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Intelligence, conscientiousness and extraversion moderate the house money effect in real-life financial decision-making

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ABSTRACT

Cognitive biases strongly influence risky decisions with payoffs. Financial risk-taking tends to increase following prior gains, as if gambling with “house money”. Intelligence and personality also influence risk preferences, but the extent to which they moderate susceptibility to cognitive biases is not understood. We evaluated the house money effect and its moderators by combining data from an online horse betting dataset, comprehensive administrative population registry, and intelligence and personality trait measures (N = 11,220). Gains on the previous betting day were associated with increased betting amounts on the following betting day and shorter time between two consequent sessions. This effect was stronger among individuals with higher extraversion, lower conscientiousness, and lower IQ. Intelligence and personality have tangible monetary implications in real-life risky choices.

1. Introduction

Human cognition is characterized by various biases and heuristics – mental shortcuts, or deviations from norms of judgement – which have been studied for decades by psychologists, cognitive scientists, and behavioral economists alike (Cárdenas et al., 2014; Gilovich et al., 2002; Rüdiger et al., 2017). Our decisions, particularly financial ones, are often made intuitively or based on affective impulses (Acciarini et al., 2021; Goyal et al., 2023; Jain et al., 2023; Mittal, 2022), which makes it notoriously difficult to systematically predict human behavior or the individual differences therein.

Decision-making and risk-taking are often investigated in controlled environments, using either one-off or iterated financial decisions designed for laboratory convenience (Breuer et al., 2022; Kahneman & Tversky, 1979). These decisions typically involve either accepting or rejecting gambles with varying known expected values but without significant adverse consequences or real-life relevance. In a laboratory setting, high stakes tend not to improve performance or debias decision-

making (Enke et al., 2023). However, real-life (human) financial decision-making, such as investing in stocks, taking loans, or gambling, often involves repeated decisions where long-term results are shrouded by statistical variance and other vagaries. In such environments, decisions have tangible and often negative consequences, and previously accrued gains and losses influence how people view their future financial prospects. Financial risk-taking in real life is, in other words, a path-dependent and dynamic process where decisions are heavily influenced by past outcomes and contextual factors (see also Häusler et al., 2018; Palomäki et al., 2020).

The *house money effect* is a well-known phenomenon where risk-taking increases following previous monetary wins in, for example, investing or gambling (Cárdenas et al., 2014; Flepp & Rüdiger, 2019; Frino et al., 2008; Grinblatt et al., 2012; Hsu & Chow, 2013; Rüdiger et al., 2017). The effect may be due to mental accounting whereby people mentally segregate their funds into what they started with and what they have won: being a winner on “house money” mitigates emotional aversion to losing money – or at least the money that came

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from the house –, thus making it easier to spend it further (Thaler & Johnson, 1990). However, financial risk-taking may also increase following previous losses, as often seen when gamblers continue betting to recoup or chase after what they lost (American Psychological Association, 2013; Zhang & Clark, 2020). These results appear to offer conflicting insights into human behavior, with risk-taking increasing following both wins and losses, depending on the context. Thaler and Johnson (1990) suggested that the house money effect occurs when, after a gain, subsequent losses are smaller than the original gain and can be integrated with it, thus mitigating loss aversion. However, the house money effect may diminish if potential losses approach the initial gains. Chasing, in turn, may occur primarily when future wagers offer a chance to break even and fully offset previous losses. In later work using simplified slot machines, Demaree et al. (2012) found support for the house money effect when trial-based winning probability was 87 % (but not when it was 13 % or 50 %), and conversely, chasing occurred when winning probability was 13 % (but not 87 % or 50 %).

Individual variation in psychological traits, such as personality, as well as cognitive abilities, have also been studied as boundary conditions (i.e., statistical moderators) to biasing effects in financial risk-taking. Behavioral economics has traditionally assumed that human actions are driven by bounded rationality, where satisfactory outcomes are accepted over strictly optimal ones (e.g., Kahneman, 2003). Similarly, within the bounded rationality framework, “fast-and-frugal” cognitive processing style dictated by emotions, gut feelings, and intuition, is known to bias decision-making (also known as “System 1” processing; e.g., Kahneman & Klein, 2009). Higher cognitive ability, however, can buffer against these biases, giving individuals better access to slow and deliberate (“System 2”) cognitive processing. For example, high cognitive ability has been linked with a lowered susceptibility to the house money effect in a laboratory setting (Hackinger, 2016) as well as to a lowered susceptibility to the disposition effect in stock trading (i.e., investors’ tendency to sell assets that have increased in value but holding on to assets that have dropped in value, see Grinblatt et al., 2012).

