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# Digit Ratio and Risk Taking: Evidence from a Large, Multi-Ethnic Sample

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**Abstract:** Using a large (*n=543*) multi-ethnic sample of laboratory subjects, we systematically investigate the link between the digit ratio (the ratio of the length of the index finger to the length of the ring finger, also called 2D:4D ratio) and two measures of individual risk taking: (i) risk preferences over lotteries with real monetary incentives and (ii) self-reported risk attitude. Previous studies have found that the digit ratio, a proxy for pre-natal testosterone exposure, correlates with risk taking in some subject samples, but not others. In our sample, we find, first, that the right-hand digit ratio is significantly associated with risk preferences: subjects with lower right-hand ratios tend to choose more risky lotteries. Second, the right-hand digit ratio is not associated with self-reported risk attitudes. Third, there is no statistically significant association between the left-hand digit ratio and either measure of individual risk taking.

**Keywords**: Testosterone; 2D:4D ratio; risk preferences; risk attitudes.

**JEL codes**: C91, C92, D44, D81, D87.

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## 1. Introduction

We report findings from a laboratory experiment conducted with a large multi-ethnic sample of subjects, which systematically investigates the links between the *digit ratio* - the ratio of the length of the index finger to the length of the ring finger – and individual risk taking. The digit ratio (also known as the 2D:4D ratio) is a sexually dimorphic measure that is strongly associated with pre-natal exposure to sex hormones, particularly testosterone (Goy and McEwen, 1980; Lutchmaya et al., 2004; Honekopp et al., 2007; Zhend and Cohn, 2011). Fetal exposure to sexual hormones has been shown to have an organizational effect on the brain that ultimately impact on decision making (see Manning, 2002 for a review). A significant association between digit ratio and individual risk taking would provide evidence for a *biological basis* for risk taking, thus contributing to the debate on the nature of people's tendency to take risk (Rangel et al. 2008; Cesarini et al., 2009; Coates et al., 2009; Dreber et al., 2009; Kuhnen and Chiao, 2009; Zethraeus et al., 2009; Zhong et al., 2009; Pearson and Schipper, 2012; Chew et al., 2014).

**Table 1:** Summary of the existing studies on 2D:4D ratio and experimental measures for risk taking

| | **Year** | **Exp** | **Money** | **Measure** | **Hands** | **Ethnicities** | **$N_M$, $N_F$** | **Result** |
|---|---|---|---|---|---|---|---|---|
| Apicella et al. | 2008 | GP | Yes | Scanner | Both | Mixed | 89, 0 | No |
| Aycinena et al. | 2014 | HL | Yes | Scanner | Both | Ladino | 125, 94 | No |
| Drichoutis et al. | 2014 | HL | Yes | Ruler | Right | Mixed | 46, 92 | No |
| Sapienza et al. | 2009 | HL | Yes | Calliper | Mean | Mixed | 117, 66 | No |
| Schipper | 2014 | HL | Yes | Scanner | Right | Mixed | 93, 115 | No |
| Brañas & Rustichini | 2011 | HL | Not | Photocopy | Right | Caucasian | 72, 116 | (-) males |
| Dreber & Hoffman | 2007 | GP | Yes | Scanner | Both | Caucasian | 87, 65 | (-) all |
| Garbarino et al. | 2011 | MPL | Yes | Scanner | Mean | Caucasian | 87, 65 | (-) all |
| Ronay &Hippel | 2010 | BART | Yes | Scanner | Both | Caucasian | 52, 0 | (-) males |

Note: *Exp* defines the type of experimental test to elicit risk-taking: *HL* refers to the Holt-Laury test; *GP* refers to the Gneezy-Potters test; *MPL* to multiple price list tests; *BART* to the Balloon Analogue Risk Task. $N_M$ and $N_F$ refer to the number of male and female subjects, respectively.

A number of studies – summarised in Table 1 - have explored the relationship between digit ratio and experimental measures for risk taking, yielding mixed evidence to date. Four studies find a negative, significant association between digit ratio and risk taking: people with a lower digit ratio take more risk in choices in the laboratory. Dreber and Hoffman (2007) and Garbarino et al. (2011) find this relationship holding for both males and females, while Ronay and von Hippel (2010) and Brañas-Garza and Rustichini (2011) find a statistically significant association for males only. On the other hand, five studies find no effect at all (Apicella et al., 2008; Sapienza et al., 2009; Schipper, 2014; Drichoutis et al., 2014; Aycinena et al., 2014). As Table 1 shows, moreover, the methods of these studies differ greatly, both in terms of measurement of key variables and in terms of the subject pool.

In our study, we follow state-of-the-art procedures to obtain high-quality digit ratio measures from hand scans (Neyse and Brañas-Garza, 2014) and report data on *both* the Right-Hand Digit Ratio (RHDR) and the Left-Hand Digit Ratio (LHDR). Apart from this enhanced measurement, we make two key contributions to the existing literature on risk and digit ratio:

(i) We gather digit ratio data from a large, multi-ethnic sample; and

(ii) We distinguish between incentivized preferences over financial risk and not incentivized self-reported risk attitudes.

Our first contribution is the recruitment of a large sample of ethnically diverse subjects. The existing evidence typically considers either (predominantly) White Caucasian subject samples (Dreber and Hoffman, 2007; Garbarino et al., 2011; Ronay and von Hippel, 2010; Brañas-Garza and Rustichini, 2011) or relatively small samples of ethnically diverse subjects (Apicella et al., 2008; Sapienza et al., 2009; Schipper, 2014; Drichoutis et al., 2014). The weak results reported in the latter mixed-ethnicity samples might be due to the relationship between digit ratio and risk taking being mediated by ethnicity. In our study, we explicitly control for ethnicity by recruiting a large subject sample consisting of students of different ethnicities from the London School of Economics and Political Science, a higher education institution located in central London. By using students from the same institution, we minimize the effect of socio-economic and educational differences on risk taking.

Ethnicity has been cited as an important source of variation in digit ratio. Manning (2002) reports that the variation of digit ratio between ethnic groups, and even between Caucasians of different European origin, is larger than the variation between sexes within an ethnic group. Such variation makes it harder to detect a relationship between digit ratio and risk taking in small samples. Apicella et al. (2008), in fact, wonder whether the null results found in ethnically diverse pools could be due to small sample sizes: "*If the effect is small, it may not have been detected due to the small sample and possible measurement error associated with calculating 2D:4D.*" (p.388). Similarly, a meta-analysis by Hoffman et al. (2013) concludes *"that there is a true relationship between 2D:4D and risk preferences, but because 2D:4D is a noisy measure, we should expect many individual studies to yield null results or even insignificant results in the opposite direction*." (p.13). To address these concerns about sample size, we recruit a large sample of subjects (*n=543*).

Our second contribution concerns the measurement of individual risk taking. The studies listed in Table 1 use different experimental measures for risk taking, some incentivized with monetary outcomes and some not incentivized. Other studies use self-reported indicators (e.g. Honekopp, 2011; Stenstrom et al., 2011). We collect both incentivized and not incentivized measures of risk taking, and test both for an association with the digit ratios. Our first measure is an experimental elicitation test for risk preferences (RP) over real monetary payments (Binswanger, 1980, 1981; Eckel and Grossman 2002, 2008). The procedure involves a choice between six lotteries with different levels of risk. It has the advantage of being simple and intuitive, thus yielding clean and consistent choices (Charness et al., 2013). Our second measure is a self-reported measure for general risk attitudes (RA) on a 10-point scale which has been validated in large-sample surveys (Dohmen et al., 2011) and used in other studies (Cesarini et al., 2009; Zethraeus et al., 2009).

