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Are high-ability individuals really more tolerant of risk? A test of the relationship between risk aversion and cognitive ability☆

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ABSTRACT

A body of literature based primarily on experiments suggests that cognitive ability and risk aversion are inversely related. In contrast, studies using observational data often find that lower ability, or lower income, is positively related to risky behaviors. One potential explanation for the conflicting conclusions is that experimental studies tend to measure risk attitudes by presenting subjects with choices between an option with a certain outcome and an option characterized by risk, which requires computation and, hence, cognitive effort. Additionally, these studies have primarily relied on the use of hypothetical choices. I use an experiment to test whether this frequently-used method of measuring risk preferences is biased toward finding results that indicate that individuals with lower cognitive ability are more risk averse than individuals with higher cognitive ability. I find that the inverse relationship between risk aversion and cognitive ability is not robust and that high-ability subjects may misrepresent their preferences when they face hypothetical choices. Also, similar to earlier studies, I find that low-ability subjects are more likely to make errors and show that the availability of a certain option reduces errors for the lowest-ability subjects.

1. Introduction

Risk preferences are fundamental to economic decision making because many of the decisions individuals make are characterized by uncertainty. Empirical studies have demonstrated that risk preferences are related to a broad range of economic decisions and outcomes, such as wealth, job mobility, and educational attainment (Guiso and Paiella, 2008; Allen et al., 2005; Harrison et al., 2007). Moreover, these choices are often complex, and this complexity may cause low- and high-ability individuals to approach these choices in systematically different ways, which could lead to significant differences in economic outcomes (Cawley et al., 2001). For instance, Heckman et al. (2006) demonstrate that higher cognitive ability is associated with higher wages.

Several studies using laboratory experiments have sought to assess whether risk preferences and cognitive ability are related, and, as a whole, these studies find that individuals with higher cognitive ability tend to be more risk tolerant (Frederick, 2005; Campitelli and Labollita, 2010; Cokely and Kelley, 2009; Oechssler and Schmitz, 2009; Dohmen et al., 2010; Benjamin et al., 2013). Not all experimental studies have come to the same conclusion, however, Bra nas-Garza et al. (2008) do not find a relationship between risk attitudes and math skills, and Taylor (2013) finds that it is only present when the choices are hypothetical.

Studies that find a relationship between cognitive ability and risk aversion have two things in common that suggest the relationship requires additional scrutiny.[1] First, with only one exception, they use an elicitation method that asks subjects to choose between a certain option and a risky option.[2] For example, a typical choice asks a subject to choose between $1000 for sure or a 75% chance of $4000 (Frederick, 2005). This format is likely to bias the results toward finding a relationship between cognitive ability and risk aversion because individuals with lower cognitive ability may choose the safe option because it requires less cognitive effort, not because they are truly more risk averse. For example, a reluctance to exert the cognitive effort to deal with options char-

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[1] Publication bias may be another potential explanation for why the published studies tend to indicate that there is a relationship between cognitive ability and risk aversion.

[2] Benjamin et al. (2013) is the exception here. They ask Chilean students to choose between two gambles in one trial of their experiment, but they use small stakes (i.e., no more than $1.60).

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acterized by risk may explain why individuals with lower levels of educational attainment in a representative sample of Italian households were more likely to refuse to provide an answer or to say that they would pay zero euros to play a gamble with a 50% t chance of 5000 euros and a 50% chance of zero euros (Guiso and Paiella, 2008), suggesting an extraordinary level of risk aversion.

Second, these studies use either hypothetical choices or small expected payoffs. Only Dohmen et al. (2010) uses relatively large payoffs (potentially 300 euros), but the expected payoffs were reduced dramatically because only one in seven subjects was actually paid based on their decisions. Taylor (2013) suggests the use of hypothetical choices is problematic because the relationship between cognitive ability and risk aversion may depend upon the use of hypothetical choices. In particular, the results show that cognitive ability is unrelated to risk aversion when the choices are real, but it is inversely related to risk aversion when the choices are hypothetical because individuals with higher cognitive ability indicate that they are significantly more risk tolerant when they face hypothetical choices.

This elevated level of risk aversion demonstrated by low-ability subjects in experiments does not appear to be a global attitude toward all risky behaviors. For instance, individuals with lower cognitive ability are more likely to participate in risky behaviors such as smoking daily, smoking marijuana, or engaging in unspecified illegal activities (Heckman et al., 2006). Moreover, there is evidence in the financial domain to suggest that lower-income individuals spend a greater proportion of their incomes on state-run lotteries than higher-income households (see, for example, Clotfelter and Cook (1989), Oster (2004)), and that lottery participation is negatively related to educational attainment (Clotfelter and Cook, 1989; Perez and Humphreys, 2011).[3]

