**Does IQ predict engagement with skill-based gambling? Large-scale evidence from horserace betting**

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**Keywords:** consumer decision making, gambling, horse betting, IQ, numerical IQ

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**Compliance with ethical standards**

This study has been approved by the University of Eastern Finland’s Committee on Research Ethics.

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**Abstract**

We examine how measured intelligence, referred to as IQ, predicts a consumer’s decisions on whether to participate in online horse wagering, how much to spend on those bets, and which horserace betting products to consume. We combine three individual-level archival data sets from Finland, including all online horse bets during a one-year period from the state-sanctioned monopoly operator, the Finnish Defence Forces’ IQ test scores from male conscripts born between 1962 and 1990 (N = 705,809), and administrative registry data on socioeconomic status, income, and education for these men. An analysis of male bettors (N = 15,488) shows that IQ is a positive predictor of participation and spending. In addition, high IQ is associated with choosing more complex (high variance) betting products. We find that these results are driven primarily by numerical IQ.

**Keywords:** consumer decision making, gambling, horse betting, IQ, numerical IQ

**1. INTRODUCTION**

Gambling is popular: most adults consume gambling products in frequencies comparable to going to bars and clubs (Calado & Griffiths, 2016; Conolly et al., 2018). Gambling products involve placing a stake in the hope of winning a monetary prize. However, why people decide to spend money on gambling products has been a puzzle because gambling products typically have a negative expected value. Theoretically, it is possible to account for gambling within the framework of rational choice by appealing to risk preferences (Friedman & Savage, 1948), or by admitting a utility or entertainment value to the process of gambling itself (Conlisk 1993). Intelligence contributes to a person’s ability to successfully execute rational plans in any environment (Baron, 2005), but its role in gambling-related decisions remains largely unknown. A theoretical link between a person’s intelligence and gambling might result from probability weighting (Barberis, 2012), which may be more biased for those with lower cognitive ability (Pachur et al., 2017).

Examining a potential link between intelligence and gambling is relevant because current research demonstrates that measured intelligence (IQ) correlates with consumer decision making in various real-life choices. The gist of this line of research suggests that IQ is a positive predictor of choice patterns that are beneficial to decision makers (e.g., Grinblatt et al., 2016; Aspara et al., 2017; Aspara & Wittkowski, 2019). However, survey-based studies point to an inconclusive correlation between IQ and gambling (Hodgins et al., 2012; Rai et al., 2014). Gong and Zhu (2019) show that verbal skills are negatively associated with gambling participation, whereas executive functioning correlates positively with gambling participation[[1]](#footnote-1).

We aim to fill part of the evidence gap and to add to the literature by investigating how IQ, and its subcomponents of numerical, verbal and spatial logic IQ, contribute to decisions as to whether to participate in horserace betting, how much to engage with it and which particular betting products to buy. Globally, horse wagering is a sizable component of the betting industry and is estimated to contribute more than 40% of the gross gaming revenue of the betting industry, rivalling soccer as the principal source of bookmaker winnings (Hancock, 2020).

We use a unique large-scale data set from Finland, which amalgamates data from three separate sources. The *betting data set* contains all horse race bets placed on the Finnish monopoly operator’s online platform by each bettor during a year. The *IQ data set* contains IQ test scores of conscripts of the Finnish Defence Forces. Finally, the *administrative* *registry data* set contains information on the socioeconomic background of the Finnish male population. The combined data set enables a large-scale investigation into how IQ predicts actual consumer decision making in a confined market, while at the same time controlling for individuals’ socioeconomic background.

We make several contributions to the literature. Prior research into links between cognitive ability and gambling have relied on self-reported survey evidence (e.g., Gong & Zhu, 2019). We extend these studies by providing large-scale evidence on how IQ predicts actual consumer choices in a market setting. Regarding the theory of gambling, our findings contribute to the stream of literature which attributes gambling foremost to its entertainment value (Conlisk, 1993). We also add to the literature that focuses on IQ and consumer decision making in real-world markets (Grinblatt et al., 2016; Aspara et al., 2017; Aspara & Wittkowski, 2019). Finally, our findings contribute to the literature investigating the role of numerical ability in decision making (Gerardi et al., 2013; Agarwal & Mazumder, 2013).

**2. INTELLIGENCE AND BETTING MARKETS**

**2.1 Gambling product categories**

Gambling products can be categorised as chance-based and skill-based gambling (Stevens and Young, 2010). In chance-based gambling, the outcome of a gamble is random. Thus, any attempts to influence the outcome are futile even if some players may have an illusion of control (Clark and Wohl, 2022). Examples of this product category include lotteries, roulette and slot machines, to name a few.

In skill-based gambling, knowledge or skill can be used to improve the chance of potential gains. This product category includes various betting formats (e.g., sports wagering and horse betting) and card games (e.g., poker), where experience and information could improve the player’s edge. For example, Dedonno and Detterman (2008) demonstrated that additional training can improve outcomes in poker. In the case of horseracing, many bettors acquire information on factors that may impact the outcome of a race, such as the qualities of the participating horses. Moreover, betting is a bundled good, which provides a source of enjoyment, related to the thrill of wagering and rooting for one’s choice, as well as the potential for making financial gains (Herskowitz, 2021).

**2.2 Theoretical background**

A negative expected value of gambling products can be regarded as the price of gambling (Eadington, 1999) comparable to the price of a ticket to a theatre show. Theoretically, it is possible to admit a utility value to the process of gambling itself (Conlisk 1993). This perspective sees gambling, at least in part, as an activity pursued for enjoyment rather than solely on the assessment of monetary risk and reward. Empirical studies support the view that gambling is a form of consumer activity (e.g., Humphreys et al., 2013).

There are varied non-financial motives for gambling. Gambling products provide sources of enjoyment, including learning to play, facing intellectual challenges and social dimensions of gambling (e.g., Binde, 2013). Motives appear to influence both choice of gambling product and frequency of play (Abarbanel, 2014). For example, escaping from troubles appears to be a common reason for gambling on slot machines, but gambling to enhance self-esteem is predominant among sports bettors (Fang & Mowen, 2009). For skill-based gambling, enjoyment appears to be a primary motivation for taking part (Barrada et al., 2019).

Horse wagering exhibits characteristics that make it appealing for non-financial reasons. It is a leisure activity where most bettors acknowledge that making a profit over time is unlikely (Neal, 2005). Bettors use knowledge and skills to make a careful judgment of the outcome of a horse race and even losing bets are a source of pride as opposed to winning by pure chance (Cassidy, 2014). In this respect, horse betting, along with poker, has been argued to be “the intellectual form of gambling par excellence” (Binde, 2013, p. 86). Furthermore, a desire for mood change is another motivation for horse betting, with a parallel drawn between bettors’ study of form and solving crosswords puzzles (Binde, 2013).

**2.3. Intelligence and gambling**

A theoretical link between gambling and intelligence is wanting. One such candidate is prospect theory where misperception of probabilities could explain gambling (Barberis, 2012). A relationship between gambling and intelligence might then result from an observed positive link between low cognitive ability and probability weighting (Pachur et al., 2017). More generally, lower cognitive ability predicts greater proclivity for taking on harmful risks, such as smoking cigarettes (Falk et al., 2018). Consequently, purchasing gambling products may be attributed to poor decision-taking resulting from cognitive failures and biases.

Empirical evidence on links between IQ and gambling is inconsistent. Ceci and Liker (1986) studied a highly selective group of active racetrack bettors and assessed their intelligence using the Wechsler Adult Intelligence Scale[[2]](#footnote-2). They found that IQ did not predict forecasting accuracy. Hodgins et al. (2012) used a community survey of Canadian adults, in which a person’s intelligence was assessed with vocabulary and matrix reasoning subtests of Wechsler Abbreviated Scale of Intelligence. They reported a positive link between IQ and infrequent non-problematic gambling. Rai et al. (2014) conducted a survey of English adults and assessed their IQ with the National Adult Vocabulary Test (NART). Their results did not establish correlation between IQ and gambling participation. Forrest and McHale (2018), in a longitudinal study of young people from England, found that the individual’s mathematical aptitude test score at age 15 was a strong (weak) positive predictor of regular gambling participation in both skill-based and non-skilled gambling formats at age 20 for males (females).

Gong and Zhu (2019) analysed Australian survey data which included questions on participation in each of ten gambling activities and also results from administering three tests of cognitive ability: (i) score on a version of the NART which tests the ability to pronounce correctly 25 written words; (ii) score on the Backward Digit Span test, which evaluates short-term memory; and (iii) the Symbol Digits Modalities Test, a general test for executive function. They found that score on the reading test was a negative predictor of participation in gambling whereas score on executive function (which they regarded as capturing innate ability that could not be learned from experience) was a positive predictor. Moreover, none of the three ability measures was associated with preference for skill-based gambling over games of pure chance.

**2.4 IQ and choice of betting products**

The cognitive demands of skill-based gambling could relate to the potential role of a person’s intelligence in gambling-related decisions. Wagering is a complex task: the decision maker must focus on relevant pieces of information, place appropriate weights on these pieces, and form an overall judgment based on this information (Campbell, 1988). Similarly, horse betting involves complex decisions (Ceci & Liker, 1986).

In horse wagering, betting formats vary in their complexity. A bet may require only that the winner of a race is chosen correctly, but other formats challenge the player with harder tasks such as to forecast both the winner and the second-placed horse (in correct order) in a race or to pick the winner of each of several consecutive races. Even within one race, both the number of alternatives and the number of attributes associated with each alternative add to the task complexity faced by the bettor (Johnson & Bruce, 1997, 1998).

The role of intelligence in the individual’s choice between gambling products is not understood. A study of Finnish young adults (aged between 18 and 29) by Latvala et al. (2018) suggested that a low grade point average (GPA) at the end of compulsory schooling was associated with playing lottery-type games. Thus, at least among young adults, poor academic skills predict engagement with games of pure chance rather than with skill-based gambling.

The relationship between intelligence and gambling product choice could also relate to product pricing. Field studies suggest that IQ is linked with price-consciousness in various markets. High-IQ individuals pay lower management fees for their mutual fund holdings (Grinblatt et al., 2016), are more likely to take advantage of favourable tax treatment on some product classes when purchasing cars (Aspara et al., 2017), and manage consumer debt cost-efficiently (Agarwal and Mazumder, 2013). Since gambling operators levy a higher take-out rate on volatile gambling products (Eadington, 1999), complex gambling formats are more expensive than simple ones. Therefore, it is possible that among horse bettors, those with higher IQ exhibit a relative preference for betting formats with a low take-out rate (a low price).

An alternative view could be that characteristics of horse betting products provide value to high-IQ customers. Psychological literature suggests that task complexity may appeal more to individuals with higher cognitive skills (e.g., Cacioppo & Petty, 1981). In financial markets, IQ is positively associated with a willingness to purchase investment products requiring a higher level of information processing skills (Christelis et al., 2010). Similarly, complex betting formats may be intellectually appealing because one can demonstrate mastery by winning from others in the betting pool (Binde, 2013). Observing behaviour and seeking out views at a betting parlour over a lengthy period, Rosecrance (1986) reported that most regular horse bettors perceived betting as a meaningful activity and a race as an ordered event capable of being understood by proper analysis. Hence, high-IQ individuals could prefer the intellectual challenge of complex betting formats despite their higher price.

**3. MATERIALS AND METHODS**

**3.1. Betting data**

In Finland, legal gambling is organized in a monopolistic market. Several offline and online gambling opportunities, such as casino games, lotteries, slot machines, and sports wagering, are widely accessible to adult Finns (Tammi et al., 2015). At the time of this study, the betting operator, Fintoto Ltd, had a state-sanctioned monopoly for offline and online horserace betting in Finland (since 2017, Fintoto has been a part of, the government-owned gambling monopoly for all legal gambling in Finland, Veikkaus Ltd). The organizing principle follows the pari-mutuel (or tote) model, which has been widely adopted for horse wagering, for example in France, Japan, and the USA. In pari-mutuel betting, the operator collects all bets placed in the pool and redistributes them to the winning bettors, excluding the take-out rate (which is a fixed fraction of the pool that covers the operator’s expenses and profit). The take-out rate may be regarded as the price of gambling in pari-mutuel betting.

The betting data contain information on betting by every individual (N = 47,324, 75.5% were male) who placed a bet on the operator’s online platform between September 1, 2015 and August 31, 2016. At the time of the study, only horse betting products could be purchased on the platform. The data include summarised information of the bettor’s transactions over the one-year window, including total stakes, overall loss (or win) and how these broke down by betting format. See Online Appendix A for more information on the betting environment.

The data include full information on all fifteen horserace betting formats available in Finland, which vary in their complexity. ‘Easy’ products involve predicting outcomes in a single race. ‘Medium’ products concern predicting two to three outcomes in a single race or in two consecutive races. In ‘Hard’ products, the bettor predicts the winners of multiple consecutive races. Betting formats also differ in take-out rates. Generally, complex betting formats have the highest take-out rates, which means that the betting company charges a higher price for difficult betting products. The betting formats are described in Online Appendix A.

**3.2. Administrative registry data**

We draw individual-level socioeconomic data from the national FOLK database for 2015. The data cover the entire Finnish population between ages 15 and 70 (4.41 million). The data are gathered by Statistics Finland from administrative registers.

