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Cognitive abilities and behavioral biases

Jörg Oechssler[a,*], Andreas Roider[a], Patrick W. Schmitz[b]

[a] Department of Economics, University of Heidelberg, Bergheimer Str. 58, 69115 Heidelberg, Germany
[b] Department of Economics, University of Cologne, Germany

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ABSTRACT

We use a simple, three-item test for cognitive abilities to investigate whether established behavioral biases that play a prominent role in behavioral economics and finance are related to cognitive abilities. We find that higher test scores on the cognitive reflection test of Frederick [Frederick, S., 2005. Cognitive reflection and decision-making. Journal of Economic Perspectives 19, 25–42] indeed are correlated with lower incidences of the conjunction fallacy and conservatism in updating probabilities. Test scores are also significantly related to subjects' time and risk preferences. Test scores have no influence on the amount of anchoring, although there is evidence of anchoring among all subjects. Even if incidences of most biases are lower for people with higher cognitive abilities, they still remain substantial.

1. Introduction

Why should economists be interested in behavioral biases and cognitive abilities? The traditional view in economics and finance is that only outcomes matter. There is a strong presumption that behavioral biases do not play a role in the aggregate because either they are averaged out or they are corrected for by rational arbitrage. However, Barberis and Thaler (2003) argue forcefully that arbitrage cannot eliminate all effects of behavioral biases in financial markets.[1] But even if it could, on the individual level it would certainly still be valuable information if one could somehow discriminate between individuals that are less or more afflicted by behavioral phenomena. For example, this information would be useful when applied to potential employees or customers. In particular, if a concise test were available that could be administered in a few minutes but would reveal a lot about the probability that those individuals exhibit a number of well-known biases in decision-making, such a test should be quite instructive.

In this paper we provide an experimental test for the hypothesis that the incidence of behavioral biases is related to cognitive abilities. For it to be useful, a test for cognitive abilities must be short and simple. One such test is suggested by Frederick (2005) who shows that his cognitive reflection test (CRT), which is a brief 3-item test that can be conducted in less than 5 min, is a good predictor of cognitive abilities, in particular with respect to mathematical abilities.

* Corresponding author. Tel.: +49 0 6221 54 3548.
E-mail address: oechssler@uni-hd.de (J. Oechssler).

[1] Such limits to arbitrage might, for example, arise from fundamental risk (e.g., due to the lack of short-selling opportunities), noise trader risk (see, e.g., De Long et al., 1990; Shleifer and Vishny, 1997), or implementation costs (see, e.g., Summers, 1986; Abreu and Brunnermeier, 2002). See also Shleifer (2000).

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Table 1
Distributions of answers on the CRT test.

Question	Correct	Impulsive	Other
Bat and ball	54.8%	40.2%	5.0%
Widgets	70.7%	21.6%	7.6%
Lily pads	78.0%	11.3%	10.6%

A number of recent studies have already demonstrated two stylized facts about the relationship between cognitive ability and economic behavior (see Frederick, 2005; Benjamin et al., 2006; Slonim et al., 2007, and Dohmen et al., 2007). First, individuals with high cognitive abilities seem to be less risk averse when gambling in the positive domain.[2] Second, they seem to be more patient.[3]

In this study, we replicate those earlier studies (and their main findings) with respect to risk and time preferences. But we also extend the hypothesis to a number of biases that play a crucial role, for example, in the behavioral finance literature (see Barberis and Thaler, 2003, for a comprehensive survey). In particular, we study the conjunction fallacy, anchoring, and conservatism with respect to probability updating. We find that individuals with low CRT scores are significantly more likely to be subject to the conjunction fallacy and to conservatism with respect to probability updating. Test scores have no influence on the amount of anchoring, although there is evidence of anchoring among all subjects.

2. Experimental design

In total, 1250 subjects participated in our online, web-based experiment. After logging in on our website and providing some personal background information, all participants played a one-shot mini-ultimatum game (see our companion paper, Oechssler et al., 2008, for results). A subset of 564 subjects also answered a questionnaire with several decision-problems related to the well-known behavioral biases discussed above, and our results relate to this subset of subjects. Mixed in among those questions were the three questions that make up the cognitive reflection test. A translation of the instructions can be found in Appendix A.

2.1. Cognitive reflection test

The cognitive reflection test (CRT) introduced by Frederick (2005) is a quick and simple 3-item test, and Frederick documents that the CRT compares very favorably (in terms of the relationship between test scores and observed behavior) to substantially more complex personality tests. The CRT differentiates between more impulsive and more reflective decision-makers. To achieve this, each of the three questions of the CRT has a seemingly intuitive (but incorrect) answer that springs quickly to mind, and the overwhelming majority of subjects indeed provides either the impulsive or the correct response (more than 89% of subjects in all three questions). The questions of the CRT are not difficult in the sense that the correct solution is easily understood when explained to subjects. Moreover, if a solution springs to mind it is easy for subjects to verify whether their response is indeed correct. However, arriving at the correct answer may require overcoming the initial, impulsive response. The CRT consists of the following three questions.

- A bat and a ball together cost 110 cents. The bat costs 100 cents more than the ball. How much does the ball cost? (impulsive answer: 10 cents; correct answer: 5 cents).
- 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; correct answer: 5 min).
- 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; correct answer: 47 days).

The average CRT score (i.e., the average number of correct responses) in our sample was 2.05, which places our subjects well between students of MIT and Princeton in Frederick's (2005) sample. Of our subjects, 41.5% answered all three questions correctly, 30.7% answered two questions correctly, 17.7% answered one question correctly, and the remaining 10.1% answered none of the questions correctly. Table 1 reports the distributions of answers separately for each question. Note that almost all subjects either chose the correct or the incorrect but impulsive answer. As in Frederick (2005), male subjects received a higher average test score (2.2) than female subjects (1.7), which is a significant difference ($p < 0.001$, MWU-test).[4]

[2] See, however, Brañas-Garza et al. (2008) who do not find evidence for a relationship between a GRE-like math test and risk attitudes.
[3] Moreover, for a representative sample of the German population, Dohmen et al. (2008) find that participants' education levels are systematically related to being prone to the gambler's fallacy (respectively, the hot hand fallacy).
[4] However, the CRT does not merely proxy for gender as our below results continue to hold qualitatively when the analysis is done separately for men and women.