In terms of personality traits, recent evidence has underscored the significant role of extraversion in financial decision-making as well as reward processing (e.g., Palomäki et al., 2021; Skatova et al., 2013). Extraverts are typically viewed as enthusiastic, talkative, and assertive; they enjoy others’ company and generally view events positively (Fishman et al., 2011). However, research has also drawn attention to the conceptual link between extraversion and reward sensitivity, suggesting that extraverted individuals are drawn to social situations primarily because they are inherently rewarding (Depue & Collins, 1999; Smillie, 2013). Extravert investors, compared with introverts, were found more susceptible to various cognitive biases such as the disposition effect, herding and overconfidence (Ahmad, 2020). In a similar vein, extraversion was found to reduce myopic loss aversion in financial decision-making (Durand et al., 2019), indicating that extraverted individuals are less concerned about losses than introverts are, putatively due to overconfidence or a bias towards optimism. Finally, Palomäki et al. (2021) found that extraversion was positively associated with the probability of being a horse race bettor and horse race betting intensity, while the reverse was true for conscientiousness, suggesting that extraverts are drawn to betting, while conscientious individuals are repelled by it.

Few studies have found links between conscientiousness and susceptibility to cognitive biases. Earlier research has linked low conscientiousness with negative attitudes towards gambling, as well as gambling problems (Brunborg et al., 2016; McGrath et al., 2018; Quigley et al., 2015). Conscientiousness is also linked with reduced risk-taking in asset accumulation, investing, and pension accumulation (Kausel et al., 2016; Letkiewicz & Fox, 2014; Oehler & Wedlich, 2018), and negatively associated with horse race betting participation and bet sizes (Palomäki et al., 2021). Conscientiousness also reflects effortful control, regulatory mechanisms, and stable psychosocial functioning (e.g., Zhao & Smillie,

2015). These findings may suggest conscientiousness is about risk averse goal selection and prioritization, as well as strategic and diligent resource management (Bagby et al., 2007; MacLaren et al., 2011; Rueter et al., 2018). In terms of reduced susceptibility to cognitive biases, however, the role of conscientiousness is not as clear. Some evidence suggests that conscientiousness is associated with increased emotional aversion towards losses, which may partly explain why conscientious individuals are diligent and avoid risks in financial decisions (Boyce et al., 2016). The house money effect may stem from emotional factors, such as a reduced fear of losing or overconfidence after winning. Because high conscientiousness, alongside high intelligence, both reflect strong executive cognitive control (Chen et al., 2019; Fleming et al., 2016), the traits may reduce the influence of emotional processes on decision-making. Moreover, if the house money effect reflects decreased emotional aversion to losses, conscientious individuals might be less susceptible to it due to a stronger initial predisposition to loss aversion.

Many studies on the house money effect have relied on voluntary self-report questionnaires and artificial laboratory settings, which have known limitations such as self-selection effects and various social biases that skew responses (e.g., Fisher, 1993). These limitations can be circumvented by analyzing actual longitudinal betting data over many consequent sessions and individuals, but such studies are scarce. One longitudinal study analyzed gambling operator data and found that while online gamblers tended to increase their betting over long-term losses, they also increased betting after more recent gains (Ma et al., 2014). Another field study discovered that gamblers reduced their wagering on sessions following large losses (Rüdiger et al., 2017). Finally, a study of individual horserace bettors’ dynamic behavior in a single race meeting found that bettors make more risky bets after gains with the money they had won, whereas after losses they reduced risk taking and focused on recouping incurred losses (Suhonen & Saastamoinen, 2018). These findings based on actual betting behavior data suggest that prior gains or losses result in riskier or more cautious betting, respectively, on the following session (though not over the long-term). However, to our best knowledge, there are no studies on actual financial risk taking which also evaluate the effects of psychological traits as behavioral moderators.