Looking at different measures is important because risk taking is likely to be largely a context-specific construct (Jackson et al. 1972; Hershey and Shoemaker, 1980; MacCrimmon and Wehrung, 1990; Viscusi and Evans, 1990; Zeckhauser and Viscusi, 1990; Bleichrodt et al., 1997; Finucane et al. 2000; Loewenstein et al. 2001; Weber et al. 2002; Blais and Weber, 2006; Prosser and Wittenberg, 2007; Galizzi et al. 2013). It is thus plausible that incentive-compatible and self-reported measures capture different aspects of individual risk-taking (Battalio, Kagel, and Jiranyakul, 1990; Holt and Laury, 2002, 2005; Harrison, 2006). Most of the studies on the links between digit ratio and risk-taking, however, have exclusively looked at Multiple Price List (MPL) measures such as the Holt and Laury (2002) test. Exceptions are the studies by

Dreber and Hoffman (2007) and Apicella et al. (2008), who consider the investment task by Gneezy and Potters (2002); Ronay and von Hippel (2010), who use the '*Balloon Analogue Risk Task*' (BART) procedure; and Brañas-Garza and Rustichini (2011), who use a series of not incentivized binary lottery choices (including Holt and Laury 2002).

Our main findings are as follows. First, in our large, ethnically diverse, sample the RHDR is significantly associated with RP: subjects with lower RHDR tend to make more risk-seeking choices in the experimental lottery test with real monetary payments.

Second, and in contrast to RP, the RHDR is never significantly associated with RA. That is, incentivized measurements are related to RHDR but hypothetical are not.

Third, there is no statistically significant association between the LHDR and both measures for individual risk taking, that is, what we find for the right hand does not appear in the left.

Finally, we are not able to find any significant association of digit ratios with risk-taking when focusing on sex- or ethnic-specific subsamples.

The rest of the article is structured as follows. Section 2 describes the methods, while Section 3 presents the results. Section 4 discusses the main findings and briefly concludes.

## 2. Methods

All experimental sessions were run at the Behavioural Research Lab (BRL) at the London School of Economics and Political Science (LSE), London, between February and March 2014. The experimental protocol was approved by the LSE Research Ethics Committee. Subjects were recruited from the BRL mailing list of volunteers (about 5,000 subjects, mostly current and former students of the LSE). There was no other eligibility or exclusion criterion to select subjects. In the email invitation, subjects were not informed about the exact nature of the experiment that would be conducted, and were only told that: the experiment would last about an hour; they would receive £10 for their participation; they would have the chance to get an extra payment related to some of the tasks. Subjects could sign up to any of five one-hour sessions starting every hour between 10 am and 5 pm at every working day in the week.

A total of 746 subjects participated in our experimental sessions. Upon arrival, subjects were identified anonymously using an ID code assigned by the online recruitment system (SONA), asked to read an informed consent form, and to sign the latter if they agreed on carry on with the experiment.

638 subjects (85%) gave consent for their left and right hands to be scanned. Note that this figure is likely an underestimation of the overall compliance rate as we lost some observations due to a technical issue with the scanner. Moreover, due to a software issue, we were only able to link the risk preferences and risk attitude data with digit ratios for 543 of these subjects. We thus focus our analysis on these 543 subjects (73% of the original sample).[1]

We distinguish between risk attitudes (RA), subjects' self-reported attitude to risk; and risk preferences (RP), subjects' observed choice between monetary *lotteries*, consisting of gambles with different outcomes, one of which is randomly chosen and paid in cash at the end of the experiment. Both measures were obtained in a computerized questionnaire administered at the start of the experimental session. The questionnaire also contained other items, such as questions about personality and demographic data. The computerized questionnaire was programmed and implemented using Z-Tree (Fischbacher, 2007).

The RA test we used was the self-reported measure from Dohmen et al. (2011). Each subject was asked the following: "*Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?*". To select an answer between 0 and 10, subjects clicked a radio button on their screen, on which the value 0 was labeled as "*Unwilling to take risks*" and the value 10 was labeled as "*Fully prepared to take risks*". In the on-screen instructions it was made clear to subjects that the question was about their own assessment of their general attitude towards risk, and that no part of their experimental earnings depended on the answer to that question. Our RA measure thus increases with individual self-reported risk attitude, taking value between 0 and

[1] To check for any selection bias of subjects with different characteristics into having their hands scanned, we compared the risk preferences and risk attitudes of subjects who did or did not have their hands scanned. For both the RA measure and RP measure we cannot reject the null hypothesis that the mean of the two samples come from the same distribution (two-tailed Mann-Whitney U test, z=-0.984, p=0.325, for RA, and z=0.757, p=0.449 for RP).

10.

The RP question we used was the lottery choice task originally proposed by Binswanger (1980, 1981) and further adapted by Eckel and Grossman (2002, 2008). The task required the subjects choosing between 6 lotteries: A, B, C, D, E and F. Each lottery gave a 50% chance of receiving a *low cash* payment and a 50% chance of a *high cash* payment. The payments for the lotteries were: A: low = £28, high = £28; B: low = £24, high = £36; C: low = £20, high = £44; D: low = £16, high = £52; E: low = £12, high = £60; F: low = £2, high = £70. These choices were thus increasing in the variance of the outcomes and in the risk they represented, with A being the safe choice (a guaranteed payment of £28 and thus a variance of $\sigma_A^2 = 0$) and F the highest-risk choice (a variance of $\sigma_F^2 = 1156$). To make a choice, subjects clicked one of six radio buttons on their screen, which were labeled with the lottery probabilities and outcomes. Our RP measure thus increases with an individual's appetite for risk, taking value 1 if the subjects choose the safe lottery A, and 6 if they choose the highest risk lottery F.

The RA question was asked first, followed by the RP test a few screens later, with the two questions being separated by other questionnaire items unrelated to risk. This separation was designed to avoid subjects, consciously or unconsciously, adjusting their answer to the RP question to match their answer to the RA question. Furthermore, the RP question was preceded by an on-screen announcement that the upcoming choices would affect subjects' earnings. The section also included time preferences questions. Subjects were explained that each of the questions would have an equal chance of being randomly selected to be played and paid out for real at the end of the experiment.

After the questionnaire and a completely unrelated task, subjects were led into a separate room where the experimenter had set up a computer with a high-resolution scanner (Canon LIDE 110). Subjects were told "*Before you leave the laboratory today, we would like to ask you to participate in an optional task. Please can you read the following consent form to see what it involves?*".[2] Subjects were then given time to read an informed consent form, which explained that they would be asked to place both of their hands on a scanner to obtain the digit ratio, which *"...has been shown in*

[2] See the Supplementary Materials for these instructions.

*various scientific studies to correlate with people's behaviour in the laboratory."* They were reminded that placing their hands on the scanner was completely voluntary and that the data would remain strictly anonymous and confidential (*"…we will not be able to share your digit ratio with anyone, including you"*). Finally, they were told they could ask as many questions ask they wanted. When subjects asked what kind of behaviour the digit ratio predicted, or what the purpose of our study was, the experimenter replied that we were looking for correlations with their answers to the questionnaire that was administered earlier. There was no indication that any of the subjects knew or suspected that we were interested in the relationship between the digit ratio and risk taking in specific.

The scans were made at the highest possible resolution (300 DPI); subjects were asked to remove any rings from their fingers, and to place both hands flat on the scanner. To get the best possible image, we followed the measurement procedure described by Neyse and Brañas-Garza (2014) as closely as possible.

After the experimental sessions were completed, we recruited two research assistants to provide us with independent measures of the length of the second and fourth finger of each hand.[3] We calculated the digit ratios from the finger length measures and checked the correlation between the digit ratios implied by the measurements from the two research assistants. These correlations (0.895 for left hand, 0.867 for right hand) suggest that measurement was highly accurate. To obtain a single measure of the digit ratio for our analysis, we computed the average of the two research assistants' ratios (Neyse and Brañas-Garza, 2014).

## 3. Results

Summary statistics

Our sample consists of 543 student subjects. The sample consists predominantly of female students (75.9%) and is highly ethnically diverse: 198 subjects described

[3] The research assistants were told to take as much time as they needed to provide us with reliable measures. Both research assistants used Adobe Photoshop to measure the length of the fingers on the scans. They were instructed by the same experimenter to follow the procedures described in Neyse and Brañas-Garza (2014). The assistants were also given a copy of this procedure, for reference. The two research assistants did not know or meet each other and worked independently at different times. Research assistants had no access to the details of the subjects' whose fingers they were measuring.

themselves as Chinese (36.5% of the sample), 184 as White (33.9%), 71 as South Asian (13.1%), 23 as Black (4.2%) and 67 as 'Other'. Given the small number of Black subjects and the composite nature of the 'Other' ethnicities in our sample, in what follows we will mainly focus on the differences between the Chinese, White and South Asian groups.