**3.3. IQ Data from Finnish Defence Forces**

In Finland, military service is compulsory for males and voluntary for females. Conscripts are predominantly male (2% female volunteers). Most conscripts carry out their service at the age of 19 or 20, usually after completion of secondary education. In our sample, approximately 70% of men have undertaken military service, with the remaining 30% consisting of men who have either opted for a non-military (civilian) service or have been exempted from military service due to medical reasons. Online Appendix B provides further statistics on differences between the two groups.

The Finnish Defence Forces (FDF) administer a mandatory IQ test to all conscripts in standardised group-administered conditions in all FDF units. The test contains subtests for numerical, verbal and spatial logic reasoning. Each subtest has 40 multiple-choice questions (the number of correct answers lies between 0 and 40).

Our data contain all individuals who took their military service between 1982 and 2010. During this period, the test has remained unchanged. The FDF IQ data cover a large proportion (71%) of Finnish men born between 1962 and 1990. The FDF data record the date when a conscript took the IQ test and the number of correct answers in each subtest for each individual. We refer to the numerical ability test score as the “numerical IQ”, the verbal ability test score as the “verbal IQ”, and the spatial logic ability test score as the “spatial logic IQ”. Further, “composite IQ” refers to the arithmetic mean of these subtests for each individual. The raw test scores were normalised by the test year (M = 0.00, SD = 1.00) to remove any influence from possible secular trends in IQ (e.g., the Flynn Effect). We also estimated the models without normalising the test scores by the test year. The results were qualitatively similar to the ones obtained with yearly normalised scores. Online Appendix C includes more details about the tests.

Subcomponents of IQ are correlated with each other. In our data, the correlation coefficient is 0.70 between numerical and verbal IQ, 0.64 between numerical and spatial logic IQ, and 0.59 between spatial logic and verbal IQ. Since these high correlations limit their simultaneous use, we follow Aspara et al. (2017) and Aspara & Wittkowski (2019), who also use the FDF IQ data, and report estimates for models that include IQ variables separately in baseline results. Models that include all subcomponent IQ variables simultaneously are reported as additional analyses.

**3.4. Combined data set**

Statistics Finland combined the three data sets described above using individuals’ encrypted social security numbers to preserve anonymity of individuals in the final data set. Table 1 illustrates how the final sample was formed. The two panels on the left describe the sample formation from the FOLK database, which contained 4,414,248 Finnish citizens in the age bracket 15 to 70 years old in 2015. Since the legal age of gambling is 18, our initial sample consists of Finnish citizens between 18 and 70 years old (N = 3,738,083), of whom 1,917,217 were male. Since we use the FDF IQ test scores for males born between 1962 and 1990, the FOLK data set has information on 992,636 males in the age cohort. Of these 705,089 undertook military service and thus took the FDF IQ test. This is the sample of *potential male bettors* (between the ages of 25 and 53) used in the analysis of how IQ predicts participation in online horse wagering.

The two panels on the right show the betting market data set. The initial sample consists of all bettors who placed at least one bet during the observation period (N= 47,324). There were 45,090 bettors in the 18-70 age bracket. Of these, 33,918 were male (approximately 75%). The number of bettors corresponding to the age cohort born between 1962 and 1990 was 20,984. Of these, 15,488 had undertaken military service and thus, a record of their IQ test score was available. This is the sample used in examining how IQ predicts consumption and choice of betting products.

[TABLE 1.Sample formation.]

**3.5. Methodology for participation and spending models**

We examine how IQ predicts the probability that an individual participates in online horserace betting and how much he wagers or loses (alternative measures of consumption) if he chooses to do so. As with other gambling products (e.g., Humphreys et al., 2010), it is plausible that two distinct mechanisms drive consumer decision making concerning consumption of horse betting products. The first mechanism relates to the consumer’s decision on *whether* to participate in horse wagering activity. The second mechanism relates to the consumer’s decision on *how much* to spend conditional on a positive participation decision. In our case, it follows from the first decision that a large majority of the population observed are non-participants. Consequently, the consumption data is zero-inflated, which characterizes many consumer goods, such as alcohol, tobacco and cinema attendance (e.g., Ateca-Amestoy, 2008; Madden, 2008).

Where there is a heavy cluster of zeros in a dependent variable of interest, the principal modelling candidates include the two-part model (TPM), the Tobit model, and the Heckman self-selection model (see e.g., Cameron & Trivedi, 2019). In our context, the Tobit model and the Heckman self-selection are unappealing on both theoretical and empirical grounds. First, the Tobit is a single equation model. While it is possible to extract separate predictions for participation and consumption from estimating the single equation, the cost of such a model is that it forces both participation and consumption to be determined by the same mechanism. Second, despite the similarities of the TPM and Heckman selection model, they should not be interpreted as equivalent models if there is no self-selection linked to non-observable characteristics of individuals (Belotti et al., 2015). More importantly, the Heckman self-selection would be intended to estimate *potential* consumption, which is inappropriate in our context because we are interested in *actual* spending[[3]](#footnote-3). In addition, the Heckman model (or Tobit) treats zeros as censored values of positive outcomes, whereas the TPM regards them as ‘true’ zeros (Belotti et al., 2015), which means that sample selection is not an issue as long as zero expenditures do not result from missing data (Dow & Norton, 2003).

We believe that this is the case in our data. Our observation period is long and abstention from any betting activity at all for a year could plausibly be interpreted as an actual choice not to gamble for preference or other reasons. Further, it is highly unlikely that a budget constraint limits horserace betting: the minimum bet size is €0.05. These arguments suggest that the decision to wager on horses is a conscious choice and that individuals with unobserved consumption are not potential consumers.

Participation in the first equation of TPM, estimated with probit regression, is unambiguously defined: an individual is a bettor if he has engaged in any online horse betting activity during the one-year period. The second equation, estimated with ordinary least squares (OLS) regression, models the level of consumption in horse wagering during the year.

We use two measures of consumption. Total net spending (i.e., the amount lost), defined as total losses minus total gains, is an analogue to consumer spending on other products or services. However, since some bettors made a profit over the year, the unappealing concept of a negative expenditure on betting emerges. Consequently, we use total stakes as a measure for a general preference for betting activity because it also accounts for possible re-investment of wins[[4]](#footnote-4). Both measures are non-normal. Hence, we use the natural logarithm of total stakes in our analyses. As total spending has negative values, log-transformation is unavailable to reduce the variable’s skewness. Therefore, we winsorise the variable with a 1% threshold in recognition that a small number of bettors made significant profits (typically from a win on a lottery-type product).

All regression models use the same set of control variables[[5]](#footnote-5). Following research on IQ and consumer behaviour (e.g., Aspara et al., 2017) and gambling studies (e.g., Rude et al., 2014), we use information on individuals’ age, native tongue, place of residence, education, labour market status, disposable income[[6]](#footnote-6), number of children, family type and whether they pay the non-mandatory Church tax as control variables in our empirical models[[7]](#footnote-7).

**3.6. Methodology for betting product choice models**

Our data set documents choices made by a very large number of bettors in a naturalistic setting and therefore enables us to test how IQ predicts a person’s choice of horse betting format. Our data contain complete information on all fifteen horse wagering products available in Finland, which vary in their complexity and take-out rates (the price of betting). For example, a *Win* bet requires the choice of only one horse in one race. In contrast, a *T5* bet involves the task of picking a winner in each of five consecutive races. Because the range of possible outcomes is large, these are complex betting formats (Johnson & Bruce, 1997). Potential payouts tend to be higher for complex betting formats. The most complex products (e.g., *Pick 86*) typically have main prizes of more than €10,000 and even a million euros or more.

We categorise the betting formats based on their complexity and take-out rate. The betting formats in which the bettor predicts how a single horse finishes a race (i.e., *Win*, *Place* and *Each Way)* are defined as *Easy* betting products, and they have a 15% take-out rate. *Medium* betting productsconcern predicting two to three outcomes in a single race or in two consecutive races (*Quinella, Trifecta, Duo, Exacta and Swinger*) and have take-out rates of more than 15% but less than 35%. The products in which the bettor picks the winners in multiple consecutive races are defined as *Hard* betting products (*Pick 4*, *Pick 5*, *Pick 64,* *Pick 65*, *Pick 75,* *Pick 76* and *Pick 86*). The take-out rates of *Hard* betting products are all 35%. This categorization is congruent with the gambling operator imposing a higher take-out rate on volatile betting products (Eadington, 1999). In our data, the operator’s mean take-out rate, aggregated from different betting formats, is 23%. However, each player has his own take-out rate, depending on how much he spends on different betting formats.

We examine how IQ predicts the choice of betting format using a fractional multinomial logit model (Buis, 2017). The dependent variable includes proportions of betting volumes in the three betting format categories (*Easy*, *Medium* and *Hard*) for each bettor.

**4. RESULTS**

**4.1. Descriptive statistics**

Table 2 reports descriptive statistics for the independent variables used in all regression models and the focus variables used in the participation and consumption models. During our observation period, the mean (median) value of total stakes (by an individual bettor) was approximately €4,000 (€231). Mean (median) net spending was €757 (€79), with gains exceeding losses (i.e., net spending was negative) for 9% of bettors. Compared to the average male in our sample, the average bettor has a higher composite and numerical IQ score. Online Appendix D provides more details on variables.

[TABLE 2.Summary statistics of dependent and independent variables.]

Figure 1 illustrates how the measures of IQ correlate with the probability of being a bettor using raw data. The points in the plots show the proportion of individuals in each IQ decile who participated in online horse betting at least once during the observation period. Composite IQ indicates a positive but low correlation between IQ and the propensity to be a horse bettor. The plots of the subcomponents of IQ suggest that numerical IQ and spatial logic IQ are respectively positive and negative predictors of participation in horse betting. However, verbal IQ is uncorrelated with betting participation.

[FIGURE 1. IQ and betting participation.]

Descriptive statistics presented in Table 3 show bettors’ relative preferences for different betting products, which are used as the dependent variable in betting format choice models. They indicate that horserace bettors prefer complex betting products. The most popular category is *Hard* games, which receives 42% of total stakes, followed by the *Medium* complexity products with a 39% share of total stakes. The *Easy* betting products are the least wagered games with a 19% share.

[TABLE 3. Descriptive statistics for betting format choice.]

**4.2. Results for participation models**

As the first part of the TPM, we estimate four probit models in which we estimate how a person’s IQ predicts the probability of being a bettor. In Table 4, we report separate estimations for composite, spatial logic, verbal and numerical IQ. The first column shows estimated marginal effects for composite IQ. The marginal effect of composite IQ ( = 0.0036) implies that a one standard deviation increase from the mean increases the individual’s predicted probability of participation by 0.4 percentage points.

Table 4 also reports the results for participation models in which we analyse each subcomponent of IQ separately. The estimate for numerical IQ ( = 0.0077) suggests that it drives the positive correlation between composite IQ and betting participation. Although verbal IQ is also positive ( = 0.0016), its magnitude is only one-fifth of that of numerical IQ. Further, the effect size of numerical IQ is relatively high when compared with the effect size of composite IQ. On average, a one standard deviation increase from the mean in numerical IQ increases the predicted probability of participating in online horse betting by 0.8 percentage points. The population participation rate was 2.2% and so a one standard deviation increase in numerical IQ, relative to mean, is associated with an increase of nearly one-third in the probability that an individual wagers on a horse race.

Among the control variables, age is entered as a quadratic function with the estimated coefficient on age positive and that on age-squared as negative. The turning-point lies beyond the age range represented in the data and thus the result shows that the probability of participation increases with age but at a decreasing rate, but with no evidence that it begins to fall at any observed level of age. Blue-collar workers are more likely to be online horse bettors than white-collar workers. Participation also increases with income but the probability of participation is negatively correlated with the level of education. Those living with a partner are more likely to participate in online horserace betting compared with those living singly but having two or more children is a negative predictor. A rural resident is more likely to participate than an urban resident, which may reflect the rural roots of horseracing. Swedish-speakers are less likely than the rest of the population to engage whereas opting in to the church tax is a positive marker for online horse betting. All these conclusions stand regardless of which IQ measure is included in the specification.

[TABLE 4. Probit regression results of betting participation models.]

**4.3. Results for consumption models**

The second part of the TPM examines the consumption level of horse betting conditional on participation, defined either as total stakes or net spending over the data period. Models include either composite IQ or one of the separate subcomponents of IQ, resulting in eight consumption models. While the R2 in our regression estimates are low, this is very common where data are cross-sectional and it implies that there is a lot of noise in the data, reflecting idiosyncratic differences in behavior between individuals.

The left-most columns of Table 5 report the results for models where composite IQ is the focus regressor. Composite IQ predicts a higher level of consumption ( = 0.191 for total stakes and  = 116.10, for net spending). In quantitative terms, increasing the value of composite IQ by one standard deviation from the mean raises predicted net spending by €116, all other things equal. Similarly, in terms of total stakes, a one standard deviation increase from the mean in composite IQ raise the predicted total stakes by 21%, which implies an €836 increase in the amount staked[[8]](#footnote-8).

[TABLE 5. OLS Regression results of consumption models.]

Table 5 also reports other consumption models in which subcomponents of IQ are estimated separately. Numerical IQ is a strong positive predictor of total stakes ( = 0.395) and net spending ( = 201.60). On average, increasing the value of the numerical IQ score by one standard deviation from the mean, *ceteris paribus*, increases expected total stakes (net spending) by 48% (27%), which is equal to approximately €1,928 (€202). Verbal IQ is also positively associated with total stakes ( = 0.085) and net spending ( = 52.60), but the magnitude of the effect is marginal in each case.