1.1. Current study

Here we evaluate how winning on the previous betting session affects betting behavior on the following session by matching data from three sources: online horse betting panel data from the Finnish monopoly betting company, Veikkaus Ltd; administrative registry data on the Finnish population from Statistics Finland; and intelligence test data from the Finnish Defence Forces (FDF). Specifically, we operationalize the house money effect as the size of individuals’ daily bets (following either winning or non-winning betting days), and as the number of days between two consequent betting sessions. This dual operationalization posits that when bettors have won on their previous betting day, their risk-taking increases, which is, in turn, reflected not only in increased bet sizes but also in decreased number of days between consecutive sessions. Notably, the number of days between betting sessions has previously been used to operationalize between-session chasing (Banerjee et al., 2023; Zhang et al., 2024), whereby risk-taking increases (i.e. there are fewer days between sessions) following losses. This indicates that the variable itself is a reasonable measure of risk-taking, despite being used in a different behavioral context, where risk-taking is assumed to increase following losses instead of wins.

We ask the following research question (RQs): 1) Can we observe the house money effect in a naturalistic betting environment over many repeated betting days? 2) Do individual differences in intelligence quotient (IQ) or personality traits moderate the possible biasing effects of prior gains; that is, do these effects manifest differently for people with varying levels of intelligence and/or personality?

Unlike previous research, we can adjust our analyses for the effects of

various socioeconomic variables, which enables controlling for many potentially confounding factors known in financial decision-making (Dhar & Zhu, 2006; Vaarmets et al., 2019). People's responses to financial gains or losses may be highly nuanced, as is evidenced by the somewhat inconclusive evidence on the house money effect. By combining three rich data sources, we seek to provide a detailed description of the trait moderators in a well-known financial decision-making bias, the house money effect.

2. Method

2.1. Design and participants

We analyzed individuals' day-to-day horse betting behavior for one year. Our dataset combined individual-level 1) IQ and personality trait data from the Finnish Defence Forces (FDF), 2) online horse betting data from Fintoto Ltd (a state-owned gambling monopoly, currently known as Veikkaus Ltd), and 3) administrative registry data from Statistics Finland. The final sample size, which represented the intersection of all data sources, included 11,220 male individuals aged 36–54 (details below). This study was approved by the University of Eastern Finland's Committee on Research Ethics. The study was not preregistered.

2.2. Betting data

The data contain all horse race wagers made by 47,234 bettors on the operator's online accounts between September 1, 2015, and August 31, 2016. This accounts for 364 potential betting days per participant (betting was possible on every day except Christmas Eve and Christmas Day). Specifically, the data include the day-to-day amounts staked on various betting products, the number of bets made and returns on wagers at the individual level (see Suhonen et al., 2023 for more details on the betting environment and betting formats).

2.3. Administrative registry data

We controlled our analyses with a range of socioeconomic variables based on previous conventions (Aspara et al., 2017; Grinblatt et al., 2011; Palomäki et al., 2021; Suhonen et al., 2023; see also the [Supplementary Materials table S1](#)). These data were drawn from the national FOLK database for 2015, which is an administrative registry database maintained by Statistics Finland. The database covers the entire Finnish population between ages 15 and 70 (~3.92 million individuals). However, since IQ and personality trait data is available only for men, as will be explained below, our analyses cannot control for biological sex.

2.4. IQ and personality trait data

The FDF administers cognitive ability and personality tests to all conscripts at the beginning of service to screen potential candidates for noncommissioned officer training. Data is available for all conscripts between 1982 and 2000, during which time the tests remained unchanged. These data cover 71 % of all Finnish men between the 1962 and 1980 birth cohorts ($N = 471,984$). Most conscripts (98 % during the period observed) are male since military service is mandatory for males between the ages of 18 and 28, and voluntary for females.

The IQ test is mandatory and taken under group-administered conditions across various FDF units. It comprises subtests for numerical-, verbal-, and spatial logic aspects of cognitive ability, with 40 multiple choice questions in total. The data records the test date as well as the individual-wise number of correct responses. We use the arithmetic mean of the three subtests as a general measure of intelligence (composite IQ, standardized year-wise [Mean = 0, SD = 1]) to remove potential secular trends in IQ such as the Flynn-effect. The IQ test subcomponents are positively correlated (r s between 0.59 and 0.7), but not analyzed separately in the current study (for more details on IQ-

related results on the same data, see Aspara et al., 2017; Aspara & Wittkowski, 2019; Grinblatt et al., 2011, 2012, 2016; Grinblatt & Keloharju, 2009; Suhonen et al., 2023).