*Digit ratios*

Using a high-resolution scanner and a standardised measurement procedure (Neyse and Brañas-Garza, 2014), we obtained measures of both left-hand digit ratio (LHDR) and right-hand digit ratio (RHDR) for each subject. Table 2 summarises these measures, in aggregate and by sex and ethnicity-specific subsamples.

**Table 2.** Summary statistics for Left-Hand and Right-Hand Digit Ratios.

| | | **Left-Hand DR (LHDR)** | | | **Right-Hand DR (RHDR)** | | |
|---|---|---|---|---|---|---|---|
| | Obs. | Mean | | St. Dev. | Mean | | St. Dev. |
| All | 543 | 0.9701 | | 0.0326 | 0.9726 | | 0.0326 |
| Female | 412 | 0.9734 | *** | 0.0319 | 0.9775 | *** | 0.0324 |
| Male | 131 | 0.9599 | | 0.0324 | 0.9574 | | 0.0281 |
| Chinese | 198 | 0.9674 | * | 0.0303 | 0.9693 | | 0.0320 |
| White | 184 | 0.9729 | | 0.0335 | 0.9793 | | 0.0335 |
| S-Asian | 71 | 0.9741 | * | 0.0363 | 0.9774 | * | 0.0341 |
| Black | 23 | 0.9596 | | 0.0302 | 0.9618 | | 0.0283 |

Note: Significant differences between sub-samples (two-tailed Wilcoxon rank-sum test) are shown as brackets in the last column: * = p < 0.1, ** = p < 0.05, *** = p < 0.01.

Overall, both the LHDR and RHDR of male subjects are lower than those of female subjects. The average LHDR is 0.9599 (SD=0.0324) for male subjects and 0.9734 (SD=0.0319) for female subjects; the averages for RHDR are 0.9574 (SD=0.0281) and 0.9775, (SD=0.0324). Both differences are strongly statistically significant (p=0.0000).

The differences of digit ratios across sexes also hold within most ethnicities. For instance, Chinese males have significantly lower LHDR and RHDR than Chinese females (p=0.0174 and p=0.0011, respectively), and the same holds for White subjects (p=0.0119 and p=0.0000). For South Asian subjects, however, the differences across sexes are statistically significant only for the RHDR, but not for the LHDR (p=0.0040 and p=0.1194, respectively). Also, for Black subjects we are not able to detect statistically significant differences between sexes (p=0.9498 for the LHDR and p=0.5287 for RHDR). Note, however, that the samples of South Asian and Black subjects are much smaller than the Chinese and White samples.

Whilst the difference in digit ratio between sexes is significant, differences between ethnicities are not clear-cut in our sample. In general, the LHDR is 0.9674 (SD=0.0303) for Chinese subjects, 0.9729 (SD=0.0335) for White subjects, 0.9741 (SD=0.0363) for South Asians and 0.9596 (SD=0.0301) for Black subjects: the LHDR for Chinese and Black subjects are statistically different from the LHDR of White subjects (p=0.0871 and p=0.0788, respectively). In general, the RHDR is 0.9693 (SD=0.0320) for Chinese subjects, 0.9793 (SD=0.0335) for White subjects, 0.9774 (SD=0.0341) for South Asians, and 0.9618 (SD=0.0283) for Black subjects, with the latter being the only value (marginally) significantly different from the RHDR for White subjects (p=0.0959).

Within the female sub-sample, the difference between White subjects (0.9753) and that of Chinese (0.9702) and Black (0.9694) subjects are marginally statistically significant (p=0.0574 and p=0.0583, respectively). For males, we found no statistically significant differences in LHDR between ethnic groups. The patterns for RHDR are similar, although more pronounced. Within the female sub-sample, the difference in RHDR between South Asian (0.9816) and White (0.9792) subjects is not significant, while the differences between the RHDR for White females and that of Chinese (0.9733) and Black (0.9592) females are both statistically significant (p=0.0529 and p=0.0173, respectively). In the male sub-sample we find no differences in RHDR between ethnic groups.

*Risk taking*

The left side of Table 3 summarises our RP measure. The mean value for RP in our sample is 2.874 (SD=1.443). Male subjects in our sample chose riskier lotteries on average, with a mean choice of 3.099 (SD=1.558) compared to 2.803 (SD=1.399) for female subjects – a marginally significant difference (p=0.0692). This result is in line with the commonly reported finding that women are more risk averse than men (Charness and Gneezy, 2012; Croson and Gneezy, 2009; Eckel and Grossman, 2008).[4] We find no significant differences between the RP of different ethnicities, neither for the whole sample nor for sex-specific subsamples. Moreover, when looking at each ethnicity separately, we cannot find any statistically significant differences in the RP between sexes.

The right side of Table 3 summarises our data for the RA measure. Also according to this measure, male subjects appears slightly more risk seeking, describing themselves as 4.87 on average (SD=2.371) compared to 4.546 (SD=2.271) among female subjects, a difference which, however, is not statistically significant (p=0.1494). Risk attitudes among South Asian (4.802) and Black (5.217) subjects are not statistically significant from White subjects (4.82), but Chinese subjects (4.262) report to take significantly less risk than White subjects (p=0.0159). None of the differences in risk attitudes are significant considering the subsample of males only, while Chinese females (4.135) report to take significantly less risk than White females (4.887, p=0.0147). Moreover, when looking at each ethnicity separately, we cannot find any statistically significant differences in the RA between sexes.

**Table 3.** Summary statistics for Risk Preferences and self-reported Risk Attitudes.

| | | **Risk Preferences (RP)** | | | **Risk Attitudes (RA)** | | |
|---|---|---|---|---|---|---|---|
| | Obs. | Mean | | St. Dev. | Mean | | St. Dev. |
| All | 543 | 2.874 | | 1.443 | 4.624 | | 2.297 |
| Female | 412 | 2.803 | ] * | 1.399 | 4.546 | | 2.271 |
| Male | 131 | 3.099 | | 1.558 | 4.870 | | 2.371 |
| Chinese | 198 | 2.691 | | 1.428 | 4.262 | ] ** | 2.221 |
| White | 184 | 2.902 | | 1.489 | 4.820 | | 2.251 |
| S-Asian | 71 | 2.887 | | 1.315 | 4.802 | | 2.115 |
| Black | 23 | 3.086 | | 1.443 | 5.217 | | 2.575 |

Note: Significant differences between sub-samples (two-tailed Wilcoxon rank-sum test) are shown as brackets in the last column: * = p < 0.1, ** = p < 0.05, *** = p < 0.01.

[4] Note that evidence on the difference between male and female risk-taking in the laboratory is currently disputed (see, for instance, Filippin and Crosetto, 2014).

Correlation analysis

Table 4 reports pairwise correlations among some of the main variables of interest. We first note that, in our sample, LHDR and RHDR are strongly positively correlated (0.7212, p=0.000). Next, looking at the measures of risk taking, we find a significant positive correlation between the incentive-compatible risk preference test and the self-reported risk attitude measure (p=0.000). However, we note that the correlation coefficient is rather low (0.193), possibly indicating that incentivized risk attitudes (RA) and revealed risk preferences (RP) over real monetary incentives capture different aspects of individual risk taking.

Furthermore, the correlation analysis reveals interesting patterns of association between digit ratios and our risk-taking measures. On the one hand, there is a negative and significant correlation between RP and RHDRs: -0.0935 (p=0.0293). So, the higher the RHDR - that is, the lower the pre-natal testosterone exposure - the less likely are the subjects to take risk in an incentivized experimental test. The sign of the association is in line with the existing literature (Dreber et al., 2007; Garbarino et al., 2011; and also Ronay and von Hippel, 2010 and Brañas-Garza and Rustichini, 2011, although for males only). The association of RP with LHDR is also negative (-0.0645) but not statistically significant (p=0.1336).