One justification for our using the TPM was that it allows covariates to be shown to influence participation and level of consumption in different ways and even in opposite directions. Results for control variables illustrate the importance of employing separate models for participation and level of consumption conditional on participation. For example, living with a partner was a positive predictor for participation in online horse betting but, among such bettors, the depth of financial involvement is lower for the married/ cohabiting group whether it is measured by total stakes or net spending over the year. Residents of urban areas were less likely to participate than those with rural addresses but, if they did so, they tended to spend more. Level of education is no longer significant except for a tendency for those with the very lowest level to spend modestly more. As in the participation results, level of consumption tends to increase with age but in this case it turns down after around age 50. Income though remains unambiguously a positive predictor. Given that both stakes and disposable income are in log values, the coefficient estimate implies an income elasticity of about +0.10, which is to say that a 10% increase in disposable income predicts that total staked will increase by only about 1%, all things being equal. This implies that, as is typically found in gambling studies (for example, Roukka & Salonen, 2019), higher income participants tend to spend more in absolute terms but less as a proportion of income (see also Forrest et al. (2022) for a more nuanced analysis of the income elasticity of horse bettors).

**4.4 Results for betting product choice models**

Table 6 shows marginal effects from estimation of a fractional multinomial logit model on shares of a bettor’s stakes accounted for by each category of bet. The results indicate that a one standard deviation increase in composite IQ ( = -0.015 for Easy and = 0.016 for Hard) predicts a 1.6 percentage point increase in the share of Hard betting formats at the expense of Easy products (a decrease of 1.5 percentage point). Regarding subcomponents of IQ, numerical ( = -0.027 for Easy, = 0.008 for Medium, and = 0.020 for Hard) and verbal IQ ( = -0.011 for Medium and = 0.016 for Hard) predict preferences for harder formats. Effects are greatest for numerical IQ where a one standard deviation increase is predicted to lower the share of Easy games by 2.7 percentage points, with most of the slack being taken up by the hardest category (+1.6 percentage points).

[TABLE 6. Fractional multinomial logit regression results of preference models.]

Estimated coefficients on the control variables provide socio-economic profiles for bettors’ preferences concerning horse betting products. First, a curious pattern concerning education emerges: highly educated bettors (college degree, post-graduate degree) are more likely to spend their highest amount on either *Easy* or *Hard* betting formats, whereas those with a basic education exhibit a preference for the *Medium* category games. Second, higher income makes it significantly more likely that the largest share of expenditure will be on *Medium* category games. Third, married men are more likely than single men to favour *Easy* games and less likely to favour *Hard* games. Finally, urban gamblers appear more likely than non-urban bettors to prefer complex betting products.

**5. ROBUSTNESS CHECKS**

We conducted three robustness checks (See Online Appendix E). First, we examined active bettors to ensure that casual bettors (14% of bettors wagered only once during the observation period) are not driving our results. Second, we also estimated the empirical models with all subcomponents of IQ admitted to a single model. Finally, we estimated the betting participation models with quadratic terms for IQ included to assess whether IQ has a nonlinear association with betting engagement. In all additional analyses, the results were qualitatively similar to the baseline results.

**6. CONCLUSION**

**6.1 Discussion**

This paper demonstrates that IQ, and especially its numerical ability subcomponent, is positively associated with an individual’s decisions relating to participation in and expenditure on horse betting, and with a relative preference for complex betting formats. It is plausible that intelligent persons and those with numerical ability gain satisfaction from absorbing themselves in tasks involving “crunching numbers”, such as horse wagering. Consequently, our study provides empirical support for treating decisions on gambling as aspects of consumer behaviour (Conlisk, 1993), at least in the case of skill-based gambling, as opposed to the proposition that gambling stems from behavioural biases (Barberis, 2012).

Consistent with Forrest and McHale (2018), our analyses suggest that IQ, and particularly numerical IQ, predicts participation in horse wagering. To some extent, this result is also congruent with Grinblatt et al. (2011) who find that IQ is positively correlated with an individual’s decision to invest in the stock market, because skill-based forms of gambling and stock markets tend to attract similar individuals in terms of motivation and personality attributes (Arthur et al., 2016). As high-IQ men tend to spend more on horse betting products than low-IQ men do, our findings may also reflect the intellectual challenge quality of horse betting, as suggested by Binde (2013).

On the other hand, our results appear to be at odds with Gong and Zhu (2019), as none of their three measures of cognitive ability were significant predictors of which gamblers choose to engage in skill-and-chance games (as opposed to pure chance games, defined by them as comprising bingo, scratchcards, lottery and keno). However, their list of skill-and-chance products included slot machines. Slot machines typically offer games where the outcome is random and tends to be generally regarded as a chance-based game (Stevens & Young, 2010). Furthermore, their data was a self-reported survey. Consequently, these aspects warrant caution when our results are compared with those presented in Gong and Zhu (2019).

Consistent with the hypothesis that a motivation for betting is the intellectual challenge (Johnson and Bruce, 1997, 1998; Binde, 2013), our results suggest that individuals seek to match their betting choice to their own level of IQ. Since high-IQ individuals appear to respond more to price (Grinblatt et al., 2016), it is fair to assume that these individuals in our context are likely to be aware of the lower take-out on easy products and in any case the different levels of take-out are clearly signaled by the operator. In particular, this result suggests that high numerical IQ consumers enjoy the intellectual challenge provided by complex betting formats and are willing to pay a greater take-out to play them. Consequently, their stronger preference for complex bets could reflect a genuine preference, which is consistent with intelligent persons exhibiting preference for performing challenging tasks (Cacioppo & Petty, 1981).

It is also possible to define the take-out rate as one of several ‘structural characteristics’ which distinguish different gambling products from each other (Newall et al., 2021). When viewed purely through the lens of expected value, complex betting formats might appear as less attractive than simple ones (Newall et al., 2021), particularly for those bettors with a high numerical ability. In our approach, however, take-out is not regarded as a structural characteristic of the product, because it is not inherent to the product, but rather is a price chosen by the supplier in response to the nature of demand. In our findings, bettors with higher cognitive skills choose to purchase more complex products *despite* their high take-out rate. This implies that degree of complexity is the ‘structural characteristic’ and it is one for which they are willing to pay a higher price.

The administrative registry data facilitated the inclusion of controls reflecting demographic and socio-economic status, which allowed us to draw conclusions about horse betting. For example, spending tends to increase with income, but slowly. This mirrors previous findings for gambling spend in general (Rude et al., 2014) and for lottery games (Combs & Spry, 2019) and implies that lower income individuals tend to allocate a higher *share* of their income to gambling (Castrén et al., 2018). Regarding age, engagement with horse betting appears to peak in middle-age, again similar to findings about participation in gambling generally (Welte et al., 2011). But whether the relatively greater engagement with horse betting in Finland among the middle-aged represents a cohort effect or a generational effect cannot be inferred from one year of data.

**6.2. Limitations and Future Research**

This paper has some limitations. Foremost, our data set includes only data on horse betting. Hence, our results may not generalise to other forms of gambling, most notably chance-based gambling. Further, we are unable to analyse propensities to problem gambling. Although some studies suggest that low IQ correlates with problem gambling (e.g., Hodgins et al., 2012; Rai et al., 2014), other factors which we could not observe are also likely to be relevant. For example, Parker et al. (2008) highlighted the role of emotional intelligence as a protective factor against the risk of developing problems.

The FDF data set also has some limitations. First, individuals have different incentives to effort when completing the test, which may bias IQ test scores. That is, if a conscript wishes to avoid training for a non-commissioned officer, which is more likely if he or she performs well in the IQ test, he or she may purposely underperform in the test. In addition, our measures of IQ may not be directly comparable to other studies, as IQ or cognitive ability is often operationalized in very different ways, depending on a study and its context. Second, some males are exempt from military service and some opt for non-military service instead. Third, the sample excludes the female population. Fourth, IQ scores were measured between 6 and 34 years prior to the betting transactions recorded in the study. To the extent that IQ can change over an adult’s lifetime, this introduces measurement error into the analysis. Finally, the data are from a limited time interval and from a single country.

Our results open avenues for future studies. Rather than examining only a general measure of IQ, future studies should examine how the separate subcomponents of IQ predict consumer decision-making. Intelligence and numerical ability could be instrumental in decisions relating to consumption, investment, and life outcomes in general. Future studies could also yield insight into theories of risk-taking behaviour by addressing correlations between IQ and a person’s risk preferences.

**6.3. Concluding remarks**

This paper demonstrates that a person’s IQ predicts his engagement with horse betting. Our results show that IQ, and especially its numerical ability subcomponent, is positively correlated with participation in and expenditure on horse betting, and a relative preference for complex betting formats. These findings are consistent with skill-based gambling, or at least horse betting, being consumption of entertainment, which intelligent individuals enjoy. Thus, it is plausible that intelligent persons and those with numerical ability gain satisfaction from absorbing themselves in tasks involving “crunching numbers”, such as horse wagering.

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**TABLES**

Table 1. Sample formation.

|  |  |  |  |
| --- | --- | --- | --- |
| FOLK sample | N | Betting market sample | N |
| Finnish citizens between 15 and 70 years old | 4,414,248 | Number of bettors (over 18 years old) | 47,324 |
| Finnish citizens between 18 and 70 years old | 3,738,083 | Number of bettors between 18 and 70 years old | 45,090 |
| Males between 18 and 70 years old | 1,917,217 | Male bettors between 18 and 70 years old | 33,918 |
| Males born between 1962 and 1990 | 992,636 | Male bettors born between 1962 and 1990 | 20,984 |
| Males born between 1962 and 1990 who have undertaken military service | 705,089 | Male bettors born between 1962-1990 who have undertaken military service | 15,488 |

Table 2.Summary statistics of dependent and independent variables.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Dependent variables | | | | | | |
|  | N | Mean | SD | Median | 10th pctl | 90th pctl |
| Participant | 705,089 | 0.02 | 0.15 | 0 | 0 | 0 |
| Total\_stakes (€) | 15,488 | 3,980.56 | 25,888.60 | 230.85 | 13.60 | 7,702.55 |
| Net:spending (€) | 15,488 | 757.36 | 2004.21 | 78.90 | 0.60 | 2,153.65 |
| Independent variables | | | | | | |
|  | All males (N=705,089) | | | Male bettors (N=15,488) | | |
|  | Mean | SD | Median | Mean | SD | Median |
| Focus variables: | | | | | | |
| Composite\_IQ | 0.00 | 1.00 | 0.06 | 0.05 | 0.96 | 0.10 |
| Spatial\_logic\_IQ | 0.00 | 1.00 | 0.10 | -0.06 | 0.96 | 0.05 |
| Verbal\_IQ | 0.00 | 1.00 | 0.01 | 0.00 | 0.95 | 0.01 |
| Numerical\_IQ | 0.00 | 1.00 | 0.04 | 0.21 | 0.99 | 0.24 |
| Control variables | | | | | | |
| Blue-collar | 0.30 | 0.46 | 0 | 0.35 | 0.48 | 0 |
| White-collar | 0.38 | 0.49 | 0 | 0.34 | 0.47 | 0 |
| Basic education | 0.12 | 0.32 | 0 | 0.14 | 0.35 | 0 |
| College | 0.23 | 0.42 | 0 | 0.22 | 0.42 | 0 |
| Post-graduate | 0.13 | 0.33 | 0 | 0.08 | 0.26 | 0 |
| Has\_one\_child | 0.19 | 0.39 | 0 | 0.20 | 0.40 | 0 |
| Has\_two\_or\_more children | 0.38 | 0.48 | 0 | 0.35 | 0.48 | 0 |
| Married\_or\_cohabiting | 0.68 | 0.47 | 1 | 0.69 | 0.46 | 1 |
| Divorced\_or\_widowed | 0.13 | 0.34 | 0 | 0.12 | 0.33 | 0 |
| Age | 39.94 | 8.46 | 40 | 40.95 | 8.06 | 42 |
| Pays\_the\_church\_tax | 0.65 | 0.48 | 1 | 0.67 | 0.47 | 1 |
| Disposable\_income (€) | 31,743 | 82,588 | 28,076 | 31,197 | 42,394 | 28,143 |
| Urban\_residence | 0.87 | 0.33 | 1 | 0.86 | 0.35 | 1 |
| Swedish-speaker | 0.04 | 0.20 | 0 | 0.01 | 0.12 | 0 |

Table 3. Descriptive statistics of betting format choice.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Proportion of the bettor’s total stakes in a betting format | | | | | |
|  | Mean | SD | Median | 10th pctl | 90th pctl |
| Easy | 0.196 | 0.289 | 0.046 | 0.000 | 0.706 |
| Medium | 0.387 | 0.322 | 0.334 | 0.000 | 0.888 |
| Hard | 0.416 | 0.353 | 0.367 | 0.000 | 0.966 |