The personality test measures the subtraits of (a) achievement striving, (b) activity-energy, (c) deliberation, (d) dutifulness, (e) leadership motivation, (f) masculinity, (g) self-confidence, and (h) sociability. The test has between 18 and 33 “yes/no” items for each subtrait (218 items in total). Overall personality scores are the sum of all “yes” responses (or “no” responses for reverse-coded items). Only the overall scores were disclosed by the FDF. The measures were standardized year-wise. The Cronbach's alphas for the subtraits range from 0.6 to 0.9 (average = 0.75; see Jokela et al., 2017; Palomäki et al., 2021). Jokela et al. (2017) established the convergent validity between the FDF personality test and the Five Factor Model of personality (FFM): Most of the FDF traits were related to Conscientiousness and Extraversion. Following Palomäki et al. (2021), we used principal component analysis (PCA) to form two constructs reflecting Conscientiousness (comprising deliberation, achievement striving and dutifulness) and Extraversion (comprising leadership motivation, activity-energy and sociability) in the FFM.

2.5. Combined panel data set

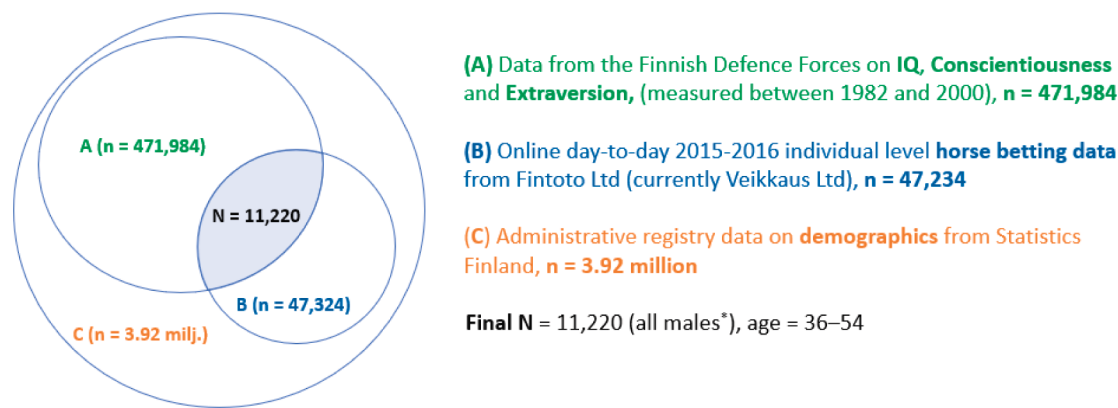
All three datasets (betting, administrative registry, and IQ and personality trait data) were combined by Statistics Finland with individual social security numbers encrypted. Combining the datasets yielded a sample of 11,220 male individuals aged 36–54 who had also participated in online horse betting – that is, they had placed at least one bet during the observation period (see Fig. 1). The IQ-, personality-, and registry data were measured only once, while betting behavior is repeatedly measured across the observation period (the data period cover 364 days between 1.9.2015 and 31.8.2016).

2.6. Variables and statistical analyses

Since there are multiple observations from a single individual's betting behavior, we used random effects regressions with clustered standard errors (Cameron & Trivedi, 2005). Our predictor variables were a) a dummy-coded variable *winner* indexing whether the bettor had won on their previous betting day, that is, came out ahead overall by the end of the betting day (1 = won on previous betting day, 0 = did not win on previous betting day), b) measures of IQ, Extraversion and Conscientiousness, c) the two-way interactions between the dummy-coded *winner* variable and the three measures of IQ, Extraversion and Conscientiousness. The dependent variables were a) the amount wagered on a given day (in euros; *daily bet*), and b) the time (in days) it took for bettors to return betting after their previous betting session (*days between sessions*, *DBS*). We use the following random effects model for an unbalanced panel:

$$\ln(DV)_{it} = \alpha_i + Dgain_{i,t} + IQ_i + Conscientiousness_i + Extraversion_i + IQ_i \times Dgain_{i,t} + Dgain_{i,t} \times Conscientiousness_i + Dgain_{i,t} \times Extraversion_i + IndividualControls_i + DayControls_t + MonthControls_t + \varepsilon_{i,t}, \quad i = 1 \dots N, \quad t = 1 \dots T \quad (1)$$

where $\alpha_i = \alpha + v_i$ and v_i is an individual random variable. Thus, $\alpha_i + \varepsilon_{i,t}$ is treated as an error term including two components: an individual-fixed component, α_i , which does not vary over time, and an error term, $\varepsilon_{i,t}$, which accounts for other unobserved factors affecting the dependent variable and is assumed to be uncorrelated over time. The indices i and t represent individuals and days, respectively. The day and month controls are, respectively, day of the week and calendar month dummy variables.