**Table 4**. Pairwise correlations between the main variables.

| | RHDR | LHDR | RP | RA |
|---|---|---|---|---|
| RHDR | 1 | | | |
| LHDR | 0.721***<br>(0.000) | | | |
| RP | -0.093**<br>(0.029) | -0.064<br>(0.133) | | |
| RA | -0.008<br>(0.830) | -0.041<br>(0.314) | 0.193***<br>(0.000) | 1 |

Note: * = p < 0.1, ** = p < 0.05, *** = p < 0.01.

On the other hand, the self-reported RA measure does not exhibit robust correlations with either digit ratio: although the association is negative with both LHDR (-0.0411) and RHDR (-0.0087), neither of these is statistically significant.

Similar patterns of association hold when only the subsample of male or female subjects is considered (Table A1 and A2 in the Appendix). Notice, however, that while the correlation of RP and RA and the correlation of LHDR and RHDR are also statistically significant for the sex-specific subsamples, the negative association between RP and RHDR is not significant in the all-female and all-male subsamples. This association is also not significant for ethnic-based subsamples.

Regression analysis

*Digit ratio and Risk Preferences (RP)*

We also conduct regression analysis to explore the links between risk taking and digit ratios, controlling for sex and ethnicity. We first consider RP as dependent variable. To start with, we model the linear relation of RP with a set of explanatory variables using standard Ordinary Least Squares (OLS) regressions. The first set of regressions thus looks at the effect on RP of sex and ethnicity only. The second set of regressions adds the RHDR into the OLS regressions, including controls for sex and ethnicity.

We also model the relation between RP and the set of explanatory variables as non-linear, using an Ordered Probit (OP) model. Allowing non-linearity in the effects is important due to potential concavity in the utility function typically associated with risk aversion. In our OP model, the dependent variable can take 6 values. The third set of regressions thus looks again at the effect on RP of sex and ethnicity only, while the fourth adds the RHDR into the OP regressions, including controls for sex and ethnicity. All regression models in this section are conducted with adjustments to the variance-covariance matrix for possible heteroskedasticity and serial correlation.

We start by describing the results of the regression with RHDR. The regression analysis reported in Table A3 (in the Appendix) confirms that female subjects are (marginally) more risk averse (p=0.053), even when controlling for ethnicity (p=0.063). Apart from a marginally significant effect for the 'Other' group, there is no significant effect for any ethnicity.

Table 5 shows that, when included in the regression on its own, the RHDR is significantly associated with RP (p=0.02): subjects with lower RHDR tend to be more risk seeking, a result which is closely line with previous studies (Dreber et al., 2007; Ronay and von Hippel, 2010; Garbarino et al., 2011; Brañas-Garza and Rustichini, 2011) and with the correlation analysis. Importantly, the association of RP with RHDR remains statistically significant even when directly controlling for sex (p=0.071), ethnicity (p=0.008), and both sex and ethnicity simultaneously (p=0.033): individuals with lower RHDR tend to make more risk-seeking choices in the incentive-compatible experimental test.

**Table 5**: Risk Preferences (RP) and individual characteristics: all subjects (OLS)

| *RP* | *m1* | *m2* | *m3* | *m4* | *m5* |
|---|---|---|---|---|---|
| RHDR | -4.139** | -3.347* | -3.682 | -4.687*** | -3.985** |
| | (1.773) | (1.853) | (4.408) | (1.769) | (1.860) |
| Female | | -0.229 | -0.627 | | -0.204 |
| | | (0.159) | (4.665) | | (0.159) |
| RHDR*Female | | | 0.414 | | |
| | | | (4.859) | | |
| Chinese | | | | -0.227 | -0.217 |
| | | | | (0.150) | (0.151) |
| S-asian | | | | 0.00632 | 0.0259 |
| | | | | (0.190) | (0.190) |
| Black | | | | 0.133 | 0.115 |
| | | | | (0.308) | (0.313) |
| Other | | | | 0.386* | 0.383* |
| | | | | (0.205) | (0.204) |
| Constant | 6.900*** | 6.304*** | 6.624 | 7.463*** | 6.929*** |
| | (1.730) | (1.775) | (4.213) | (1.737) | (1.791) |
| Observations | 543 | 543 | 543 | 543 | 543 |

Note: Standard errors in parentheses; * p<.10, ** p<.05, *** p<.01.

The results are qualitatively identical when the OP model is used to allow for non-linear effects (Tables A4 and A5 in the Appendix). In particular, female subjects tend to be less risk seeking, even controlling for ethnicity. When included on its own RHDR has a significant, negative effect on RP (p=0.034), which is robust to the introduction of ethnicity dummies (p=0.015), and both ethnicity and sex variables (p=0.053).

Finally, Table A7 (Appendix) shows that there is no significant effect of LHDR on RP, neither when included on its own, nor when accompanied by the sex and/or the ethnicity variables. The lack of statistical association with LHDR is also confirmed by the analysis using the non-linear OP models (Table S1).

*Digit ratio and self-reported Risk Attitudes (RA)*

We next consider RA as dependent variable, and we model a linear relationship using standard OLS regressions: the following set of regressions considers the effect of sex and ethnicity, while the second set adds in the digit ratios (LHDR and RHDR).

Tables A6 and 6 report the findings from the OLS regression models of RA. Some differences emerge compared to the findings for RP. In particular, female subjects in our ethically diverse sample do not report significantly different risk attitudes, suggesting that the two measures for risk-taking behaviour appeal to two potentially distinct constructs within the same respondents (Table A6).

Furthermore, among the various ethnic groups, only the Chinese subjects report significantly more risk-averse attitudes when directly asked how risk-seeking they are. Interestingly, these same subjects do not show any statistically different risk-taking choice when these are elicited with incentive-compatible methods.

The second result refers to the association between RA and RHDR. In no regression, in fact, is the RHDR significantly associated with self-reported risk attitude, neither on its own, nor when included together with sex and/or ethnicity variables (Table 6). The lack of statistical association is confirmed when alternative models are employed, such as non-linear models (not reported here but available on request).

Table A8 (Appendix) reports the OLS regression models of RA and LHDR. As with RHDR, there is no significant association between RA and LHDR, neither when included in the regressions on its own, nor with the sex and/or ethnicity variables.

**Table 6**. Risk attitudes and individual characteristics: all subjects (OLS)

| *RA* | *m1* | *m2* | *m3* | *m4* | *m5* |
|---|---|---|---|---|---|
| RHDR | -0.611 | 0.550 | -5.411 | -1.033 | -0.00854 |
| | (2.924) | (3.021) | (6.726) | (2.943) | (3.044) |
| Female | | -0.335 | -7.426 | | -0.298 |
| | | (0.244) | (7.229) | | (0.244) |
| RHDR*Female | | | 7.377 | | |
| | | | (7.517) | | |
| Chinese | | | | -0.562** | -0.546** |
| | | | | (0.230) | (0.231) |
| S-asian | | | | -0.0132 | 0.0154 |
| | | | | (0.302) | (0.303) |
| Black | | | | 0.385 | 0.359 |
| | | | | (0.556) | (0.549) |
| Other | | | | -0.0519 | -0.0557 |
| | | | | (0.364) | (0.362) |
| Constant | 5.219* | 4.344 | 10.05 | 5.825** | 5.047* |
| | (2.847) | (2.897) | (6.440) | (2.862) | (2.918) |
| Observations | 543 | 543 | 543 | 543 | 543 |

Note: Standard errors in parentheses; * p<.10, ** p<.05, *** p<.01.

*Sub-sample analysis*

We finally briefly report the main results from the analogous regressions conducted splitting the sample in two sex-specific sub-samples (Tables S2-S5).

The general message for both male and female sub-samples seems to be that RP does not significantly associate with either RHDR or LHDR. This is true both when the digit ratios are used on their own, and when the analysis controls for ethnicity and/or interaction effects, and holds both when using OLS and OP models. In some regressions with RHDR there are only marginally significant associations for females (p=0.088 for OLS, and p=0.095 for the OP), but they are generally not robust across specifications.