Two previous studies have considered whether the elicitation instrument used to measure risk preferences can cause low-ability individuals to *appear* more risk averse than high-ability individuals. Both studies focus on the possibility that more complicated tasks can result in low-ability subjects making "noisier" choices. Dave et al. (2010) find that low-ability subjects tend to make noisier choices relative to high-ability subjects when faced with a more complex elicitation task, such as the Holt and Laury multiple-price list (HL MPL), and they conclude that "low-numeracy can produce an effect that looks like risk aversion" (Dave et al., 2010, p.239). Their conclusions imply that a simpler elicitation format should reduce the inconsistency of low-ability subjects and my experimental design allows me to test this directly. Andersson et al. (2015) also doubt the robustness of the inverse relationship between risk aversion and cognitive ability, and they introduce a model that shows how errors can make low-ability subjects appear *either* more or less risk averse depending upon the MPL used to elicit preferences.

I show how differences in choice complexity and incentives can affect errors and, potentially, the measurement of risk aversion in the context of a HL MPL. I also propose an alternate model that explains the relationship between risk aversion and ability as a function of low-ability subjects increased "preference for certainty" and a tendency for high-ability subjects to misrepresent their preferences when facing hypothetical choices. I then explore which model explains subjects' choices better.

Consistent with Andersson et al. (2015), I find evidence that low-ability subjects are more likely to make errors relative to high-ability subjects, and, similar to Dave et al. (2010), I find that the availability of the certain-safe option (the simpler instrument) significantly reduces the likelihood of an error by those subjects at the lowest end of the ability spectrum. However, I do not find that the use of certain-safe options reduces the likelihood of errors, or that hypothetical choices increase this likelihood, to a sufficient degree to explain differences in risk preferences resulting from the difference elicitation methods. Also, similar to Andersson et al. (2015), I find that the inverse relationship between risk aversion and cognitive ability is not robust and may be an artifact of the elicitation method.

However, I do not find evidence that supports my hypothesis that low-ability subjects have a preference for certainty. Rather, the results indicate that high-ability subjects misrepresent their preferences when they face hypothetical choices, at least when the choices have a certain-safe option. This finding is consistent with Taylor (2013) that finds evidence to suggest that it is high-ability subjects who behave differently in the hypothetical setting relative to the real setting. Finally, I consider one potential mechanism that may explain this behavior by including a subject's self-reported familiarity with the concept of expected value as a control and find that cognitive ability is not related to risk aversion under any of the treatments when this knowledge is accounted for in the model.

2. Experimental design, procedures, and hypotheses

2.1. Structure of the experiment

This experiment measured risk aversion using one of two multiple price lists (MPL). Both MPLs present individuals with ten decisions involving a "safe" lottery and a "risky" lottery and subjects were asked to indicate which lottery they preferred to play. Half of the subjects were randomly assigned to a treatment in which the safe lottery was characterized by uncertainty and the other half was assigned to a treatment in which the safe lottery had a certain outcome. Subjects assigned to the treatments with the uncertain-safe option faced the frequently-used multiple-price list introduced by Holt and Laury (2002), and their risk preferences are inferred from the point at which they switch from the safe option to the risky option. Those individuals who switch later in the list, i.e., more safe choices, are indicating that they are more risk averse than subjects who switch earlier. Fig. 1 shows the HL MPL that was presented to subjects in this treatment. Option A is the safer of the two options in each choice and had potential payoffs of $30 or $24; Option B is the risky option and it had potential payoffs of $58 or $1.50. The expected value of the options are structured such that an individual with risk neutral preferences would select the safe option for the first four decisions and then switch to the risky option for the remaining six decisions.[4]

While half of the sample completed the conventional HL MPL, the other half completed a multiple-price list adapted from the HL MPL so that these subjects made choices between a certain option and an uncertain option. Fig. 2 shows how the choices with the certain-safe option were presented to subjects assigned to this treatment. Again, the choices in this Alternate MPL (AMPL) are structured such that a risk-neutral individual will select the safe option for the first four decisions and then select the risky option for the final six decisions. In particular, the coefficients of risk aversion implied by the switch points in the conventional HL MPL were

[3] A particular intriguing strain in the literature has explored a genetic explanation of the relationship between ability and risk aversion. Using a sample of twins, Cesarini et al. (2009) finds that twenty percent of the variation in risk attitudes can be explained by genetic differences. However, like the studies mentioned above, it also measured risk aversion using hypothetical choices and a certain-versus-uncertain choice format. Bra nas-Garza and Rustichini (2011) explore the relationship between pre-natal testosterone exposure (as measured by the ratio of the lengths of the index finger to the ring finger (2d:4d)) and conclude that the inverse relationship between testosterone and risk aversion is partially mediated by cognitive ability. Again, however, this study used choices with hypothetical payments.

[4] The payoffs used in this experiments were fifteen times the low, baseline payoffs used in Holt and Laury (2002).