Note. Diagram visualization of the data sources used. *Military service is mandatory only for males.

Of the betting account holders, 75.2% were male.

Fig. 1. Diagram of data sources.

2.7. Transparency and Openness

We report how we determined our sample size, all data exclusions, and all measures in the study. There were no experimental manipulations. This study's design and its analysis were not pre-registered. The materials for this study are not available due to legal constraints.

3. Results

3.1. Descriptive statistics

There were 11,220 bettors in total, whose average betting volume per day was 47.8 euros (SD = 280.9) and the median was 18.7 euros. The average betting volumes following *winning* and *losing* days were 71.75 (SD = 323.2, $n = 7,339$) and 48.17 (SD = 298.5, $n = 9,772$) euros, with medians of 26.47 and 18.55 euros, respectively. Thus, as can be seen in Table 1 and Fig. 2, average daily betting volume was significantly larger on days that follow a winning day, compared with days that followed a losing day (and all days combined), which reflects the *house money* effect. Similarly, the average numbers of days between sessions following winning and losing days were 6.18 (SD = 16.65, $n = 7,339$) and 18.12 (SD = 32.81, $n = 9,772$), with medians of 1.93 and 6.88, respectively, while the total average was 13.38 (SD = 6.07) and the median was 6.97 (see Table 1 and Fig. 2).¹

3.2. Regression modelling

Table 2 presents regression coefficients and other model statistics for two models with *daily bet* and *days between sessions (DBS)* as the dependent variables. If the bettor had won on their previous betting day (dichotomous measure), their amount wagered on the following day increased ($B = 0.373$, $SE = 0.006$, $p < 0.001$), corresponding to a proportional increase of 45.2 % for the average bettor. There was a similar effect for *DBS*: having won on the previous day decreased the number of

days it took for bettors to return playing ($B = -0.178$, $SE = 0.003$, $p < 0.001$), corresponding to a proportional decrease of 16.3 % for the average bettor. Together, these results reflect the house money effect, providing positive evidence for RQ 1 (“Can we observe the house money effect in a naturalistic betting environment over many repeated betting days?”).

For *daily bet*, there were significant interaction effects between the dichotomous *winner* variable and IQ as well as the personality variables (IQ interaction: $B = -0.039$, $SE = 0.007$, $p < 0.001$; Conscientiousness interaction: $B = -0.038$, $SE = 0.008$, $p < 0.001$; Extraversion interaction: $B = 0.041$, $SE = 0.008$, $p < 0.001$). Thus, a one SD increase in IQ was associated with a 3.9 % decrease, a one SD increase in conscientiousness was associated with a 3.8 % decrease, and a one SD increase in extraversion was associated with a 4.3 % increase in the strength of the statistical effect of *winner* on daily bet sizes. There were similar significant interactions with *DBS* as the dependent variable (IQ interaction: $B = 0.0238$, $SE = 0.003$, $p < 0.001$; Conscientiousness interaction: $B = 0.008$, $SE = 0.003$, $p < 0.05$; Extraversion interaction: $B = -0.0141$, $SE = 0.003$, $p < 0.001$). Thus, a one SD increase in IQ was associated with a 2.4 % increase, a one SD increase in conscientiousness was associated with a 0.8 % increase, and a one SD increase in extraversion was associated with a 1.4 % decrease in the strength of the statistical effect of *winner* on *DBS*. To sum, the effect of *winner* on both daily bet and *DBS*, that is, the house money effect, was stronger for individuals with lower IQ, low conscientiousness, and high extraversion scores (see table 2 and figure 3 for a visualization of marginal effects). This provided positive evidence for RQ 2 (“Do individual differences in IQ or personality traits moderate the possible biasing effects of prior gains?”).

The main effects of IQ, conscientiousness and extraversion were also statistically significant (except the effect of extraversion with *DBS* as the dependent variable). These effects have, however, been previously reported and discussed in a separate article (Palomäki et al., 2021) and are thus not focused on here.

