

Investigating an alternate form of the cognitive reflection test

Keela S. Thomson*

Daniel M. Oppenheimer*

Abstract

Much research in cognitive psychology has focused on the tendency to conserve limited cognitive resources. The CRT is the predominant measure of such miserly information processing, and also predicts a number of frequently studied decision-making traits (such as belief bias and need for cognition). However, many subjects from common subject populations have already been exposed to the questions, which might add considerable noise to data. Moreover, the CRT has been shown to be confounded with numeracy. To increase the pool of available questions and to try to address numeracy confounds, we developed and tested the CRT-2. CRT-2 questions appear to rely less on numeracy than the original CRT but appear to measure closely related constructs in other respects. Crucially, substantially fewer subjects from Amazon's Mechanical Turk have been previously exposed to CRT-2 questions. Though our primary purpose was investigating the CRT-2, we also found that belief bias questions appear suitable as an additional source of new items. Implications and remaining measurement challenges are discussed. Keywords: cognitive reflection, CRT.

1 Introduction

The CRT is one of the most widely used instruments in heuristics-and-biases research. It is designed to measure a person's propensity to override an intuitive, but incorrect, response with a more analytical correct response (Frederick, 2005). Miserly processing (the tendency not to override the intuitive response) as measured by the CRT is frequently associated with non-normative responses across a number of cognitive domains.

CRT performance has been linked with an extensive list of rational thinking tasks. For example, Frederick (2005) found relationships between CRT scores and time preference (preference for immediate versus delayed outcomes), risk preference (preference for risky versus certain outcomes), and need for cognition (a tendency to enjoy effortful thinking). CRT scores are also related to belief bias (the tendency to be influenced by the believability of the conclusion when evaluating the validity of logical arguments) and denominator neglect (the tendency to focus on the number of a particular kind of outcome, the numerator, without considering the total number of possible events, the denominator; Toplak, West & Stanovich, 2014a).

In addition, CRT scores have been linked with: SAT scores (Frederick, 2005; Obrecht, Chapman & Gelman, 2009), frequency of choices consistent with expected value (Cokely & Kelley, 2009; Oechssler, Roeder & Schmitz, 2009), the likelihood of committing the conjunction fallacy (Oechssler et al., 2009), probability updating, base rate neglect, under- and over-confidence (Hoppe & Kusterer,

2011), regression to the mean, errors in Bayesian reasoning, framing effects (Toplak, West & Stanovich, 2011), Wason selection task performance, (Toplak et al., 2014a), using and endorsing maximizing strategies on probabilistic prediction tasks (Koehler & James, 2010), and a reduction in the degree to which people underweight sample size and standard deviation in making pairwise comparisons (Obrecht, Chapman & Gelman, 2007). CRT scores have also been associated with utilitarian moral judgments (Paxton, Ungar & Greene, 2012; Royzman, Landy & Leeman, 2014; Baron, Scott, Fincher & Metz, 2015).

In fact, Toplak et al. (2011) found that the CRT better predicted performance on a composite of 15 separate rational-thinking tasks than either intelligence measures or measures of executive functioning. They suggest that a major strength of the CRT is that it is a direct measure of miserly processing as opposed to a self-report measure (as is the case for most other measures of thinking dispositions), and that the CRT goes beyond measures of cognitive ability by examining the depth of processing that is actually used.

Unsurprisingly, there is a high degree of interest in studying cognitive reflection using the CRT. However, the CRT is so widely used that subject pools may be polluted, so that many subjects are already familiar with the questions (Toplak et al., 2014a; Baron et al., 2015; Chandler, Mueller & Paolacci, 2014). Frederick's original publication of the CRT has over 1,300 citations on Google Scholar. The iconic "bat and ball" question has appeared in popular non-fiction books such as Kahneman's *Thinking, Fast and Slow* (Kahneman, 2011), and mainstream media outlets like *The New York Times* (Postrel, 2006) and *Business Insider* (Lubin, 2012), which means that many potential subjects have been exposed to CRT questions. Moreover, the CRT is fre-