The same, generally negative, pattern seems to also apply to self-reported RA: for both males and females samples there is no significant association between RA and RHDR. When looking at LHDR, while there is no significant effect for females, there is some significant association for males between RA and LHDR, both when the latter is included on its own (p=0.012) or along with ethnicity controls (p=0.017 and p=0.047): men with lowest LHDR seem to report more risk-seeking attitudes.

Furthermore, when the sample is split into ethnic subgroups, all the associations that are significant at the whole sample level are no longer significant. The only exception is the largest subsample of Chinese subjects (*n=198*) where highest RHDR (i.e. lowest testosterone prenatal exposure) is significantly associated with higher risk aversion measured by RP, both when RHDR is included on its own (p=0.042 in OLS, p=0.052 in OP), and when controlling for sex (p=0.059 in OLS, and p=0.069 in OP). There is no significant association of RA with RHDR at any ethnic subgroup level. Moreover, there is no significant association between LHDR with either RP or RA.

Finally, notice that all the results are qualitatively identical when the regressions are re-run using ordered logit hierarchical regressions, or standardized z-values for the digit ratios, as done in Garbarino et al. (2011) (not reported but available on request).

## 4. Discussion and conclusions

Our main findings are four. First, in our large, ethnically diverse, sample, right-hand digit ratio (RHDR) has a negative and significant association with incentivized risk preferences: subjects with lower RHDR make more risk-taking choices between experimental lotteries with real monetary payments. This finding is robust across a wide range of alternative specifications, which vary the estimation strategies, and include sex and ethnicity dummies as well as other controls. We thus contribute to the existing literature (Dreber et al., 2007; Garbarino et al., 2011; Ronay and von Hippel, 2010; Branas-Garza et al. 2011) by showing that the association between RHDR and financial risk-taking documented in relatively small samples of White Caucasian subjects also holds within large samples of ethnically diverse subjects.

Second, in our sample, RHDR is not associated with not incentivized self-reported risk attitudes. This second result is in line with the abundant experimental literature showing that self-reported and incentive-compatible measures for economic preferences do not always perfectly correlate (Battalio, Kagel, and Jiranyakul, 1990; Blackburn, Harrison, and Rutstrom, 1994; Cummings, Harrison, and Rutstrom, 1995; Cummings et al. 1997; Rutstrom, 1998; Camerer and Hogarth, 1999; List, 2001; Holt and Laury, 2002, 2005; Harrison, 2006). The result is also in line with the idea that risk-taking is a complex, multi-dimensional aspect of individual behaviour, and that different measures could well capture different nuances and angles of it (Jackson et al., 1972; Hershey and Shoemaker, 1980; MacCrimmon and Wehrung, 1990; Viscusi and Evans, 1990; Zeckhauser and Viscusi, 1990; Bleichrodt et al., 1997; Finucane et al. 2000; Loewenstein et al. 2001; Weber et al. 2002; Blais and Weber, 2006; Prosser and Wittenberg, 2007; Galizzi et al., 2013).

The fact that a biological measure like the RHDR associates with an experimental measure of risk taking with real monetary rewards can seemingly surprise, since monetary transactions are a relatively recent phenomenon in human history (Lea and Webley, 2006). As noticed by Apicella et al. (2008), however, the acquisition and accumulation of resources is not at all new in human history. From this perspective, thus, money can be a proxy for other currencies, such as utility, survival, or fitness, whose returns are routinely maximised by humans (Daly and Wilson, 2002).

Third, we find no statistically significant association between the LHDR and both measures for individual risk taking. This third result directly emphasises the importance of considering distinctively both hands' measures when looking at the links between digit ratios and behavioural attitudes (Dreber and Hoffman, 2007; Apicella et al., 2008). In light of this result, it does not surprise that no association has previously been found when the two hands digit ratios were combined into a unique indicator calculated as a simple average of both hands (Sapienza et al., 2009; Garbarino et al., 2011).

Fourth, we are not able to find any significant association of digit ratios with risk-taking when focusing on sex- or ethnicity-specific subsample. This seems to be due to the relatively small sizes of our sub-samples. This last result reinstates the importance of conducting sub-sample analyses with sufficiently high numbers of ethnically homogeneous subjects. Our evidence in general, and our subsample of female Chinese students, in particular (*n=153*), seems to suggest that significant associations are more likely to start being detected when sub-group analysis is conducted with samples of few hundreds, rather than few dozens, of subjects (Apicella et al., 2008; Hoffman et al., 2013).

One limitation of our study is that, by construction, it looks at the links between risk taking and digit ratios among subjects in an ethnically diverse, but socially homogeneous, large pool of subjects. It is widely known, however, that university students may be a peculiar and not representative sub-sample of the population (Enis, Cox, and Stafford, 1972; Cunningham, Anderson, and Murphy, 1974; Gachter, Herrmann, and Thoni, 2004; Carpenter, Connolly, and Myers, 2008). Further research is needed to systematically explore the association of digit ratios and risk taking in more socially and culturally diverse groups.

## References

Apicella, C.L., Dreber, A., Campbell, B., Gray, P.B., Hoffman, M., Little, A.C. (2008). Testosterone and Financial Risk Preferences. *Evolution and Human Behavior*, 29, 384-390.

Aycinena, D., Baltaduonis, R., Rentschler, L. (2014). Risk Preferences and Prenatal Exposure to Sex Hormones for Ladinos. *PLoS ONE*, 9(8), e103332.

Battalio, R.C., Kagel, J.C., Jiranyakul, K. (1990). Testing between alternative models of choice under uncertainty: some initial results. *Journal of Risk and Uncertainty*, 3, 25-50.

Binswanger, H.P. (1980). Attitudes toward risk: experimental measurement in rural India. *American Journal of Agricultural Economics*, 62, 395-407.

Binswanger, H.P. (1980). Attitudes toward risk: theoretical implications of an experiment in rural India. *The Economic Journal*, 91, 867-890.

Blackburn, M., Harrison, G.W., Rutstrom, E. (1994). Statistical bias functions and informative hypothetical surveys. *American Journal of Agricultural Economics*, 76(5), 1084-1088.

Blais, A.R., Weber, E.U. (2006). A domain-specific risk-taking (DOSPERT) scale for adult populations. *Judgment and Decision Making*, 1(1), 33-47.

Bleichrodt, H., Wakker, P.P., Johannesson, M. (1997). Characterizing QALYs by risk neutrality. *Journal of Risk and Uncertainty*, 15, 107-114.

Brañas-Garza, P., Rustichini, A. (2011). Organizing Effects of Testosterone on Economic Behavior: Not Just Risk Taking. *PLoS ONE*, 6(12), e0029842.

Butler, S., Rosman, A., Seleski, S., Garcia, M., Lee S., Barnes J., Schwartz A. (2012) A Medical Risk Attitude Subscale for DOSPERT. *Judgment and Decision Making*, 7(2), 189-195.

Cesarini, D., Dawes, C.T., Johannesson, M., Lichtenstein, P., Wallace, B. (2009). Genetic Variation in Preferences for Giving and Risk-Taking. *The Quarterly Journal of Economics*, 124, 809–842.

Charness, G., Gneezy, U., Imas, A. (2013). Experimental Methods: Eliciting Risk Preferences. *Journal of Economic Behavior and Organization*, 87, 43-51.

Chew S. H., Ebstein, R. P., Zhong, S. (2014) Modelling Decision Making under Risk using Neurochemistry. *Mimeo*. National University of Singapore.

Coates, J.M., Gurnell, M., Rustichini, A. (2009). Second-to-fourth digit ratio predicts success among high-frequency financial traders. *Proceedings of the National Academy of Sciences*, 106(2), 623-628.

Cummings R.G., Harrison, G.W., Rutstrom, E.E. (1995). Homegrown values and hypothetical surveys: is the dichotomous choice approach incentive-compatible? *The American Economic Review*, 85, 260-266.