Table 4. Probit regression results of betting participation models.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent variable | Participant | | | |
|  | Marginal effect | Marginal effect | Marginal effect | Marginal effect |
|  |  | Focus Variable |  |  |
| Composite\_IQ | 0.0036\*\*\* | - | - | - |
|  | (0.0002) |  |  |  |
| Spatial\_logic\_IQ | - | -0.0003 | - | - |
|  |  | (0.0002) |  |  |
| Verbal\_IQ | - | - | 0.0016\*\*\* | - |
|  |  |  | (0.0002) |  |
| Numerical\_IQ | - | - | - | 0.0077\*\*\* |
|  |  |  |  | (0.0002) |
| Control variables | | | | |
| Age | 0.0035\*\*\*  (0.0002) | 0.0032\*\*\*  (0.0002) | 0.0033\*\*\*  (0.0002) | 0.0037\*\*\*  (0.0002) |
| Age2 | -4.0×10-5\*\*\*  (3.0×10-6) | -3.6×10-5\*\*\*  (3.0×10-6) | -3.8×10-5\*\*\*  (3.0×10-6) | -4.3×10-5\*\*\*  (3.0×10-6) |
| Blue-collar | 0.0026\*\*\*  (0.0005) | 0.0022\*\*\*  (0.0005) | 0.0024\*\*\*  (0.0005) | 0.0032\*\*\*  (0.0005) |
| White-collar | -0.0017\*\*\*  (0.0005) | -0.0008  (0.0005) | -0.0012\*\*  (0.0005) | -0.0024\*\*\*  (0.0005) |
| Basic\_education | 0.0039\*\*\*  (0.0005) | 0.0024\*\*\*  (0.0005) | 0.0031\*\*\*  (0.0006) | 0.0053\*\*\*  (0.0005) |
| College | -0.0027\*\*\*  (0.0005) | -0.0010\*\*  (0.0005) | -0.0017\*\*\*  (0.0005) | -0.0044\*\*\*  (0.0005) |
| Post-graduate | -0.0146\*\*\*  (0.0007) | -0.0112\*\*\*  (0.0007) | -0.0128\*\*\*  (0.0007) | -0.0182\*\*\*  (0.0007) |
| Pays\_the\_church\_tax | 0.0033\*\*\*  (0.0004) | 0.0027\*\*\*  (0.0004) | 0.0029\*\*\*  (0.0004) | 0.0037\*\*\*  (0.0004) |
| Ln(Disposable\_income) | 0.0009\*\*\*  (0.0002) | 0.0010\*\*\*  (0.0002) | 0.0009\*\*\*  (0.0002) | 0.0007\*\*\*  (0.0002) |
| Has\_one\_child | -0.0004  (0.0005) | -0.0005  (0.0005) | -0.0005  (0.0005) | -0.0005  (0.0005) |
| Has\_two\_or\_more\_children | -0.0043\*\*\*  (0.0005) | -0.0043\*\*\*  (0.0005) | -0.0043\*\*\*  (0.0005) | -0.0044\*\*\*  (0.0005) |
| Married\_or\_cohabiting | 0.0015\*\*\*  (0.0005) | 0.0016\*\*\*  (0.0005) | 0.0016\*\*\*  (0.0005) | 0.0016\*\*\*  (0.0005) |
| Divorced\_or\_widowed | 0.0003  (0.0007) | 0.0002  (0.0007) | 0.0003  (0.0007) | 0.0004  (0.0007) |
| Urban\_residence | -0.0026\*\*\*  (0.0005) | -0.0020\*\*\*  (0.0005) | -0.0022\*\*\*  (0.0005) | -0.0032\*\*\*  (0.0005) |
| Swedish-speaker | -0.0219\*\*\*  (0.0013) | -0.0237\*\*\*  (0.0013) | -0.0224\*\*\*  (0.0013) | -0.0210\*\*\*  (0.0013) |
| Pseudo R2 | 0.0124 | 0.0103 | 0.0107 | 0.0206 |
| Notes: N = 705,809. The reference categories are not employed, secondary education, no children, single, first language not Swedish. The table presents average marginal effects from probit models. A marginal effect is calculated for each individual at the covariate values for that individual and these marginal effects are then averaged over all individuals. Standard errors in parentheses.  Statistical significance: \*\*\*Significant at 1%, \*\*Significant at 5%, \*Significant at 10%. | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Dependent variable | Total\_stakes | Net\_spending | Total\_stakes | Net\_spending | Total\_stakes | Net\_spending | Total\_stakes | Net\_spending |
|  | Focus variables | | | | | | | |
| Composite\_IQ | 0.191\*\*\* | 116.10\*\* | - | - | - | - | - | - |
|  | (0.023) | (18.59) |  |  |  |  |  |  |
| Spatial\_logic\_IQ | - | - | -0.020 | 24.94 | - | - | - | - |
|  |  |  | (0.022) | (17.56) |  |  |  |  |
| Verbal\_IQ | - | - | - | - | 0.085\*\*\* | 52.60\*\*\* | - | - |
|  |  |  |  |  | (0.023) | (18.51) |  |  |
| Numerical\_IQ | - | - | - | - | - | - | 0.395\*\*\* | 201.60\*\*\* |
|  |  |  |  |  |  |  | (0.022) | (17.60) |
|  | Control variables | | | | | | | |
| Age | 0.166\*\*\*  (0.0269) | 106.90\*\*\*  (21.89) | 0.156\*\*\*  (0.0270) | 102.20\*\*\*  (21.91) | 0.163\*\*\*  (0.0270) | 104.80\*\*\*  (21.93) | 0.167\*\*\*  (0.0267) | 106.40\*\*\*  (21.82) |
| Age2 | -0.002\*\*\*  (3.4×10-4) | -1.108\*\*\*  (0.27) | -0.001\*\*\*  (3.4×10-4) | -1.042\*\*\*  (0.27) | -0.002\*\*\*  (3.4×10-4) | -1.076\*\*\*  (0.27) | -0.002\*\*\*  (3.3×10-4) | -1.107\*\*\*  (0.27) |
| Blue-collar | -0.0531  (0.051) | -121.10\*\*\*  (40.99) | -0.065  (0.051) | -127.70\*\*\*  (41.02) | -0.061  (0.051) | -125.54\*\*\*  (41.02) | -0.028  (0.050) | -109.40\*\*\*  (40.88) |
| White-collar | -0.146\*\*\*  (0.055) | -58.80  (44.88) | -0.099\*  (0.055) | -36.34  (44.83) | -0.120\*\*  (0.055) | -43.47  (44.90) | -0.187\*\*\*  (0.055) | -75.56\*  (44.70) |
| Basic\_education | 0.130\*\*  (0.060) | 113.80\*\*  (48.77) | 0.059  (0.060) | 80.62\*  (48.65) | 0.092  (0.060) | 90.61  (48.76) | 0.186\*\*\*  (0.059) | 136.00\*\*\*  (48.51) |
| College | 0.043  (0.056) | -11.22  (45.15) | 0.128\*\*  (0.055) | 29.73  (44.85) | 0.090  (0.056) | 17.26  (45.08) | -0.042  (0.055) | -46.44  (44.95) |
| Post-graduate | 0.060  (0.086) | -5.03  (69.54) | 0.238\*\*\*  (0.084) | 82.23  (68.49) | 0.154\*  (0.086) | 51.26  (69.52) | -0.114  (0.085) | -77.76  (69.11) |
| Pays\_the\_church\_tax | 0.093\*\*  (0.043) | 30.29  (34.66) | 0.063  (0.043) | 17.07  (34.68) | 0.078\*  (0.043) | 20.90  (34.68) | 0.105\*\*  (0.042) | 33.70  (34.50) |
| Ln(Disposable\_income) | 0.095\*\*\*  (0.0254) | 80.34\*\*\*  (20.66) | 0.099\*\*\*  (0.026) | 81.65\*\*\*  (20.69) | 0.098\*\*\*  (0.0255) | 82.65\*\*\*  (20.67) | 0.093\*\*\*  (0.0252) | 80.09\*\*\*  (20.59) |
| Has\_one\_child | -0.057  (0.058) | 44.96  (47.41) | -0.058  (0.059) | 44.17  (47.47) | -0.056  (0.059) | 45.55  (47.46) | -0.060  (0.058) | 43.25  (47.27) |
| Has\_two\_or\_more\_children | 0.002  (0.052) | 33.39  (42.40) | -0.002  (0.052) | 33.40  (42.45) | -0.0001  (0.052) | 34.41  (42.44) | -0.011  (0.052) | 28.75  (42.27) |
| Married\_or\_cohabiting | -0.207\*\*\*  (0.061) | -95.01\*  (49.50) | -0.208\*\*\*  (0.061) | -97.17\*\*  (49.57) | -0.209\*\*\*  (0.061) | -96.18\*  (49.55) | -0.184\*\*\*  (0.060) | -83.66\*  (49.37) |
| Divorced\_or\_widowed | 0.019  (0.080) | 38.90  (64.62) | 0.011  (0.080) | 34.52  (64.69) | 0.013  (0.080) | 35.42  (64.68) | 0.040  (0.079) | 48.96  (64.44) |
| Urban\_residence | 0.197\*\*\*  (0.057) | 155.40\*\*\*  (46.11) | 0.224\*\*\*  (0.057) | 168.00\*\*\*  (46.13) | 0.215\*\*\*  (0.057) | 166.10\*\*\*  (46.11) | 0.162\*\*\*  (0.056) | 139.90\*\*\*  (45.98) |
| Swedish-speaker | -0.235  (0.171) | 50.08  (138.70) | -0.310\*  (0.171) | 8.48  (138.70) | -0.253  (0.172) | 40.04  (139.18) | -0.212  (0.169) | 55.14  (138.18) |
| Constant | 0.472\*\*\*  (0.590) | -2577.10\*\*\*  (479.52) | 0.564  (0.586) | -2520.00\*\*\*  (461.30) | -0.472  (0.569) | -2578.10\*\*\*  (461.60) | 0.458\*\*\*  (0.562) | -2575.20\*\*\*  (459.40) |
| *R2* | 0.567 | 0.0140 | 0.0256 | 0.0116 | 0.0264 | 0.0120 | 0.0463 | 0.0198 |
| Notes: N = 15,488 The reference categories are not employed, secondary education, no children, single, first language not Swedish. Standard errors in parentheses.  Statistical significance: \*\*\*Significant at 1%, \*\*Significant at 5%, \*Significant at 10%. | | | | | | | | |

