more of these questions correctly.

A System 1 person will do better with the shorter time limit, and a System 2 person will do better with the longer time limit.

Goals of This Research

The purpose of this research is to enhance the interpretation, integration, and application of information by tailoring the way in which it is presented, specifically in user interfaces:

- 1) By accommodating a person's favored system of cognitive reflection → enhancing performance
- 2) By encouraging the use of one cognitive system over the other as a situation might require → training desired behavior

Cognitive Reflection Test (CRT)

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

Figure 2: Cognitive Reflection Test

Heuristics and Example Questions



Figure 3: Heuristic descriptions and example questions

In a city with 100 criminals and 100,000 innocent citizens there is a surveillance camera with an automatic face recognition software. If the camera sees a known criminal, it will trigger the alarm with 99 % probability; if the camera sees an innocent citizen, it will trigger the alarm with a probability of 1 %. What is the probability that indeed a criminal was filmed when the alarm is triggered?

- A. 1%
- B. 9%
- C. 90%
- D. 99%

Figure 4: Example question from computer program

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