Cummings, R.G., Elliott, S., Harrison, G.W., Murphy, J. (1997). Are hypothetical referenda incentive compatible? *Journal of Political Economy*, 105(3), 609-621.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., Wagner, G.G. (2011). Individual risk attitudes: measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, 9(3), 522-50.

Dreber, A., Hoffman M (2007). Portfolio selection in utero. *Mimeo*. Stockholm School of Economics.

Dreber, A., Apicella, C.L., Eisenberg, D.T.A., Garcia, J.R., Zamoree, R.S., Lume, J.K., Campbell, B. (2009). The 7R polymorphism in the dopamine receptor D4 gene (DRD4) is associated with financial risk taking in men. *Evolution and Human Behavior*, 30, 85-92.

Drichoutis, A.C., Nayga, R.M. Jr. (2014). Do risk and time preferences have biological roots? *Southern Economic Journal* (in press).

Eckel, C.C., Grossman, P.J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evolution and Human Behavior*, 23(4), 281-95.

Enis, B.E., Cox, K., Stafford, J. (1972). Students as subjects in consumer behavior experiments. *Journal of Marketing Research*, 6, 72-74.

Filippin, A., Crosetto, P. (2014). A reconsideration of gender differences in risk attitudes. *IZA Discussion Paper* 8184.

Finucane, M.L., Alhakami, A., Slovic, P., Johnson, S.M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 13(1), 1-17.

Gachter, S., Herrmann, B., Thoni, C. (2004). Trust, voluntary cooperation and socio-economic background: survey and experimental evidence. *Journal of Economic Behavior and Organization*, 55, 505-531.

Galizzi, M.M., Miraldo, M., Stavropoulou, C. (2013). In Sickness but not in Wealth: Field Evidence on Patients' Risk Preferences in the Financial and Health Domain. *Imperial College Business School Discussion Paper* 2013-08.

Garbarino, E., Slonim, R., Sydnor, J. (2011). Digit ratios (2D: 4D) as predictors of risky decision making for both sexes. *Journal of Risk and Uncertainty*, 42(1), 1-26.

Gneezy, U., Potters, J. (1997). An Experiment on Risk Taking and Evaluation Periods. *The Quarterly Journal of Economics*, 112(2), 631-45.

Goy, R.W., McEwen, B.S. (1980). *Sexual differentiation of the brain*. Cambridge, MA: MIT Press.

Hershey, J.C., Schoemaker, P.J.H. (1980). Risk Taking and Problem Context in the Domain of Losses: An Expected Utility Analysis. *Journal of Risk and Insurance*, 47(1), 111-32.

Honekopp, J. (2011). Relationships between digit ratio 2D:4D and self-reported aggression and risk taking in an online study. *Personality and Individual Differences*, 51(1), 77–80.

Hoffman, M., Jordan, J., Yoeli, E. (2013). The Evolutionary Basis of Sex Differences in Risk Preferences. *Mimeo*. University of California.

Holt, C.A., Laury, S.K. (2002). Risk Aversion and Incentive Effects. *The American Economic Review*, 92(5), 1644-55.

Holt, C.A., Laury, S.K. (2005). Risk Aversion and Incentive Effects: New Data Without Order Effects. *The American Economic Review*, 95(3), 902-904.

Honekopp, J., Bartholdt, L., Beier, L., Liebert, A. (2007). Second to fourth digit length ratio (2D:4D) and adult sex hormone levels: new data and a meta-analytical review. *Psychoneuroendocrinology*, 32, 313-321.

Jackson, D.N., Hourany, L., Vidmar, N.J. (1972). A four-dimensional interpretation of risk taking. *Journal of Personality*, 40(3), 483-501.

Kuhnen CM, Chiao JY (2009) Genetic Determinants of Financial Risk Taking. *PLoS ONE*, 4(2), e4362. doi:10.1371/journal.pone.0004362

Lea, S.E.G., Webley, P. (2006). Money as a Tool, Money as a Drug: the Biological Psychology of a Strong Incentive. *Behavioural and Brain Sciences*, 29(2), 161-209.

Lutchmaya, S., Baron-Cohen, S., Raggatt, P., Knickmeyer, R., Manning, J. (2004) 2nd to 4th digit ratios, fetal testosterone and estradiol. *Early Human Development,* 77, 23–28. doi: 10.1016/j.earlhumdev.2003.12.002

Lusk, J.K., Shogren, J.F. (2007). *Experimental Auctions: Methods and Applications in Economics and Business Research*. Cambridge: Cambridge University Press.

MacCrimmon, K.R., Wehrung, D.A. (1990). Characteristics of Risk Taking Executives. *Management Science*, 36(4), 422-435.

Manning, J.T. (2002). Digit ratio: a pointer to fertility, behavior, and health. New Brunswick, NJ: Rutgers University Press.

Neyse, L., Brañas-Garza, P. (2014). Digit Ratio Measurement Guide, *MPRA Working Paper* 54134.

Pearson, M., Schipper, B.C. (2012). The visible hand: finger ratio (2D:4D) and competitive bidding. *Experimental Economics*, 15, 510-529.

Prosser, L.A., Wittenberg, E. (2007). Do risk attitudes differ across domains and respondent types? *Medical Decision Making*, 27(3), 281-287.

Rangel. A., Camerer, C., Montague, P.R. (2008). A Framework for studying the neurobiology of value-based decision making. *Nature Reviews: Neuroscience*, 9, 1-13.

Ronay, R., von Hippel, W. (2010). Power, testosterone, and risk ‐ taking. *Journal of Behavioral Decision Making*, *23*(5), 473-482.

Sapienza, P., Zingales, L., Maestripieri, D. (2009). Gender differences in financial risk aversion and career choices are affected by testosterone. *Proceedings of the National Academy of Sciences*, *106*(36), 15268-15273.

Schipper, B. C. (2014). Sex hormones and choice under risk. *Mimeo*. University of California.

Stenstrom, E., Saad, G., Nepomuceno, M. V., Mendenhall, Z. (2011). Testosterone and domain-specific risk: Digit ratios (2D:4D and rel2) as predictors of recreational, financial, and social risk-taking behaviors. *Personality and Individual Differences*, 51(4), 412–416.

Viscusi, W.K., Evans, W.N. (1990). Utility functions that depend on health status: estimates and economic implications. *American Economic Review*, 80(3), 353-374.

Weber, E.U., Blais, A-R., Betz, N.E. (2002). A domain-specific risk-attitude scale: measuring risk perceptions and risk behaviors. *Journal of Behavioral Decision Making*. 15(4), 263-290.

Zeckhauser, R.J., Viscusi, W.K. (1990). Risk within reason. *Science*. 248, 4955, 559-564.

Zethraeus, N., Kocoska-Maras, L., Ellingsen, T., von Schoultz, Bo., Hirschberg, A.L., Johannesson, M. (2009). A randomized trial of the effect of estrogen and testosterone on economic behavior. *Proceedings of the National Academy of Sciences*, 106, 16, 6535-6538.

Zheng, Z., Cohn, M.J. (2011). Developmental basis of sexually dimorphic digit ratios. *Proceedings of the National Academy of Sciences,* 108, 16289–16294. doi: 10.1073/pnas.1108312108

Zhong, S., Chew, S. H., Set, E., Zhang, J., Xue, H., Sham, P. C., Ebstein, R. P., Israel, S. (2009). The Heritability of Attitude Toward Economic Risk. *Twin Research and Human Genetics*, 12(1), 103-107.