Table 5. OLS Regression results of consumption models.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Betting format | Easy | Medium | Hard | | Easy | Medium | Hard | Easy | Medium | Hard | Easy | Medium | Hard |
|  | Focus variables | | | | | | | | | | | | |
| Composite\_IQ | -0.015\*\*\* | -0.001 | 0.016\*\*\* | - | | - | - | - | - | - | - | - | - |
|  | (0.003) | (0.003) | (0.003) |  | |  |  |  |  |  |  |  |  |
| Spatial\_logic\_IQ | - | - | - | -0.004 | | -0.001 | 0.005 | - | - | - | - | - | - |
|  |  |  |  | (0.003) | | (0.003) | (0.003) |  |  |  |  |  |  |
| Verbal\_IQ | - | - | - | - | | - | - | -0.005\* | -0.011\*\*\* | 0.016\*\*\* | - | - | - |
|  |  |  |  |  | |  |  | (0.003) | (0.003) | (0.003) |  |  |  |
| Numerical\_IQ | - | - | - | - | | - | - | - | - | - | -0.027\*\*\* | 0.008\*\*\* | 0.020\*\*\* |
|  |  |  |  |  | |  |  |  |  |  | (0.003) | (0.003) | (0.003) |
|  | Control variables | | | | | | | | | | | | |
| Age | -0.007\*\*  (0.003) | 0.005  (0.004) | 0.002  (0.004) | -0.006\*  (0.003) | | 0.005  (0.004) | 0.001  (0.004) | -0.006\*  (0.003) | 0.004  (0.004) | 0.002  (0.004) | -0.006\*\*  (0.003) | 0.005  (0.004) | 0.001  (0.004) |
| Age2 | 4.5×10-5  (3.9×10-5) | -3.1×10-5  (4.5×10-5) | -1.4×10-5  (4.9×10-5) | 3.7×10-5  (3.9×10-5) | | -3.1×10-5  (4.5×10-5) | -5.5×10-5  (4.9×10-5) | 3.9×10-5  (3.9×10-5) | -2.2×10-5  (4.5×10-5) | -1.7×10-5  (4.9×10-5) | 4.6×10-5  (3.9×10-5) | -3.5×10-5  (3.9×10-5) | -1.1×10-5  (4.9×10-5) |
| Blue-collar | -0.018\*\*\*  (0.006) | -0.010  (0.007) | 0.028\*\*\*  (0.007) | -0.017\*\*\*  (0.006) | | -0.010  (0.007) | 0.027\*\*\*  (0.007) | -0.017\*\*\*  (0.006) | -0.010  (0.007) | 0.027\*\*\*  (0.007) | -0.019\*\*\*  (0.006) | -0.010  (0.007) | 0.028\*\*\*  (0.007) |
| White-collar | -0.011\*  (0.006) | -0.002  (0.007) | 0.012  (0.008) | -0.014\*\*  (0.006) | | -0.002  (0.007) | 0.015\*\*  (0.008) | -0.013\*\*  (0.006) | 0.005  (0.007) | 0.013  (0.008) | -0.008  (0.006) | -0.004\*\*\*  (0.007) | 0.012  (0.008) |
| Basic\_education | -0.028\*\*\*  (0.007) | 0.032\*\*\*  (0.008) | -0.004  (0.008) | -0.024\*\*\*  (0.007) | | 0.032\*\*\*  (0.008) | -0.009  (0.008) | -0.024\*\*\*  (0.007) | 0.029\*\*\*  (0.008) | -0.005  (0.008) | -0.031\*\*\*  (0.007) | 0.035\*\*\*  (0.008) | -0.004  (0.008) |
| College | -0.001  (0.007) | -0.025\*\*\*  (0.007) | 0.026\*\*\*  (0.008) | -0.006  (0.006) | | -0.025\*\*\*  (0.007) | 0.031\*\*\*  (0.008) | -0.006  (0.006) | -0.021\*\*\*  (0.007) | 0.027\*\*\*  (0.008) | 0.004  (0.007) | -0.029\*\*\*  (0.007) | 0.025\*\*\*  (0.008) |
| Post-graduate | 0.035\*\*\*  (0.010) | -0.056\*\*\*  (0.012) | 0.021\*  (0.013) | 0.023  (0.010) | | -0.056\*\*\*  (0.011) | 0.033\*\*\*  (0.012) | 0.026\*\*  (0.010) | -0.048\*\*\*  (0.012) | 0.022\*  (0.013) | 0.045\*\*\*  (0.010) | -0.064\*\*  0.011) | 0.019  (0.012) |
| Pays\_the\_church\_tax | -0.013\*\*  (0.005) | 0.012\*\*  (0.006) | 3.7×10-4  (0.006) | -0.011\*\*  (0.005) | | 0.012\*\*  (0.006) | -0.001  (0.006) | -0.011\*\*  (0.005) | 0.011\*\*  (0.006) | 2.1×10-4  (0.006) | -0.013\*\*\*  (0.005) | 0.013\*\*\*  (0.006) | -4.8×10-5  (0.006) |
| Ln(Disposable\_income) | -0.002  (0.003) | 0.017\*\*\*  (0.004) | -0.016\*\*\*  (0.004) | -0.002\*\*  (0.003) | | 0.017\*\*\*  (0.004) | -0.016\*\*\*  (0.004) | -0.002  (0.003) | 0.017\*\*\*  (0.004) | -0.015\*\*\*  (0.004) | -0.001  (0.003) | 0.017  (0.004) | -0.016\*\*\*  (0.004) |
| Has\_one\_child | -0.004  (0.007) | -0.008  (0.008) | 0.012  (0.008) | -0.004  (0.007) | | -0.008  (0.008) | 0.012  (0.008) | -0.004  (0.007) | -0.008  (0.008) | 0.013  (0.008) | -0.004  (0.007) | -0.008  (0.008) | 0.012  (0.008) |
| Has\_two\_or\_more\_children | -0.004  (0.006) | -0.013\*  (0.007) | 0.017\*\*  (0.007) | -0.004  (0.006) | | -0.013\*  (0.007) | 0.017\*\*  (0.007) | -0.004  (0.006) | -0.013\*  (0.007) | 0.017\*\*  (0.007) | -0.004  (0.006) | -0.013\*  (0.007) | 0.017\*\*  (0.007) |
| Married\_or\_cohabiting | 0.032\*\*\*  (0.007) | 0.010  (0.008) | -0.042\*\*\*  (0.009) | 0.032\*\*\*  (0.007) | | 0.010  (0.008) | -0.042\*\*\*  (0.009) | 0.032\*\*\*  (0.007) | 0.010  (0.008) | -0.042\*\*\*  (0.009) | 0.031\*\*\*  (0.007) | 0.010  (0.008) | -0.041\*\*\*  (0.009) |
| Divorced\_or\_widowed | 0.019\*\*  (0.009) | 0.015  (0.010) | -0.034\*\*\*  (0.011) | 0.020\*\*  (0.009) | | 0.015  (0.010) | -0.034\*\*\*  (0.011) | 0.020\*\*  (0.009) | 0.015  (0.010) | -0.034\*\*\*  (0.011) | 0.018\*  (0.009) | 0.015  (0.010) | -0.033\*\*\*  (0.011) |
| Urban\_residence | -0.045\*\*\*  (0.006) | 0.001  (0.007) | 0.044\*\*\*  (0.008) | -0.047\*\*\*  (0.006) | | 0.001  (0.007) | 0.046\*\*\*  (0.008) | -0.047\*\*\*  (0.006) | 0.002  (0.007) | 0.045\*\*\*  (0.008) | -0.043\*\*\*  (0.006) | 1.8×10-4  (0.007) | 0.043\*\*\*  (0.008) |
| Swedish-speaker | -0.001  (0.020) | -0.072\*\*\*  (0.024) | 0.074\*\*\*  (0.025) | 0.004  (0.020) | | -0.072\*\*\*  (0.024) | 0.068\*\*\*  (0.025) | 0.002  (0.020) | -0.079\*\*\*  (0.024) | 0.078\*\*\*  (0.025) | -0.002  (0.020) | -0.070\*\*\*  (0.024) | 0.072\*\*\*  (0.025) |
| Notes: N = 15,488. The reference categories are not employed, secondary education, no children, single, first language not Swedish. The table presents average marginal effects from fractional multinomial logit models. A marginal effect is calculated for each individual at the covariate values for that individual and these marginal effects are then averaged over all individuals. Standard errors in parentheses. Statistical significance: \*\*\*Significant at 1%, \*\*Significant at 5%, \*Significant at 10%. | | | | | | | | | | | | | |

Table 6. Fractional multinomial logit regression results of preference models.

**APPENDIX**

**Appendix A**

**The betting company and betting environment**

Gambling in Finland is organized by the monopoly operator, Veikkaus Ltd, which was formed by a merger of three gambling monopoly operators focusing on casino games, lotteries, poker and sports wagering (Veikkaus Ltd), slot machines (Raha-automaattiyhdistys), and horse betting (Fintoto Ltd) in 2017. Gambling is very accessible in Finland: in addition to online gambling, offline gambling opportunities, including slot machines, can be found in gambling arcades, kiosks, restaurants and supermarkets (Tammi et al., 2015). In 2019, adult Finns spent, on average, €430 on gambling services, making per capita spending among the highest in the world (Police of Finland, 2022).

At the time of this study, the betting operator, Fintoto Ltd., had a legal monopoly for offline and online horse race betting in the country[[9]](#footnote-9). According to the company’s annual report for fiscal year 2016 (Suomen Hippos Group, 2017), its turnover was €235.3m. Of this, 72.5% was paid back to winning bettors (who had no liability to tax on these receipts), 11.5% covered operating costs, and 3.6% was handed to the Government in tax and levies. The residual, amounting to €32.8m, was used to support the racing and equine sector in Finland[[10]](#footnote-10). In Finland, horse betting is a relatively minor gambling product compared with other activities such as lotteries and slot machines. The pari-mutuel betting system is used for all horse betting types, with a separate pool for each betting product. During our observation period, approximately 60% of horse race bets were placed at the online platform. These stakes were pooled with bets from on-track and retail outlets. The total monetary value of online stakes was €141 million, and the operator’s takeout from these bets was €33 million.

Our data set has information on all bets placed at the monopoly operator’s online betting platform between September 1, 2015 and August 31, 2016. Given that 2016 was a leap year, the data period was 366 days. Betting was available every day except Christmas Eve and Christmas Day, so we observe each player’s bets on each of 364 days.

Online horse race bettors have a wide variety of race meetings available to wager on. In addition to horse race meetings in Finland, a bettor may wager on races in nine other countries. The races are mainly harness trot racing, but thoroughbred racing and Monte racing are also featured. The main betting days in Finland are Wednesdays and Saturdays. On each day, betting typically starts in the morning with foreign thoroughbred races. During the afternoon trotting races in the Nordic countries are available. The main domestic trotting race meetings are held in the evening. After this, there are night trotting events, mainly from Sweden. Recently, the supply of foreign horse races has been increasing (e.g. gallop events). While their share of total turnover increased from 15% in 2015 to 22% in 2016, most of the volume still originated from domestic race meetings. Finnish races are not offered widely on international markets, so betting on Finnish races takes place within a somewhat closed betting environment.

**Betting formats**

Table A1 presents information on all fifteen betting formats available in horse race betting in Finland. Columns starting from the left show the name of the betting format and a description of what the bettor must select correctly in order to win, the share of total online turnover accounted for by that product in our data year, and its take-out rate. The final column shows the product group to which the particular product was assigned for purposes of analysis. of the betting format, and the category of the betting format as defined in this study, respectively.

Table A.1. Descriptions of betting formats, their share of total turnover and takeout rate.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Betting format | Descriptions of betting format | % of total turnover | Takeout rate (%) | Betting format category |
|  |  |  |  |  |
| Win | The winning horse of a race. | 7.53 | 15 | Easy |
| Place | Pick a horse that finishes in the first three places of the race. | 3.96 | 15 | Easy |
| Each Way | A combination of two sub-bets: Win and a Place | 1.21 | 15 | Easy |
| Quinella | The first two horses in a race regardless of their finishing order. | 28.06 | 21 | Medium |
| Trifecta | The first three horses of a race in the correct order. | 13.32 | 30 | Medium |
| Duo | The winners of two consecutive races. | 3.34 | 25 | Medium |
| Exacta | The first two horses in a race in the correct order. | 0.50 | 25 | Medium |
| Swinger | Two horses that both finish either as the first, second or third in a race. | 0.03 | 25 | Medium |
| Pick 4 | The winners of four consecutive races. No consolation wins. | 13.34 | 35 | Hard |
| Pick 76 | The winners of seven consecutive races, a consolation win for 6 correct picks. | 6.57 | 35 | Hard |
| Pick 64 | The winners of six consecutive races, consolation wins for 5 and 4 correct picks. | 6.56 | 35 | Hard |
| Pick 75 | The winners of seven consecutive races, consolation wins for 6 and 5 correct picks. | 6.12 | 35 | Hard |
| Pick 65 | The winners of six consecutive races, a consolation win for 5 correct picks. | 5.55 | 35 | Hard |
| Pick 5 | The winners of five consecutive races. No consolation wins. | 3.48 | 35 | Hard |
| Pick 86 | The winners of eight consecutive races, consolation wins for 7 and 6 correct picks. | 0.40 | 35 | Hard |

**A. References**

Suomen Hippos –group’s Annual report 2016 (2017). (The Finnish Trotting and Breeding Association) (<https://www.hippos.fi/uploads/sites/1/2021/02/9260b321-vuosikertomus-2016.pdf>) (In Finnish only). Last accessed July 5, 2022.

Police of Finland (2022). Gambling in Finland. (<https://poliisi.fi/en/gambling>) Last accessed July 5, 2022.

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**Appendix B**

**Comparison of men who have and have not undertaken military service**

Table B.1 shows the summary statistics for men who have conducted military service (panels on the left) and for men who have not undertaken military service. While military service is compulsory for Finnish males aged 18 to 30, individuals can also opt for non-military (civilian) service. Furthermore, some men are exempted from military (and non-military) service for medical reasons, including physical or psychological preconditions that preclude them from entering service.

The figures reported in Table B.1 suggest that there are differences between the two groups. Men who undertake military service are more likely to engage with horse betting. They also spend more on betting products. Regarding the socio-economic background of the two groups, men who do not undertake military service have a lower socioeconomic status: they are less likely to have education beyond compulsory basic education and they are also less likely to have an occupational status of a blue-collar or white-collar worker. Furthermore, average annual disposable income is significantly lower in this group. Another distinction can be made based on family relationships: men who have not served in the military are more likely to be divorced or widowed and less likely to be married or in a cohabiting relationship.

Table B.1. Descriptive statistics of men who have and have not undertaken military service.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Military service** | | | |  | | **No military service** | | | | | |
|  | Mean | N | | SD |  | | | Mean | N | | SD | |
| **Dependent variables** | | | | | | | | | | | | |
| Participant | 0.022 | 705,089 | | 0.15 |  | | 0.014 | | | 287,547 | | 0.12 |
| Total\_stakes (€) | 3,980.56 | 15,488 | | 25,888.60 |  | | 3,045.53 | | | 3,915 | | 12,492.09 |
| Net\_spending (€) | 734.47 | 15,488 | | 7985.75 |  | | 678.05 | | | 3,915 | | 3175.03 |
| **Independent variables** | | | | | | | | | | | | |
| Age | 39.94 | 705,089 | 8.46 | |  | 37.38 | | | | 287,547 | | 8.18 |
| Blue-collar | 0.30 | 705,089 | 0.46 | |  | 0.24 | | | | 287,547 | | 0.43 |
| White-collar | 0.38 | 705,089 | 0.49 | |  | 0.32 | | | | 287,547 | | 0.47 |
| Basic education | 0.12 | 705,089 | 0.32 | |  | 0.27 | | | | 287,547 | | 0.45 |
| College | 0.23 | 705,089 | 0.42 | |  | 0.16 | | | | 287,547 | | 0.37 |
| Post-graduate | 0.13 | 705,089 | 0.33 | |  | 0.12 | | | | 287,547 | | 0.33 |
| Pays the church tax | 0.65 | 705,089 | 0.48 | |  | 0.44 | | | | 287,547 | | 0.50 |
| Disposable\_income (€) | 31,177.79 | 705,089 | 67,455.42 | |  | 24,883.95 | | | | 287,547 | | 32,386.64 |
| Has\_one\_child | 0.19 | 705,089 | 0.39 | |  | 0.18 | | | | 287,547 | | 0.39 |
| Has\_two\_or\_more\_children | 0.38 | 705,089 | 0.49 | |  | 0.38 | | | | 287,547 | | 0.49 |
| Married\_or\_cohabiting | 0.68 | 705,089 | 0.47 | |  | 0.56 | | | | 287,547 | | 0.50 |
| Divorced\_or\_widowed | 0.13 | 705,089 | 0.34 | |  | 0.22 | | | | 287,547 | | 0.41 |
| Urban\_residence | 0.87 | 705,089 | 0.34 | |  | 0.90 | | | | 287,547 | | 0.31 |
| Swedish-speaker | 0.04 | 705,089 | 0.20 | |  | 0.06 | | | | 287,547 | | 0.25 |

**Appendix C**

**FDF IQ test scores**

FDF has administered a cognitive ability test to all conscripts since 1955. It is a multiple-choice test to be completed in two hours using pencil and paper. The conscripts usually take the test during their second week of military service. The raw data exclude test scores for non-conscript FDF personnel as well as for soldiers serving with the Finnish Border Guard. We dropped female conscripts from our analysis because the IQ data and the betting data contain a limited number of females and few of them will have served in the military.