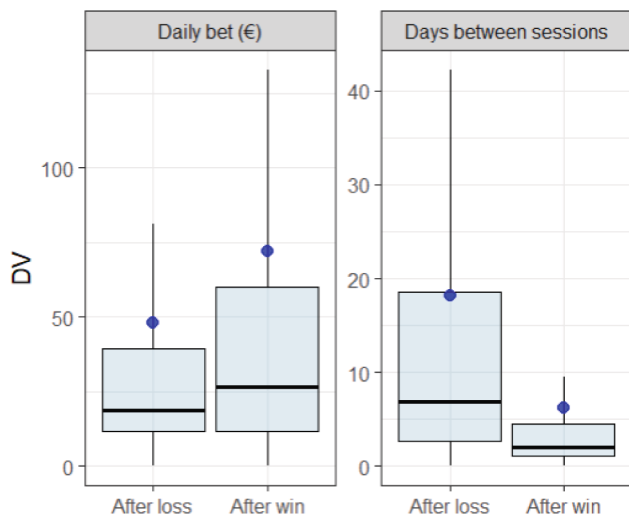
Fig. 3 depicts the estimated marginal effects of winning on the previous day on daily bet sizes (left-hand side) and days between sessions (right-hand side) across the value ranges of Extraversion, Conscientiousness, and IQ, while other covariates are held constant at their means. For individuals with low or high IQ scores (2 SDs below or above the mean), daily bet sizes were 57.9 % or 34.8 % higher, respectively, after winning days than non-winning days. In monetary terms, after a winning day, individuals with low or high IQ had daily bet sizes of €75.49 (i.e., $€47.81 \times 1.579$) or €64.44 (i.e., $€47.81 \times 1.348$),

¹ The numbers 9772 and 7339 do not refer to the total number of losing and winning days, respectively, across all individuals. Rather, they are the numbers of individuals who were counted towards the means of each variable. For example, for “daily bet after win”, the mean is 71.79 based on 7339 individuals with at least one winning session across the year. Across all individuals and all betting days, 84 % days were losing days, and 14.5 % were winning (the remaining 1.5 % being first days, thus reference points).

Table 1
Descriptive statistics (N = 11220).

	N	Mean	Median	SD	p1	p10	p25	p75	p99
Daily bet all	11,220	47.81	18.70	280.91	0.90	1.00	8.94	39.03	415.72
Daily bet after win	7,339	71.76	26.48	323.21	1.20	5.40	11.56	60.00	686.25
Daily bet after loss	9,772	48.17	18.56	298.60	1.00	4.25	11.56	39.33	427.03
Days between sessions (DBS)	9,880	13.38	6.07	19.15	1.00	1.42	2.50	15.98	95.33
DBS after win	7,339	6.18	1.93	16.65	1.00	1.00	1.09	4.46	81.67
DBS after loss	9,772	18.12	6.88	32.81	1.00	1.48	2.68	18.50	169.00
Game types played	11,220	1.96	1.8	0.851	1	1	1.316	2.371	4.798
Days played	11,220	59.13	17	83.565	1	1	4	81	337

Note. p1 – p99 refer to data percentiles. The Ns for “Daily bet all” and “Days between sessions” also include the participants who only placed one bet during the observation period, and for whom there are thus no repeated measurements.



Note. Outliers are removed for clarity, please refer to Table 1. Blue dots represent mean values.

Fig. 2. Boxplot of raw data for Daily bet (in euros) and Days between sessions.

respectively (with average bet sizes after all betting days being €47.81). For Conscientiousness the results were very similar: individuals with low or high Conscientiousness scores ($-/+ 2$ SDs) had 55.4 % or 33.1 % higher daily bet sizes, respectively, after winning days than non-winning days – corresponding to daily bet sizes of €74.29 (low Conscientiousness) and €63.63 (high Conscientiousness) following winning days. For Extraversion, however, the results were the opposite: individuals with low or high Extraversion scores ($-/+ 2$ SDs) had 33.5 % or 57.8 % higher daily bet sizes, respectively, after winning days than non-winning days, which correspond to daily bet sizes of €63.82 (low Extraversion) and €75.42 (high Extraversion) following winning days.