## Appendix. Tables

**Table A1**. Pairwise correlations between the main variables, male subjects only.

| | **RHDR** | **LHDR** | **RP** | **RA** |
|---|---|---|---|---|
| **RHDR** | 1 | | | |
| **LHDR** | 0.656***<br>(0.000) | 1 | | |
| **RP** | -0.066<br>(0.450) | -0.082<br>(0.349) | 1 | |
| **RA** | -0.005<br>(0.946) | -0.106<br>(0.145) | 0.264***<br>(0.000) | 1 |

**Table A2**. Pairwise correlations between the main variables, female subjects only.

| | RHDR | LHDR | RP | RA |
|---|---|---|---|---|
| **RHDR** | 1 | | | |
| **LHDR** | 0.735***<br>(0.000) | 1 | | |
| **RP** | -0.076<br>(0.124) | -0.038<br>(0.437) | 1 | |
| **RA** | 0.0281<br>(0.569) | 0.015<br>(0.754) | 0.162***<br>(0.001) | 1 |

**Table A3**: Risk preferences and individual characteristics: all subjects (OLS)

| *RP* | *m1* | *m2* | *m3* |
|---|---|---|---|
| Female | -0.296* | | -0.283* |
| | (0.152) | | (0.152) |
| Chinese | | -0.210 | -0.199 |
| | | (0.150) | (0.150) |
| S-asian | | -0.0148 | 0.0167 |
| | | (0.191) | (0.189) |
| Black | | 0.185 | 0.149 |
| | | (0.316) | (0.321) |
| Other | | 0.352* | 0.355* |
| | | (0.207) | (0.204) |
| Constant | 3.099*** | 2.902*** | 3.110*** |
| | (0.136) | (0.110) | (0.160) |
| Observations | 543 | 543 | 543 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Table A4**: Risk preferences and individual characteristics: all subjects (OP)

| *RP* | *m1* | *m2* | *m3* |
|---|---|---|---|
| Female | -0.207* | | -0.200* |
| | (0.109) | | (0.109) |
| Chinese | | -0.134 | -0.127 |
| | | (0.110) | (0.111) |
| S-asian | | 0.0165 | 0.0377 |
| | | (0.136) | (0.136) |
| Black | | 0.144 | 0.117 |
| | | (0.220) | (0.225) |
| Other | | 0.264* | 0.266* |
| | | (0.144) | (0.143) |
| _cut1 | -2.601*** | -2.466*** | -2.617*** |
| | (0.204) | (0.202) | (0.223) |
| _cut2 | -0.898*** | -0.752*** | -0.902*** |
| | (0.106) | (0.0914) | (0.125) |
| _cut3 | -0.461*** | -0.313*** | -0.462*** |
| | (0.103) | (0.0871) | (0.122) |
| _cut4 | 0.383*** | 0.536*** | 0.389*** |
| | (0.103) | (0.0870) | (0.121) |
| _cut5 | 0.879*** | 1.033*** | 0.889*** |
| | (0.108) | (0.0915) | (0.125) |
| _cut6 | 1.518*** | 1.671*** | 1.532*** |
| | (0.125) | (0.111) | (0.140) |
| Observations | 543 | 543 | 543 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Table A5**. Risk preferences and individual characteristics: all subjects (OP)

| *RP* | *m1* | *m2* | *m3* | *m4* | *m5* |
|---|---|---|---|---|---|
| RHDR | -2.726** | -2.164 | -2.772 | -3.160** | -2.656* |
| | (1.284) | (1.353) | (3.112) | (1.299) | (1.374) |
| Female | | -0.163 | -0.886 | | -0.148 |
| | | (0.115) | (3.298) | | (0.115) |
| RHDR*Female | | | 0.752 | | |
| | | | (3.437) | | |
| Chinese | | | | -0.149 | -0.141 |
| | | | | (0.111) | (0.112) |
| S-asian | | | | 0.0299 | 0.0435 |
| | | | | (0.137) | (0.136) |
| Black | | | | 0.107 | 0.0931 |
| | | | | (0.217) | (0.221) |
| Other | | | | 0.287** | 0.285** |
| | | | | (0.144) | (0.143) |
| _cut1 | -5.090*** | -4.672*** | -5.254* | -5.543*** | -5.164*** |
| | (1.302) | (1.340) | (2.967) | (1.329) | (1.374) |
| _cut2 | -3.394*** | -2.973** | -3.554 | -3.834*** | -3.453*** |
| | (1.257) | (1.298) | (2.972) | (1.282) | (1.329) |
| _cut3 | -2.956** | -2.535* | -3.117 | -3.392*** | -3.010** |
| | (1.254) | (1.296) | (2.972) | (1.279) | (1.326) |
| _cut4 | -2.109* | -1.687 | -2.268 | -2.536** | -2.154 |
| | (1.251) | (1.292) | (2.970) | (1.275) | (1.321) |
| _cut5 | -1.613 | -1.189 | -1.771 | -2.035 | -1.651 |
| | (1.248) | (1.289) | (2.967) | (1.271) | (1.317) |
| _cut6 | -0.978 | -0.550 | -1.131 | -1.395 | -1.008 |
| | (1.247) | (1.288) | (2.965) | (1.269) | (1.315) |
| Observations | 543 | 543 | 543 | 543 | 543 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Table A6**. Risk attitudes and individual characteristics: all subjects (OLS)

| *RA* | *m1* | *m2* | *m3* |
|---|---|---|---|
| Female | -0.324 | | -0.298 |
| | (0.235) | | (0.235) |
| Chinese | | -0.558** | -0.546** |
| | | (0.229) | (0.231) |
| S-asian | | -0.0178 | 0.0153 |
| | | (0.301) | (0.303) |
| Black | | 0.397 | 0.360 |
| | | (0.553) | (0.548) |
| Other | | -0.0595 | -0.0557 |
| | | (0.361) | (0.360) |
| Constant | 4.870*** | 4.821*** | 5.039*** |
| | (0.207) | (0.166) | (0.236) |
| Observations | 543 | 543 | 543 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Table A7**. Risk preferences and individual characteristics: all subjects (OLS)

| *RP* | *m1* | *m2* | *m3* | *m4* | *m5* |
|---|---|---|---|---|---|
| LHDR | -2.856 | -2.238 | -3.962 | -3.053 | -2.483 |
| | (1.864) | (1.885) | (4.178) | (1.875) | (1.903) |
| Female | | -0.266* | -2.466 | | -0.250 |
| | | (0.154) | (4.511) | | (0.154) |
| LHDR*Femal | | | 2.284 | | |
| | | | (4.680) | | |
| Chinese | | | | -0.225 | -0.212 |
| | | | | (0.151) | (0.151) |
| S-asian | | | | -0.00908 | 0.0177 |
| | | | | (0.191) | (0.190) |
| Black | | | | 0.146 | 0.122 |
| | | | | (0.315) | (0.320) |
| Other | | | | 0.350* | 0.353* |
| | | | | (0.206) | (0.204) |
| Constant | 5.645*** | 5.247*** | 6.903* | 5.870*** | 5.500*** |
| | (1.812) | (1.816) | (4.015) | (1.839) | (1.846) |
| Observations | 543 | 543 | 543 | 543 | 543 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Table A8**. Risk attitudes and individual characteristics: all subjects (OLS)

| *RA* | *m1* | *m2* | *m3* | *m4* | *m5* |
|---|---|---|---|---|---|
| LHDR | -3.311 | -2.640 | -14.17** | -3.669 | -3.084 |
| | (3.126) | (3.155) | (5.557) | (3.133) | (3.175) |
| Female | | -0.289 | -14.99** | | -0.257 |
| | | (0.237) | (6.459) | | (0.238) |
| LHDR*Female | | | 15.27** | | |
| | | | (6.689) | | |
| Chinese | | | | -0.575** | -0.563** |
| | | | | (0.230) | (0.232) |
| S-asian | | | | -0.0109 | 0.0166 |
| | | | | (0.301) | (0.303) |
| Black | | | | 0.351 | 0.326 |
| | | | | (0.556) | (0.551) |
| Other | | | | -0.0617 | -0.0581 |
| | | | | (0.360) | (0.359) |
| Constant | 7.836** | 7.404** | 18.47*** | 8.388*** | 8.008*** |
| | (3.035) | (3.040) | (5.347) | (3.057) | (3.071) |
| Observations | 543 | 543 | 543 | 543 | 543 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Digit ratio and risk taking: Evidence from a large, multi-ethnic sample**