The questionnaire used in the FDF cognitive ability test is classified. Thus, we are unable to provide its details to the reader. However, the contents of its subtests are described in more detail in Tiihonen et al. (2005). According to them, the verbal reasoning subtest contains four types of questions in which a subject: 1) chooses synonyms or antonyms for a word, 2) selects a word belonging to the same category as a given word pair, 3) infers which word in a list of words does not belong in the list, and 4) assigns relationships between two word pairs. The subtest for arithmetic reasoning comprises four types of problem. The subject has to complete a series of numbers that have been arranged to follow a certain rule, to solve verbally expressed short problems, to compute simple arithmetic operations, and to assign relationships between two pairs of numbers. The spatial logic reasoning task is a set of matrices containing a pattern problem with one part removed. The subject is asked to decide which one of the given figures completes the matrix. The spatial logic reasoning test is a standard “culture-free” intelligence test based on Raven’s progressive matrices, and therefore its results should be less affected by pretest schooling (Pekkala Kerr, Pekkarinen and Uusitalo, 2013).

**C. References**

Pekkala Kerr, S., Pekkarinen, T. & Uusitalo, R. (2013). School tracking and development of cognitive skills. *Journal of Labor Economics*, *31*(3), 577-602.

Tiihonen, J., Haukka, J., Henriksson, M., Cannon, M., Kieseppä, T., Laaksonen, I., Sinivuo, J. &

Lönnqvist, J. (2005). Premorbid intellectual functioning in bipolar disorder and schizophrenia: Results from a cohort study of male conscripts. *American Journal of Psychiatry*, *162*(10), 1904-1910.

**Appendix D**

**Variable definitions**

Table D.1. Variable definitions.

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Time period** | **Definition** |
| - Dependent variables - | | |
| Participant | Sep. 1, 2015 – Aug. 31, 2016 | Equals 1 if an individual participates at leastoncein online horse race betting, 0 otherwise |
| Total\_stakes | Sep. 1, 2015 – Aug. 31, 2016 | Totalamount stakedover the one-year period |
| Net\_spending | Sep. 1, 2015 – Aug. 31, 2016 | Net spending is net return (i.e., total amount of wins minus total amount staked) from gambling. The values of Net Spending are winsorized at the 1st and 99th percentiles by assigning the variable’s value at the 1st percentile (- €12,804.25) for all values below the 1st percentile and by assigning the variable’s value at the 99th percentile (€1,925.20) for all values above the 99th percentile. |
| Proportion\_of\_bets | Sep. 1, 2015 – Aug. 31, 2016 | The share of total stakes accounted for by betting formats, defined as Easy, Medium and Hard. |
| - Independent variables - | | |
| Composite\_IQ | 1982 – 2010 | Arithmetic average of Spatial logic, Verbal and Numerical IQ test scores that is yearly normalised (with mean 0 and SD 1). Composite IQ is available for conscripts who performed their military service between 1982 and 2010. |
| Spatial\_logic\_IQ | 1982 – 2010 | Yearly normalised (with mean 0 and SD 1) Spatial logic IQ test scores for conscripts who undertook their military service between 1982 and 2010. |
| Verbal\_IQ | 1982 – 2010 | Yearly normalised (with mean 0 and SD 1) Verbal IQ test scores for conscripts who undertook their military service between 1982 and 2010. |
| Numerical\_IQ | 1982 – 2010 | Yearly normalised (with mean 0 and SD 1) Numerical IQ test scores for conscripts who undertook their military service between 1982 and 2010. |
| Age | Dec. 31, 2015 | Person’s age in full years |
| Age2 | Dec. 31, 2015 | Square of age |
| Blue-collar | Dec. 31, 2015 | Equals 1 if person’s labour force status is manual worker, 0 otherwise |
| White-collar | Dec. 31, 2015 | Equals1 if person’s labour force status is clerical worker, professional or executive, 0 otherwise |
| Entrepreneur | Dec. 31, 2015 | Equals 1 if person’s labour force status is entrepreneur, 0 otherwise |
| Pensioner | Dec. 31, 2015 | Equals1 if person’s labour force status is pensioner, 0 otherwise |
| Student | Dec. 31, 2015 | Equals1 if person’s labour force status is student, 0 otherwise |
| Unemployed | Dec. 31, 2015 | Equals1 if person’s labour force status is unemployed, 0 otherwise**=** 1 |
| Other | Dec. 31, 2015 | Equals1 if person’s labour force status is unknown, 0 otherwise |
| Basic\_education | Dec. 31, 2015 | Equals 1 if person’s highest education qualification is basic education, 0 otherwise |
| Secondary\_education | Dec. 31, 2015 | Equals 1 if person’s highest education qualification is secondary education (e.g. vocational school, special vocational school, commercial school etc.), 0 otherwise |
| College | Dec. 31, 2015 | Equals 1 if person’s highest education qualification is college education (e.g. Bachelor degree in Science or Engineering etc.), 0 otherwise |
| Post-graduate | Dec. 31, 2015 | Equals 1 if person’s highest education qualification is master's degree or doctoral thesis, 0 otherwise |
| Pays\_the\_church\_tax | Dec. 31, 2015 | Equals1 if individual pays Church taxes, 0 otherwise. |
| Log(Disposable\_income) | Dec. 31, 2015 | A natural logarithm of the mean disposable income of individual in 2015 and 2016 +1€. |
| Has\_no\_children | Dec. 31, 2015 | Equals 1 if an individual has no children living with him, 0 otherwise |
| Has\_one\_child | Dec. 31, 2015 | Equals1 if an individual has one child living with him, 0 otherwise |
| Has\_two\_or\_more\_children | Dec. 31, 2015 | Equals1 if an individual has at least two children living with him, 0 otherwise |
| Single | Dec. 31, 2015 | Equals1 if a person lives alone and has never married. 0 otherwise |
| Married\_or\_cohabiting | Dec. 31, 2015 | Equals 1 if a person lives in a relationship (cohabiting or married), 0 otherwise |
| Divorced\_or\_widowed | Dec. 31, 2015 | Equals 1 if a person is divorced or widowed and does not live in a relationship (cohabiting or married), 0 otherwise |
| Urban\_residence | Dec. 31, 2015 | Equals 1 if an individual’s municipality of domicile is an urban or semi-urban municipality, 0 otherwise. |
| Finnish-speaker | Dec. 31, 2015 | Equals 1 if1 if an individual’s native language is Finnish, 0 otherwise. |
| Swedish-speaker | Dec. 31, 2015 | Equals1 if an individual’s native language is Swedish, 0 otherwise. |
| Other\_first\_language | Dec. 31, 2015 | Equals 1 if an individual’s native language is other than Finnish or Swedish, 0 otherwise. |

**Appendix E**

**Robustness checks**

***Focus only on more active bettors***

To ensure that casual bettors who wager only occasionally are not driving our results (14% of bettors wagered only once during the observation period), we ran a robustness check by estimating the empirical models on a sample of the more ‘active’ bettors. Using the median number of days (13 days) a bettor participated in horse wagering, we limit our focus to the more ‘active’ half of the sample (7,761 bettors).

In the consumption model (Table E.1), the results reveal a pattern that is similar to the baseline results in terms of numerical and verbal IQ, namely that of a positive relationship between consumption and IQ. However, they also indicate that consumption is positively correlated with spatial logic IQ, which was negative though insignificant in the baseline results. In other words, our findings constitute evidence that all subcomponents of IQ are positive predictors of consumption within the more active half of the bettor population.

In the betting preference model (Table E.2), composite IQ is congruent with the baseline model indicating a positive, though not statistically significant, correlation with the *Hard* betting formats, and a statistically significant negative correlation with *Easy* betting formats. Further, numerical IQ predicts less consumption of *Easy* games, which is consistent with the baseline model. In a similar manner, the signs for verbal IQ and spatial logic IQ are consistent with the baseline model, indicating a preference for *Hard* betting formats. In this case, the estimated coefficient on spatial logic IQ is statistically significant, the one for verbal IQ is not. These findings are consistent with a conclusion that a high IQ score predicts a preference for more complex betting products and a relative distaste for *Easy* betting formats.

Table E.1 OLS regression results of consumption models for more ‘active’ bettors.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Dependent variable | Total stakes | Net Spending | Total stakes | | Net Spending | Total stakes | Net Spending | Total stakes | Net Spending |
|  | | | | Focus variables | | | | | |
| Composite\_IQ | 0.178\*\*\* | 165.1\*\*\* |  | |  |  |  |  |  |
|  | (0.022) | (35.01) |  | |  |  |  |  |  |
| Spatial\_logic\_IQ |  |  | 0.044\*\* | | 72.96\*\* |  |  |  |  |
|  |  |  | (0.021) | | (33.18) |  |  |  |  |
| Verbal\_IQ |  |  |  | |  | 0.088\*\*\* | 76.08\*\* |  |  |
|  |  |  |  | |  | (0.022) | (34.91) |  |  |
| Numerical\_IQ |  |  |  | |  |  |  | 0.292\*\*\* | 245.3\*\*\* |
|  |  |  |  | |  |  |  | (0.021) | (32.98) |
|  | | | | Control variables | | | | | |
| Age | 0.104\*\*\* | 168.7\*\*\* | 0.0988\*\*\* | | 164.1\*\*\* | 0.104\*\*\* | 167.9\*\*\* | 0.102\*\*\* | 166.6\*\*\* |
|  | (0.028) | (44.00) | (0.0279) | | (44.03) | (0.0279) | (44.09) | (0.0276) | (43.89) |
| Age2 | -0.001\*\*\* | -2.040\*\*\* | -0.00128\*\*\* | | -1.979\*\*\* | -0.00134\*\*\* | -2.022\*\*\* | -0.001\*\*\* | -2.014\*\*\* |
|  | (3.4×10-4) | (0.540) | (3.4×10-4) | | (0.540) | (3.4×10-4) | (0.541) | (3.4×10-4) | (0.538) |
| Blue-collar | -0.153\*\*\* | -250.7\*\*\* | -0.163\*\*\* | | -258.9\*\*\* | -0.162\*\*\* | -259.8\*\*\* | -0.139\*\* | -240.7\*\*\* |
|  | (0.048) | (75.88) | (0.048) | | (75.95) | (0.048) | (75.94) | (0.048) | (75.74) |
| White-collar | -0.039 | -27.67 | -0.00696 | | -2.182 | -0.0197 | -8.930 | -0.0648 | -46.26 |
|  | (0.052) | (82.77) | (0.052) | | (82.64) | (0.053) | (82.85) | (0.052) | (82.58) |
| Basic\_education | 0.186\*\*\* | 198.3\* | 0.139\*\* | | 162.7\* | 0.156\*\*\* | 168.6\* | 0.206\*\*\* | 209.6\* |
|  | (0.057) | (90.74) | (0.057) | | (90.52) | (0.058) | (90.85) | (0.057) | (90.23) |
| College | -0.019 | -55.97 | 0.043 | | -8.469 | 0.022 | -16.28 | -0.0661 | -88.96 |
|  | (0.053) | (82.92) | (0.0522) | | (82.30) | (0.0525) | (82.82) | (0.0519) | (82.59) |
| Post-graduate | 0.038 | -78.71 | 0.172\*\* | | 26.34 | 0.119 | 1.992 | -0.0525 | -140.1 |
|  | (0.081) | (128.2) | (0.0799) | | (126.0) | (0.0813) | (128.3) | (0.0799) | (127.1) |
| Pays\_the\_church\_tax | -0.050 | -15.81 | -0.072 | | -31.10 | -0.066 | -31.55 | -0.044 | -12.90 |
|  | (0.041) | (65.03) | (0.0413) | | (65.07) | (0.0412) | (65.05) | (0.0407) | (64.77) |
| Ln(Disposable\_income) | 0.108\*\*\* | 151.4\*\*\* | 0.109\*\*\* | | 151.2\*\*\* | 0.112\*\*\* | 154.8\*\*\* | 0.109\*\*\* | 152.2\*\*\* |
|  | (0.023) | (36.66) | (0.0233) | | (36.72) | (0.0233) | (36.70) | (0.0230) | (36.58) |
| Has\_one\_child | -0.051 | 69.85 | -0.0535 | | 67.15 | -0.0502 | 70.06 | -0.0516 | 68.87 |
|  | (0.056) | (88.41) | (0.0562) | | (88.51) | (0.0561) | (88.52) | (0.0555) | (88.22) |
| Has\_two\_or\_more\_children | 0.001 | 52.83 | 0.00501 | | 55.71 | 0.00702 | 58.10 | -0.0126 | 41.57 |
|  | (0.051) | (79.98) | (0.051) | | (80.06) | (0.051) | (80.06) | (0.050) | (79.83) |
| Married\_or\_cohabiting | -0.126\*\* | -48.45 | -0.131\*\* | | -53.07 | -0.128\*\* | -50.09 | -0.114\* | -38.12 |
|  | (0.059) | (92.41) | (0.0587) | | (92.52) | (0.0586) | (92.51) | (0.0580) | (92.23) |
| Divorced\_or\_widowed | 0.002 | 125.1 | -0.00781 | | 116.7 | -0.00461 | 118.9 | 0.0174 | 137.3 |
|  | (0.075) | (119.2) | (0.0757) | | (119.4) | (0.0757) | (119.4) | (0.0748) | (119.0) |
| Urban\_residence | 0.263\*\*\* | 281.1\*\* | 0.283\*\*\* | | 297.6\*\*\* | 0.278\*\*\* | 296.0\*\*\* | 0.237\*\*\* | 261.4\*\*\* |
|  | (0.055) | (86.29) | (0.0548) | | (86.30) | (0.0547) | (86.33) | (0.0542) | (86.17) |
| Swedish-speaker | -0.148 | 145.9 | -0.211 | | 93.81 | -0.167 | 125.5 | -0.147 | 140.6 |
|  | (0.165) | (260.3) | (0.165) | | (260.3) | (0.166) | (261.1) | (0.163) | (259.5) |
| Constant | 4.397\*\*\* | -3619.0\*\*\* | 4.469\*\*\* | | -3535.8\*\*\* | 4.349\*\*\* | -3657.5\*\*\* | 4.387\*\*\* | -3623.1\*\*\* |
|  | (0.587) | (927.8) | (0.589) | | (928.9) | (0.589) | (929.6) | (0.582) | (925.8) |
| R2 | 0.025 | 0.013 | 0.017 | | 0.011 | 0.019 | 0.010 | 0.041 | 0.017 |
| Notes: N = 7,761. The reference categories are not employed, secondary education, no children, single, first language not Swedish. Standard errors in parentheses.  Statistical significance: \*\*\*Significant at 1%, \*\*Significant at 5%, \*Significant at 10%. | | | | | | | | | |

