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Risk taking, behavioral biases and genes: Results from 149 active investors☆

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ABSTRACT

Recent evidence suggests that there is genetic basis for economic behaviors, including preferences for risk taking. We correlate variation in risk taking and behavioral biases with two genetic polymorphisms related to the uptake of dopamine and serotonin (7R+ DRD4 and s/s 5-HTTLPR), hypothesizing that they are positively (negatively) related to risk taking. We use a small but detailed sample of active investors where we combine survey data with DNA samples and data from Swedish tax records that give us objective information about actual economic choices. We find a positive (negative) relationship between the dopamine (serotonin) gene and life expectancy bias, but no other significant correlations between the two genes and behaviors, including risk taking and measures of equity holdings. We acknowledge that our tests suffer from low power originating from the small sample size, which warrants some caution when interpreting these results.

1. Introduction

There is substantial individual variation in many economic behaviors, including behaviors related to risk taking and consumption–savings allocation over time (e.g., Tversky and Kahneman, 1992, Andersen et al., 2008, Dohmen et al., 2011, Andreoni and Sprenger, 2012). Recent studies, employing for example the twin methodology and genome-wide association techniques (GWAS), show that there is a genetic basis of economic risk taking as well as various behavioral biases such as loss aversion, the conjunction fallacy and the default bias (e.g., Cesarini et al., 2009, 2010, 2012).

Our research method is novel in that we are able to draw from three distinct sources of data; DNA samples, registry data, and responses from an administrated survey. We study whether variation in two different genetic polymorphisms, the dopamine receptor D4 gene (DRD4) and the serotonin transporter gene (5-HTTLPR), correlate with variation in risk taking measured in two different ways as well as behavioral biases such as loss aversion, impatience, life expectancy bias and overconfidence in the cognitive reflection task (CRT; Fredrick, 2005). The neurotransmitter dopamine plays a key role in reward processing and reinforcement of behaviors that are associated with the anticipation of rewards. Dopaminergic pathway activation releases dopamine molecules that can generate feelings of well-being and pleasure that become associated with the

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behaviors that triggered the activation. The neurotransmitter serotonin is also linked to well-being and in particular anxiety, where the serotonergic system is often involved in the treatment of depression and other affective disorders. There is substantial evidence that these neurotransmitters are involved in different types of decision making, as evidenced by studies using neuroimaging procedures linking brain activity to financial risk taking (Kuhnen and Knutson, 2005).

We measure risk taking both through an incentivized lottery measure and self-reported risk taking following Dohmen et al. (2011). We measure loss aversion through hypothetical choices in a survey, where we also ask for the relative performance of the subjects' investments. We study life expectancy bias, measured as the difference in self-assessed and actuarial life expectancy. We measure CRT overconfidence through the difference in self-assessed and actual performance on the CRT. Finally, we compute the equity share and stock share from registry data, measuring the fraction of equities (individual stocks and equity mutual funds) and individual stocks in subjects' financial wealth portfolios.

In a sample of 149 active investors, we compare those with at least one 7-repeat allele of DRD4 (7R+) with those without this allele (7R−), as well as those with two short (s) alleles (s/s) of 5-HTTLPR with those with at least one long (l) allele (s/l or l/l). 7R+ individuals are thought to be less sensitive to dopamine uptake than 7R− individuals, making them need higher levels of dopamine than 7R− individuals in order to get similar responses in the brain's corticomesolimbic dopamine reward pathway. The 5-HTTLPR s-allele in turn has a lower serotonin transporter transcription level than the l-allele. There are some previous attempts in correlating variation in DRD4 and 5-HTTLPR with risk preferences. The results are so far mixed. For example, while Dreber et al. (2009), Kuhnen and Chiao (2009) and Dreber et al. (2011) find that 7R+ individuals (in Dreber et al., 2011's case only men and not women) are more economically risk taking than those with 7R−, Frydman et al. (2011), Carpenter et al. (2011) and Dreber et al. (2012) do not find any evidence of this. While Kuhnen and Chiao (2009), Crisan et al. (2009) and Kuhnen et al. (2013) find that s/s individuals are less risk taking than others, Roiser et al. (2009) and Frydman et al. (2011) do not find this. Given these results, we expect, if anything, 7R+ individuals to be more risk taking than 7R− individuals, and s/s individuals to be less risk taking than others.

We find a positive correlation between 7R+ and s/s genotypes, indicating that a significant fraction having one of these variations, actually carry both. There is a weak, but positive (negative) correlation between individuals carrying 7R+ (s/s) gene variations and our survey risk measures. The results are similar, but reversed, for loss aversion. We do not find any significant correlations between the two genetic polymorphisms, CRT overconfidence, and our two registry measures of equity risk taking (Equity share and Stock share). We obtain one significant result, namely that 7R+ (s/s) individuals are significantly more positively (negatively) biased in life expectancy than 7R−(s) individuals. This result is robust to the inclusion of various controls. However, our sample size is small and the literature on candidate genes and economic behaviors is likely to contain large shares of both false positive results and false negative results (Benjamin et al., 2012). Moreover, we perform multiple tests in this paper. Our results should thus be interpreted with caution until they have been replicated in a substantially larger sample size.

2. Method

Sample

This study was conducted with members of an association for private investors—the Swedish Shareholders' Association (*Aktiespararna*). They organize themselves into 144 local clubs spread all over the country. We visited 18 of those all over Sweden in 2011–2012 and recruited a total of 174 participants.

After receiving information about the content of the study, we asked participants for their written informed consent to participate in the experiment. The experiment consisted of a survey module and DNA sampling. The written consent allows us to link their survey answers and genetic data to Swedish registry data on socio-demographic characteristics and detailed asset holdings. After matching the survey answers with a genetic test and registry-based variables, we obtain a sample of 149 observations.[1]

Survey-based measures

In the survey module we measure risk taking in two different ways. The first measure is a multiple price listing where participants choose between a certain amount, varying from SEK 1000 (USD 140) to SEK 10,000 (USD 1000), and a gamble that could give them SEK 10,000 or nothing with equal probability.[2] Participants were informed that one response would be randomly picked, and a prize paid out in accordance with her stated preferences given in the gambling question. The response gives us a measure of risk taking that ranges between 1 and 10.

The second risk measure follows Dohmen et al. (2011), asking participants to self-report their risk taking on a scale from 0 to 10, where a higher number indicates more risk taking. This general risk taking, or self-reported measure, has been found to correlate with other types of risk taking, including incentivized risk taking.

Loss aversion is measured by having participants choosing certainty over an uncertainty in the gain domain, but choosing the reverse in the domain of losses.[3] We measure self-assessed relative performance (SARP) with a question if the respondent believes that his or her financial portfolio outperforms that of the Stockholm Stock Exchange value weighted index (SIXRX). Life expectancy bias is measured through the difference in self-reported

[1] The study was approved by the Ethical Review Board of Stockholm in September 2010, with an addendum approved in January 2013.

[2] The eight certain amounts were SEK 1000, 2000, 3000, 4000, 5000, 6000, 8000 and 10,000.

[3] In accordance with the reflection-effect, see Kahneman and Tversky (1979).