Pablo Brañas Garza, Matteo M. Galizzi, Jeroen Nieboer

## SUPPLEMENTARY MATERIALS

**Table S1**. Risk preferences and individual characteristics: all subjects (OP)

| *RP* | *m1* | *m2* | *m3* | *m4* | *m5* |
|---|---|---|---|---|---|
| LHDR | -1.990 | -1.561 | -2.846 | -2.154 | -1.755 |
| | (1.328) | (1.348) | (2.933) | (1.347) | (1.371) |
| Female | | -0.186* | -1.825 | | -0.177 |
| | | (0.111) | (3.179) | | (0.111) |
| LHDR*Female | | | 1.702 | | |
| | | | (3.299) | | |
| Chinese | | | | -0.146 | -0.137 |
| | | | | (0.112) | (0.112) |
| S-asian | | | | 0.0204 | 0.0385 |
| | | | | (0.136) | (0.136) |
| Black | | | | 0.115 | 0.0973 |
| | | | | (0.220) | (0.225) |
| Other | | | | 0.262* | 0.265* |
| | | | | (0.144) | (0.143) |
| _cut1 | -4.373*** | -4.101*** | -5.335* | -4.564*** | -4.309*** |
| | (1.310) | (1.316) | (2.821) | (1.345) | (1.352) |
| _cut2 | -2.671** | -2.398* | -3.631 | -2.849** | -2.593* |
| | (1.293) | (1.300) | (2.818) | (1.325) | (1.333) |
| _cut3 | -2.234* | -1.961 | -3.194 | -2.409* | -2.152 |
| | (1.292) | (1.299) | (2.818) | (1.323) | (1.331) |
| _cut4 | -1.390 | -1.115 | -2.348 | -1.557 | -1.299 |
| | (1.290) | (1.297) | (2.817) | (1.321) | (1.329) |
| _cut5 | -0.896 | -0.618 | -1.851 | -1.058 | -0.798 |
| | (1.289) | (1.296) | (2.814) | (1.319) | (1.327) |
| _cut6 | -0.261 | 0.0221 | -1.211 | -0.419 | -0.154 |
| | (1.291) | (1.298) | (2.813) | (1.320) | (1.328) |
| Observations | 543 | 543 | 543 | 543 | 543 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Table S2:** Risk preferences and individual characteristics: females only (OLS)

| *RP* | *m1* | *m2* | *m3* |
|---|---|---|---|
| RHDR | -3.268 | -3.564* | -1.140 |
| | (2.041) | (2.085) | (4.256) |
| Chinese | | -0.184 | 5.484 |
| | | (0.168) | (4.984) |
| S-Asian | | -0.0209 | -2.438 |
| | | (0.212) | (6.211) |
| Black | | 0.314 | 15.77 |
| | | (0.414) | (14.28) |
| Other | | 0.234 | 2.109 |
| | | (0.232) | (8.271) |
| RHDR*Chinese | | | -5.808 |
| | | | (5.074) |
| RHDR*S-Asian | | | 2.456 |
| | | | (6.328) |
| RHDR*Black | | | -16.06 |
| | | | (14.94) |
| RHDR*Other | | | -1.918 |
| | | | (8.357) |
| Constant | 5.997*** | 6.319*** | 3.946 |
| | (2.001) | (2.060) | (4.193) |
| Observations | 412 | 412 | 412 |

Standard errors in parentheses. * $p<.10$, ** $p<.05$, *** $p<.01$

**Table S3.** Risk attitudes and individual characteristics: females only (OLS)

| *RA* | *m1* | *m2* | *m3* |
|---|---|---|---|
| RHDR | 1.966 | 1.348 | 5.531 |
| | (3.351) | (3.398) | (5.901) |
| Chinese | | -0.668** | 4.403 |
| | | (0.265) | (7.573) |
| S-Asian | | -0.0459 | 9.726 |
| | | (0.344) | (9.425) |
| Black | | -0.118 | -4.166 |
| | | (0.683) | (18.75) |
| Other | | -0.428 | 6.211 |
| | | (0.407) | (16.48) |
| RHDR*Chinese | | | -5.185 |
| | | | (7.762) |
| RHDR*S-Asian | | | -9.965 |
| | | | (9.582) |
| RHDR*Black | | | 4.307 |
| | | | (19.28) |
| RHDR*Other | | | -6.763 |
| | | | (16.72) |
| Constant | 2.624 | 3.540 | -0.557 |
| | (3.278) | (3.327) | (5.766) |
| Observations | 412 | 412 | 412 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Table S4:** Risk preferences and individual characteristics: males only (OLS)

| *RP* | *m1* | *m2* | *m3* |
|---|---|---|---|
| RHDR | -3.682 | -4.641 | -4.953 |
| | (4.426) | (4.278) | (6.629) |
| Chinese | | -0.324 | -10.27 |
| | | (0.336) | (10.21) |
| S-Asian | | 0.256 | 24.78 |
| | | (0.415) | (19.56) |
| Black | | -0.165 | 23.03 |
| | | (0.481) | (17.99) |
| Other | | 0.820** | 5.108 |
| | | (0.413) | (10.49) |
| RHDR*Chinese | | | 10.40 |
| | | | (10.77) |
| RHDR*S-Asian | | | -25.69 |
| | | | (20.29) |
| RHDR*Black | | | -24.01 |
| | | | (18.43) |
| RHDR*Other | | | -4.444 |
| | | | (11.03) |
| Constant | 6.624 | 7.538* | 7.835 |
| | (4.230) | (4.097) | (6.343) |
| Observations | 131 | 131 | 131 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Table S5:** Risk attitudes and individual characteristics: males only (OLS)

| *RA* | *m1* | *m2* | *m3* |
|---|---|---|---|
| RHDR | -5.411 | -7.753 | -9.740 |
| | (6.753) | (6.530) | (8.249) |
| Chinese | | -0.180 | -16.14 |
| | | (0.483) | (16.03) |
| S-Asian | | 0.00434 | -3.937 |
| | | (0.624) | (33.80) |
| Black | | 1.366 | -20.90 |
| | | (0.893) | (29.97) |
| Other | | 1.058 | 31.92** |
| | | (0.736) | (15.31) |
| RHDR*Chinese | | | 16.70 |
| | | | (16.79) |
| RHDR*S-Asian | | | 4.127 |
| | | | (35.49) |
| RHDR*Black | | | 23.07 |
| | | | (31.45) |
| RHDR*Other | | | -31.99** |
| | | | (15.69) |
| Constant | 10.05 | 12.12* | 14.02* |
| | (6.466) | (6.256) | (7.904) |
| Observations | 131 | 131 | 131 |

Standard errors in parentheses. * p<.10, ** p<.05, *** p<.01

**Subject consent form for Digit Ratio measurement**

Please read this consent form carefully and ask as many questions as you like before you decide whether or not you want to participate in the next measurement. Before you leave the laboratory today, we are asking everyone to take a measure called the digit ratio. This ratio is calculated by combining the length of your $2^{nd}$ and $4^{th}$ finger, and it has been shown in various scientific studies to correlate with people's behaviour in the laboratory. The most efficient and reliable way of measuring the ratio is by scanning someone's hand on a flatbed scanner.

As with all responses during our experiments, we will collect your digit ratio completely anonymously. No-one, not even the researcher in charge of the study, will be able to link your digit ratio to your identity, name, and personal information. As such, we will not be able to share your digit ratio with anyone, including you.

There are no risks to you from this research and no foreseeable direct benefits. It is hoped that the research will benefit others (or science) who wish to understand behaviour and decisions. The researcher in charge of today's study has collected digit ratio data in the LSE Behavioural Research Lab before. The image data will only be used for calculating the digit ratios, and it will be stored on an encrypted hard drive with no access to any external networks, kept in a secure storage space which will only be accessible by the researchers directly involved in this project.

If you have any questions about anything, please ask them now and/or contact the researcher in charge of the study: [contact details provided]. If you agree to provide a digit ratio measure, please continue.

*****************************************************************

**I have read and understand this consent form and I am willing to provide a digit ratio measure**

| | | |
|---|---|---|
| ______________________ | __________________________ | ___________ |
| Signature | Name (please print) | Date |