Table E.2. Fractional multinomial regression results of betting preference models for more ‘active’ bettors.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Dependent variable | Easy | Medium | Hard | Easy | Medium | Hard | Easy | Medium | Hard | Easy | Medium | Hard |
|  | Focus variables | | | | | | | | | | | |
| Composite\_IQ | -0.0118\*\*\* | 0.0002 | 0.0116\*\*\* |  |  |  |  |  |  |  |  |  |
|  | (0.0030) | (0.0037) | (0.0041) |  |  |  |  |  |  |  |  |  |
| Spatial\_logic\_IQ |  |  |  | -0.0061\*\* | -0.0034 | 0.0096\*\* |  |  |  |  |  |  |
|  |  |  |  | (0.0028) | (0.0035) | (0.0039) |  |  |  |  |  |  |
| Verbal\_IQ |  |  |  |  |  |  | -0.0045 | -0.0039 | 0.0083\*\* |  |  |  |
|  |  |  |  |  |  |  | (0.0030) | (0.0037) | (0.0042) |  |  |  |
| Numerical\_IQ |  |  |  |  |  |  |  |  |  | -0.0176\*\*\* | 0.0074\*\* | 0.0102\*\*\* |
|  |  |  |  |  |  |  |  |  |  | (0.0028) | (0.0035) | (0.0039) |
|  | Control variables | | | | | | | | | | | |
| Age | -0.0035 | 0.0036 | -0.0001 | -0.0032 | 0.0036 | -0.0004 | -0.0034 | 0.0034 | 1.5×10-5 | -0.0033 | 0.0037 | -3.9×10-4 |
|  | (0.0035) | (0.0045) | (0.0050) | (0.0035) | (0.0045) | (0.0050) | (0.0035) | (0.0045) | (0.0050) | (0.0035) | (0.0045) | (0.0050) |
| Age2 | 2.4×10-5 | -1.4×10-5 | 9.7×10-6 | 2.0×10-5 | -1.3×10-5 | -6.6×10-6 | 2.2×10-5 | -1.1×10-5 | -1.1×10-5 | 2.2×10-5 | -1.6×10-5 | -5.9×10-6 |
|  | (4.4×10-5) | (5.6×10-5) | (6.2×10-5) | (4.4×10-5) | (5.6×10-5) | (6.2×10-5) | (4.4×10-5) | (5.6×10-5) | (6.2×10-5) | (4.4×10-5) | (5.6×10-5) | (6.2×10-5) |
| Blue-collar | -0.0209\*\*\* | -0.0132\* | 0.0341\*\*\* | -0.0204\*\*\* | -0.0134\* | 0.0338\*\*\* | -0.0202\*\*\* | -0.0134\* | 0.0336\*\*\* | -0.0216\*\*\* | -0.0125 | 0.0341\*\*\* |
|  | (0.0063) | (0.0080) | (0.0090) | (0.0063) | (0.0080) | (0.0090) | (0.0063) | (0.0080) | (0.0090) | (0.00632) | (0.0080) | (0.0090) |
| White-collar | -0.0159\*\* | -0.0093 | 0.0252\*\*\* | -0.0176\*\*\* | -0.0088 | 0.0264\*\*\* | -0.0174\*\* | -0.0085 | 0.0259\*\*\* | -0.0145\*\* | -0.0109 | 0.0254\*\*\* |
|  | (0.0069) | (0.0085) | (0.0097) | (0.0068) | (0.0085) | (0.0097) | (0.0069) | (0.0085) | (0.0097) | (0.0069) | (0.0085) | (0.0097) |
| Basic\_education | -0.0205\*\*\* | 0.0298\*\*\* | -0.0093 | -0.0181\*\* | 0.0288\*\*\* | -0.0107 | -0.0180\*\* | 0.0284\*\*\* | -0.0104 | -0.0213\*\*\* | 0.0317\*\*\* | -0.0104 |
|  | (0.0078) | (0.0094) | (0.0106) | (0.0077) | (0.0094) | (0.0106) | (0.0078) | (0.0094) | (0.0106) | (0.0077) | (0.0094) | (0.0106) |
| College | -0.0016 | -0.0218\*\* | 0.0233\*\* | -0.0048 | -0.0206\*\* | 0.0254\*\*\* | -0.0049 | -0.0201\*\* | 0.0250\*\*\* | 0.0009 | -0.0248\*\*\* | 0.0239\*\* |
|  | (0.0070) | (0.0087) | (0.0098) | (0.0069) | (0.0086) | (0.0097) | (0.0069) | (0.0086) | (0.0098) | (0.0070) | (0.0086) | (0.0098) |
| Post-graduate | 0.0185\* | -0.0511\*\*\* | 0.0326\*\* | 0.0115 | -0.0488\*\*\* | 0.0373\*\* | 0.0117 | -0.0473\*\*\* | 0.0356\*\* | 0.0231\*\* | -0.0573\*\*\* | 0.0342\*\* |
|  | (0.0106) | (0.0134) | (0.0151) | (0.0103) | (0.0132) | (0.0149) | (0.0106) | (0.0134) | (0.0151) | (0.0105) | (0.0134) | (0.0151) |
| Pays\_the\_church\_tax | -0.0079 | 0.0116\* | -0.00369 | -0.0070 | 0.0110 | -0.0041 | -0.0067 | 0.0110 | -0.0044 | -0.0081 | 0.0125 | -0.0044 |
|  | (0.0055) | (0.0069) | (0.0077) | (0.0055) | (0.0069) | (0.0077) | (0.0055) | (0.0069) | (0.0077) | (0.0055) | (0.0069) | (0.0077) |
| Ln(Disp. income) | -0.0053\* | 0.0134\*\*\* | -0.0081\* | -0.0052\* | 0.0135\*\*\* | -0.0083\* | -0.0055\*\* | 0.0133\*\*\* | -0.0079\* | -0.0053\* | 0.0133\*\*\* | -0.0079\* |
|  | (0.0027) | (0.0043) | (0.0046) | (0.0027) | (0.0044) | (0.0046) | (0.0027) | (0.0044) | (0.0046) | (0.0027) | (0.0043) | (0.0046) |
| Has\_one\_child | -0.0004 | 0.0023 | -0.0019 | -0.0002 | 0.0023 | -0.0021 | -0.0004 | 0.0021 | -0.0017 | -0.0004 | 0.0023 | -0.0019 |
|  | (0.0075) | (0.0094) | (0.0105) | (0.0075) | (0.0094) | (0.0105) | (0.0075) | (0.0094) | (0.0105) | (0.0074) | (0.0094) | (0.0105) |
| Has\_two\_or\_more\_’children | -0.0130\* | -0.0019 | 0.0148 | -0.0132\*\* | -0.0018 | 0.0149 | -0.0133\*\* | -0.0019 | 0.0152 | -0.0121\* | -0.0023 | 0.0145 |
|  | (0.0067) | (0.0083) | (0.0094) | (0.0067) | (0.0083) | (0.0094) | (0.0068) | (0.0083) | (0.0094) | (0.0067) | (0.0083) | (0.0094) |
| Married\_or\_ cohabiting | 0.0132\* | 0.0006 | -0.0139 | 0.0136\* | 0.0007 | -0.0143 | 0.0134\* | 0.0006 | -0.0139 | 0.0126 | 0.0010 | -0.0136 |
|  | (0.0077) | (0.0097) | (0.0110) | (0.0077) | (0.0097) | (0.0110) | (0.0077) | (0.0097) | (0.0110) | (0.0077) | (0.0097) | (0.0110) |
| Divorced\_or\_ widowed | 0.0112 | -0.0056 | -0.0056 | 0.0118 | -0.0057 | -0.0061 | 0.0117 | -0.0058 | -0.0059 | 0.0104 | -0.0050 | -0.0054 |
|  | (0.0101) | (0.0126) | (0.0140) | (0.0101) | (0.0126) | (0.0140) | (0.0101) | (0.0126) | (0.0140) | (0.0101) | (0.0126) | (0.0140) |
| Urban\_residence | -0.0317\*\*\* | 0.00143 | 0.0303\*\*\* | -0.0329\*\*\* | 0.0017 | 0.0311\*\*\* | -0.0329\*\*\* | 0.0018 | 0.0311\*\*\* | -0.0304\*\*\* | 0.0002 | 0.0301\*\*\* |
|  | (0.0069) | (0.0093) | (0.0105) | (0.0069) | (0.0093) | (0.0105) | (0.0069) | (0.0093) | (0.0105) | (0.0069) | (0.0093) | (0.0105) |
| Swedish-speaker | 0.0061 | -0.0672\*\* | 0.0612\* | 0.0096 | -0.0680\*\* | 0.0584\* | 0.0083 | -0.0697\*\* | 0.0615\* | 0.0063 | -0.0655\* | 0.0592 |
|  | (0.0213) | (0.0291) | (0.0311) | (0.0212) | (0.0290) | (0.0310) | (0.0213) | (0.0292) | (0.0312) | (0.0212) | (0.0291) | (0.0310) |
| Notes: N = 7,761. The reference categories are not employed, secondary education, no children, single, first language not Swedish. The table presents average marginal effects from fractional multinomial logit models. A marginal effect is calculated for each individual at the covariate values for that individual and these marginal effects are then averaged over all individuals. Standard errors in parentheses.  Statistical significance: \*\*\*Significant at 1%, \*\*Significant at5%, \*Significant at 10%. | | | | | | | | | | | | |

***Include the three subcomponents of IQ scores together in the same models***

As an additional robustness check, we also estimated all empirical models by admitting all IQ variables (except for the composite IQ variable) simultaneously into a single model (see Table E.3). While the results of the participation and consumption models for numerical IQ are qualitatively similar to the baseline models, the estimated marginal effects on participation, amount staked and amount spent are nearly twice as great. Spatial logic IQ is a negative predictor as in the baseline models, but it is statistically significant when all variables measuring the subcomponents of IQ are in the same model. On the other hand, the sign of verbal IQ changes from positive to negative. Some volatility in coefficient estimates is to be expected because of multicollinearity but the importance of numerical IQ remains clear in this alternative specification. Indeed, the size of its estimated effect on both the probability and the level of consumption is such as to imply that the results in our baseline model may be conservative.

Regarding the preference models, the results are similar for numerical IQ, which predicts less spending on *Easy* betting products. However, although verbal IQ predicts a preference for *Hard* betting formats, it also suggests that bettors favour *Easy* betting products as well, which points to a relatively low preference for the *Medium* complexity betting formats. Spatial logic IQ predicts a preference for *Easy* games though it was not significant in the baseline model.

Overall, our results suggest that it is numerical IQ which dominates decisions, which is the main conclusion of this study. Compared to the baseline models, the predictions of spatial logic and verbal IQ are, however, more unstable. The baseline models, on the other hand, yield more moderate estimates, which can be regarded as conservative. In addition, Aspara et al. (2017) and Aspara and Wittkowski (2019) raise the issue of potentially problematic multicollinearity in a study that uses the same IQ data base. Consequently, one should be cautious when interpreting the results of models that include all IQ variables simultaneously.