In the models, for low IQ (-2 SDs) bettors, winning on the previous day was observed to reduce the number of days between betting sessions from 13.38 days to 10.67 days, corresponding to a 20.3 % decrease. For high IQ ($+2$ SDs) bettors the number of days between sessions was observed to be 11.73 (a 12.3 % decrease) after a winning day. Bettors with low or high Conscientiousness scores ($-/+ 2$ SDs) were observed to return to betting in 11.06 (a 17.3 % decrease) or 11.45 (a 14.5 % decrease) days, respectively, after a winning day. Finally, bettors with low or high Extraversion scores ($-/+ 2$ SDs) were observed to return to betting in 11.55 (a 13.6 % decrease) or 10.92 (a 18.4 % decrease) days, respectively, after a winning day.

3.3. Additional analyses

As a robustness check, we fit additional models without including the IQ and personality variables. This allowed for including also biological sex in the analysis, and a significantly larger sample size due to the inclusion of females and males for whom there is no IQ and personality data, but who have played on the gambling operator’s site (Daily bet N = 45,090; Days between sessions N = 39,275). The main results for the house money effect remained by and large the same (Daily bet: $B_{winner} = 0.357, p < 0.001$; Days between sessions: $B_{winner} = -0.163, p < 0.001$), demonstrating the robustness of the findings (see the [Supplementary Materials](#), tables S3–S5). We also performed our analyses using fixed (instead of random) effects modelling, since some unobserved effects of, for example, betting skill or risk aversion may have correlated with other independent variables. Additionally, we fit a model controlling for individuals’ betting gametype categories based on their takeout rates, which to some extent reflect the “riskiness” of betting (the difficulty of the game increases with increasing takeout rates; see the [Supplementary Materials](#) tables S6–S7). The results largely mirrored our main findings: the random- and fixed effects models produced estimates of 0.373 and 0.364 (DV: Daily bet), and of -0.178 and -0.173 (DV: Days between sessions) for the “winner” dummy variable, respectively.

In our main analyses, decisions were compared against the baseline

Table 2

Regression coefficients for two models (DV 1: Daily bet, DV 2: Days between sessions, both DVs log-transformed).

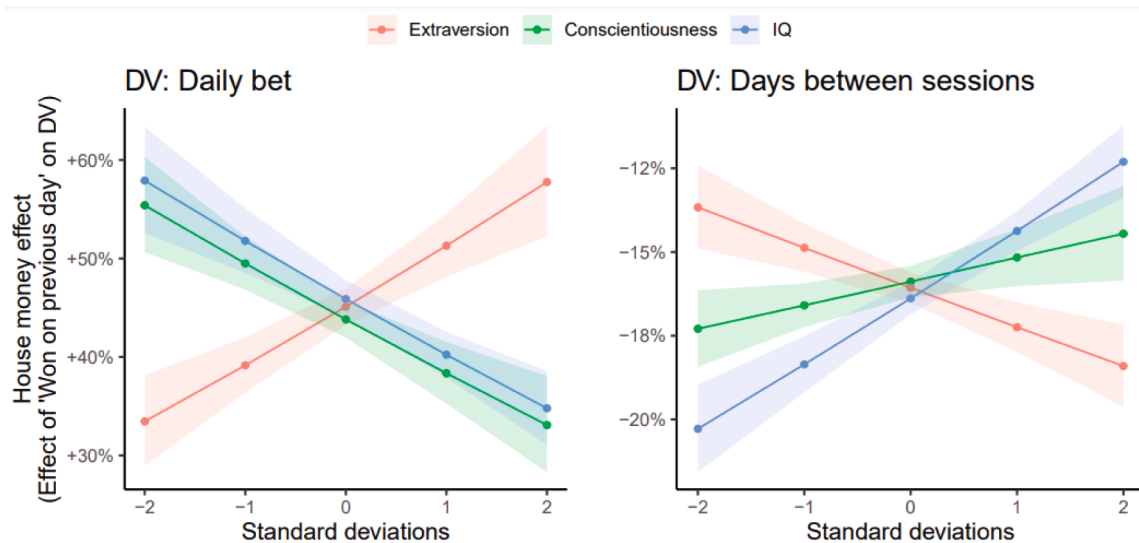
	Dependent variable	
	ln(Daily bet) (SE)	ln(Days between sessions) (SE)
Focus variables		
Winner (0 = did not win, 1 = won)	0.373*** (0.00687)	-0.178*** (0.00304)
IQ (standardized)	0.131*** (0.0136)	-0.0337** (0.0107)
Conscientiousness	-0.0956*** (0.0147)	0.0268* (0.0118)
Extraversion	0.119*** (0.0148)	0.0150 (0.0116)
Winner * IQ	-0.0396*** (0.00719)	0.0238*** (0.00339)
Winner * Conscientiousness	-0.0387*** (0.00800)	0.00844* (0.00361)
Winner * Extraversion	0.0418*** (0.00835)	-0.0141*** (0.00349)
+ Several control variables (see the Supplementary Materials table S2 for details)		
Intercept	2.228*** (0.177)	2.208*** (0.123)
R ² within, between, overall	0.0491, 0.0465, 0.0541	0.0385, 0.0444, 0.0375
Wald Chi ² test (p-value)	8,620.07 (<.001)	6,655.45 (<.001)
Number of individual bettors	11,220	9,880
Number of observations	663,439	652,219