Table E.3. Results for the participation, consumption and betting preference models when all IQ variables are included in the same model.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Dependent variable | Participant | Ln(Total\_stakes) | Net\_spending | Easy | Medium | Hard |
|  | Marginal effect | Coefficient | Coefficient | Marginal effect | Marginal effect | Marginal effect |
|  | Focus variables | | | | | |
| Spatial\_logic\_IQ | -0.006\*\*\* | -0.306\*\*\* | -105.1\*\*\* | 0.0130\*\*\* | -0.0020 | -0.0110\*\*\* |
|  | (2.4×10-4) | (0.027) | (21.75) | (0.0032) | (0.0035) | (0.0038) |
| Verbal\_IQ | -0.003\*\*\* | -0.177\*\*\* | -90.49\*\*\* | 0.0163\*\*\* | -0.0248\*\*\* | 0.0085\*\* |
|  | (2.6×10-4) | (0.029) | (23.95) | (0.0036) | (0.0038) | (0.00424) |
| Numerical\_IQ | 0.013\*\*\* | 0.670\*\*\* | 313.0\*\*\* | -0.0443\*\*\* | 0.0235\*\*\* | 0.0208\*\*\* |
|  | (2.8×10-4) | (0.029) | (23.76) | (0.0035) | (0.0037) | (0.0042) |
|  | Control variables | | | | | |
| Age | 0.004\*\*\* | 0.151\*\*\* | 99.17\*\*\* | -0.0053 | 0.0036 | 0.0016 |
|  | (2.4×10-4) | (0.027) | (21.81) | (0.0031) | (0.0036) | (0.0039) |
| Age2 | -4.1×10-5\*\*\* | -0.001\*\*\* | -1.011\*\*\* | 3.0×10-5 | 1.7×10-5 | -1.2×10-5 |
|  | (3.0×10-4) | (3.3×10-4) | (0.273) | (3.9×10-5) | (4.5×10-5) | (4.9×10-5) |
| Blue-collar | 0.003\*\*\* | -0.016 | -105.1\*\*\* | -0.0198\*\*\* | -0.0089 | 0.0287\*\*\* |
|  | (4.5×10-4) | (0.050) | (40.83) | (0.0058) | (0.0066) | (0.0072) |
| White-collar | -0.002\*\*\* | -0.156\*\*\* | -62.10 | -0.0102 | -0.0013 | 0.0115 |
|  | (4.9×10-4) | (0.054) | (44.69) | (0.0065) | (0.0072) | (0.0079) |
| Basic\_education | 0.004\*\*\* | 0.130\* | 112.3\* | -0.0278\*\*\* | 0.0314\*\*\* | -0.0036 |
|  | (5.4×10-4) | (0.059) | (48.56) | (0.0071) | (0.0076) | (0.0084) |
| College | -0.004\*\*\* | 0.004 | -26.74 | 7.9×10-4 | -0.0250\*\*\* | 0.0242\*\*\* |
|  | (4.9×10-4) | (0.055) | (45.00) | (0.0065) | (0.0072) | (0.0079) |
| Post-graduate | -0.017\*\*\* | -0.026 | -36.68 | 0.0384\*\*\* | -0.0549\*\*\* | 0.0164 |
|  | (7.3×10-4) | (0.085) | (69.50) | (0.0101) | (0.0116) | (0.0125) |
| Pays\_the\_church\_tax | 0.003\*\*\* | 0.066 | 17.83 | -0.0109\* | 0.0112\* | -0.0003 |
|  | (3.8×10-4) | (0.042) | (34.52) | (0.0049) | (0.0056) | (0.0061) |
| Ln(Disposable\_income) | 7.5×10-4\*\*\* | 0.102\*\*\* | 82.84\*\*\* | -0.0018 | 0.0169\*\*\* | -0.0151\*\*\* |
|  | (2.2×10-4) | (0.025) | (20.58) | (0.0031) | (0.0038) | (0.0038) |
| Has\_one\_child | -5.7×10-4 | -0.064 | 41.04 | -0.0036 | -0.0088 | 0.0124 |
|  | (5.2×10-4) | (0.058) | (47.20) | (0.0068) | (0.0076) | (0.0084) |
| Has\_two\_or\_more\_’children | -0.004\*\*\* | -0.021 | 24.16 | -0.0028 | -0.0140\*\* | 0.0168\*\* |
|  | (4.6×10-4) | (0.051) | (42.21) | (0.0060) | (0.0067) | (0.0075) |
| Married\_or\_cohabiting | 0.002\*\*\* | -0.157\*\*\* | -73.19 | 0.0291\*\*\* | 0.0114 | -0.0405\*\*\* |
|  | (5.4×10-4) | (0.060) | (49.32) | (0.0071) | (0.0080) | (0.0088) |
| Divorced\_or\_widowed | 5.6×10-4 | 0.053 | 54.13 | 0.0171\* | 0.0159 | -0.0330\*\*\* |
|  | (6.9×10-4) | (0.078) | (64.34) | (0.0094) | (0.0103) | (0.0113) |
| Urban\_residence | -2.7×10-4\*\*\* | 0.167\*\* | 141.6\*\*\* | -0.0435\*\*\* | 1.4×10-4 | 0.0434\*\*\* |
|  | (5.1×10-4) | (0.056) | (45.91) | (0.0063) | (0.0075) | (0.0083) |
| Swedish-speaker | -0.023\*\*\* | -0.291\* | 12.93 | 0.0057 | -0.0826\*\*\* | 0.0770\*\*\* |
|  | (0.001) | (0.169) | (138.5) | (0.0202) | (0.0243) | (0.0253) |
| Constant | - | 0.565 | -2510.8\*\*\* | - | - | - |
|  |  | (0.559) | (459.3) |  |  |  |
| R2 (Pseudo R2) [Log likelihood] | (0.027) | 0.060 | 0.023 | [-16,158.121] | | |
| Notes: N = 705,089 in the participation model. N = 15,488 in other models. The reference categories are not employed, secondary education, no children, single, first language not Swedish. The Table presents average marginal effects from probit and fractional multinomial logit models. A marginal effect is calculated for each individual at the covariate values for that individual and these marginal effects are then averaged over all individuals. Statistical significance: \*\*\*Significant at 1%, \*\*Significant at 5%, \*Significant at 10%. | | | | | | |

***Using non-linear measures of IQ in empirical models***

We also estimated the participation model with non-linear measures of IQ. The model specification included quadratic terms of IQ variables. The models were estimated with probit regression and we report marginal effects of coefficient estimates, which are evaluated at means.

The results reported in Table E.4 indicate that, by and large, the results are qualitatively consistent with the baseline model reported in the paper. Composite IQ is a positive predictor of participation, but the quadratic term is not statistically significant. In regard to spatial logic IQ, the results imply a participation rate that becomes increasingly lower as spatial logic IQ increases. The marginal effects of verbal IQ and its quadratic term suggest a parabolic relationship between verbal IQ and participation: individuals that have high scores on verbal IQ tend to be less likely to wager on horse races even though the first order effect is positive. Finally, the marginal effects of mathematical IQ and its quadratic term indicate an increasingly increasing relationship between mathematical aptitude and participation in horse betting. Results on control variables are congruent with the baseline model.

Table E.4. Probit regression results of participation models when IQ variables are entered in the model with a quadratic term.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent variable | Participation | | | |
| Focus variables | Marginal effect | Marginal effect | Marginal effect | Marginal effect |
|  | Focus variables | | | |
| Composite\_IQ | 0.0004\*\*\*  (2.1×10-5) | - | - | - |
| Composite\_IQ2 | -2.6×10-5\*  (1.4×10-5) | - | - | - |
| Spatial\_logic\_IQ | - | -0.0009\*\*\*  (0.0002) | - | - |
| Spatial\_logic\_IQ2 | - | -0.0009\*\*\*  (0.0001) | - | - |
| Verbal\_IQ | - | - | 0.0015\*\*\*  (0.0002) | - |
| Verbal\_IQ2 | - | - | -0.0008\*\*\*  (0.0001) | - |
| Numerical\_IQ | - | - | - | 0.0076\*\*\*  (0.0002) |
| Numerical\_IQ2 | - | - | - | 0.0007\*\*\*  (0.0001) |
| Control variables | | | | |
| Age | 0.0035\*\*\*  (0.0002) | 0.0032\*\*\*  (0.0002) | 0.0033\*\*\*  (0.0002) | 0.0037\*\*\*  (0.0002) |
| Age2 | -4.0×10-5\*\*\*  (3.0×10-6) | -3.6×10-5\*\*\*  (3.0×10-6) | -3.8×10-5\*\*\*  (3.0×10-6) | -4.4×10-5\*\*\*  (0.0002) |
| Blue-collar | 0.0026\*\*\*  (0.0005) | 0.0022\*\*\*  (0.0005) | 0.0023\*\*\*  (0.0005) | 0.0032\*\*\*  (0.0005) |
| White-collar | -0.0017\*\*\*  (0.0005) | -0.0008  (0.0005) | -0.0012\*\*  (0.0005) | -0.0023\*\*\*  (0.0005) |
| Basic\_education | 0.0040\*\*\*  (0.0005) | 0.0024\*\*\*  (0.0005) | 0.0032\*\*\*  (0.0006) | 0.0051\*\*\*  (0.0005) |
| College | -0.0026\*\*\*  (0.0005) | -0.0009\*  (0.0005) | -0.0017\*\*\*  (0.0005) | -0.0044\*\*\*  (0.0005) |
| Post-graduate | -0.0144\*\*\*  (0.0007) | -0.0108\*\*\*  (0.0007) | -0.0122\*\*\*  (0.0007) | -0.0187\*\*\*  (0.0007) |
| Pays\_the\_church\_tax | 0.0033\*\*\*  (0.0004) | 0.0026\*\*\*  (0.0004) | 0.0029\*\*\*  (0.0004) | 0.0037\*\*\*  (0.0004) |
| Ln(Disposable\_income) | 0.0009\*\*\*  (0.0002) | 0.0010\*\*\*  (0.0002) | 0.0009\*\*\*  (0.0002) | 0.0007\*\*\*  (0.0002) |
| Has\_one\_child | -0.0004  (0.0005) | -0.0005  (0.0005) | -0.0005  (0.0005) | -0.0005  (0.0005) |
| Has\_two\_or\_more\_children | -0.0043\*\*\*  (0.0005) | -0.0043\*\*\*  (0.0005) | -0.0043\*\*\*  (0.0005) | -0.0044\*\*\*  (0.0005) |
| Married\_or\_cohabiting | 0.0015\*\*\*  (0.0005) | 0.0016\*\*\*  (0.0005) | 0.0015\*\*\*  (0.0005) | 0.0017\*\*\*  (0.0005) |
| Divorced\_or\_widowed | 0.0003  (0.0007) | 0.0003  (0.0005) | 0.0003  (0.0007) | 0.0004  (0.0007) |
| Urban\_residence | -0.0026\*\*\*  (0.0005) | -0.0019\*\*\*  (0.0005) | -0.0022\*\*\*  (0.0005) | -0.0031\*\*\*  (0.0005) |
| Swedish-speaker | -0.0218\*\*\*  (0.0013) | -0.0237\*\*\*  (0.0013) | -0.0224\*\*\*  (0.0013) | -0.0210\*\*\*  (0.0013) |
| Pseudo R2 | 0.0124 | 0.0106 | 0.0109 | 0.0208 |
| Notes: N = 705,809. The reference categories are not employed, secondary education, no children, single, first language not Swedish.  The Table presents average marginal effects from probit models. A marginal effect is calculated for each individual at the covariate values for that individual and these marginal effects are then averaged over all individuals.  Statistical significance: \*\*\*Significant at 1%, \*\*Significant at 5%, \*Significant at 10%. | | | | |

**E. References**

Aspara, J., Luo, X., and Dhar, R. (2017). Effect of intelligence on consumers’ responsiveness to a pro-environmental tax: Evidence from large-scale data on car acquisitions of male consumers. *Journal of Consumer Psychology*, 27(4), 448-455.

Aspara, J., and Wittkowski, K. (2019). Sharing-Dominant Logic? Quantifying the Association between Consumer Intelligence and Choice of Social Access Modes. *Journal of Consumer Research*, 46, 201-222.

1. Verbal intelligence is a form of ‘crystallized intelligence’ whereas executive functioning is a form of ‘fluid intelligence’. Gong and Zhu (2019) also demonstrate that Big 5 personality characteristics predict gambling participation. Palomäki et al (2021) combine personality traits and online horse wagering data and report findings that are largely consistent with Gong and Zhu (2019). [↑](#footnote-ref-1)
2. The findings presented in Ceci and Liker (1986) drew subsequent criticism (Reagan, 1987; Detterman & Spry, 1988), which warrants caution when interpreting their results. [↑](#footnote-ref-2)
3. The motivation of the Heckman model (Heckman, 1979) was to predict the *potential* wages of women who currently had zero income because they were not in the labour force. However, our goal is to predict the marginal effects of IQ on *actual* rather than *potential* consumption. [↑](#footnote-ref-3)
4. Suhonen and Saastamoinen (2018) show that horse bettors tend to spend the money they have won on further betting. [↑](#footnote-ref-4)
5. We also estimated our regression models without control variables. The results were qualitatively similar to the ones obtained with them included. [↑](#footnote-ref-5)
6. Disposable income is income (including any social security payments) minus taxes paid. [↑](#footnote-ref-6)
7. Finns can opt in to paying an additional levy to support the Lutheran church. Previous empirical research finds that paying the church tax is a positive predictor of participation in gambling even with a rich array of controls (Roukka and Salonen, 2019). [↑](#footnote-ref-7)
8. The effect size is calculated by . [↑](#footnote-ref-8)
9. Since January 1st, 2017, Fintoto Ltd has been a part of Veikkaus Ltd, a government-owned company which has a monopoly for all gambling products in Finland. [↑](#footnote-ref-9)
10. At the time, Suomen Hippos Group (The Finnish Trotting and Breeding Association) was the parent company of Fintoto Ltd. [↑](#footnote-ref-10)