Note. Standard errors in parentheses. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

of “not winning”. For a more transparent baseline, we included also a dummy variable for “losses” as a predictor. The results showed that having lost on the previous betting day decreased daily bet sizes and increased the number of days between sessions (see tables S8 and S9 for details). To evaluate whether the size of previous winnings affects subsequent betting behavior, we included a continuous variable for the previous day’s gains in the model, the slope of which was not statistically significant (see table S10 for details). This suggests that merely having won on the previous day, *not* the size of the winnings, has a stronger effect on subsequent betting behavior. Finally, we also examined potential nonlinear effects by including squared terms for IQ, Conscientiousness, and Extraversion in the models (see table S11). However, these analyses did not reveal any substantial nonlinear effects that would affect the interpretation of the results.

4. Discussion

In this study, we evaluated individual differences in a well-known bias in financial decision-making called the house money effect. We combined longitudinal data on online horse race betting with large datasets on IQ, personality traits, as well as various demographic background variables collected from the registries of the Finnish Defence Forces and Statistics Finland. We operationalized the house money effect as the influence of prior gains on subsequent betting behavior, namely, daily bet amounts and time (days) between playing sessions. We found evidence for the house money effect, and that it was moderated by IQ, conscientiousness, and extraversion: Individuals with lower IQ, higher extraversion, and lower conscientiousness were more susceptible to the bias. Our finding of bettors exhibiting behavior



Note. Daily bet and Days between sessions are log-transformed, while the scores for Extraversion, Conscientiousness, and IQ (on the x-axis) are standardized year-wise. The y-axis depicts the model coefficient (slope) of the dichotomous *winner* variable, which is transformed to percentages (via $\exp(\text{coefficient}) - 1$).

Fig. 3. Marginal effects from statistical interactions with Daily bet and Days between sessions as the dependent variables (DVs).

consistent with the house money effect between betting days extends those reported by [Suhonen and Saastamoinen \(2018\)](#) who documented the house money effect in a single race meeting.

Extraversion has traditionally been associated with sociability, but more recently also with reward processing ([Smillie, 2013; Smillie et al., 2019](#)). Conscientiousness and higher IQ have, in turn, been associated with goal prioritization and executive control, reduced impulsivity, increased self-control, and diligent financial management ([Bagby et al., 2007; Chen et al., 2019; Fleming et al., 2016; MacLaren et al., 2011; Rueter et al., 2018](#)). Our results are in line with [Ahmad \(2020\)](#) and [Durant et al. \(2019\)](#) who found links between extraversion and increased susceptibility to cognitive biases; as well as [Hackinger \(2016\)](#) and [Grimblatt et al. \(2011\)](#) showing that high IQ is associated with reduced bias susceptibility. Extraversion may be reflected in a bias towards optimism and overconfidence, which, in turn, results in overreacting to previous monetary gains ([Ahmad, 2020](#)). Being optimistic, overconfident and reward seeking in a betting environment may lead to an inflated belief of one's chances of winning in the future, especially when combined with low IQ and low impulse control, which is in line with our current findings. Our results also align with the reward processing framework of extraversion ([Smillie, 2013](#)), as well as the recent findings showing that extraversion is associated with increased betting propensity ([Palomäki et al., 2021](#)).

Our findings suggest that conscientiousness is much like IQ in that high scores in both traits are strongly associated with a diminished house money effect. Both traits, to some extent, reflect effortful control, proficient psychosocial functioning, and affective regulation. It is notable that despite this conceptual overlap, and after controlling for the effects of IQ, conscientiousness still had a significant effect in our models. Conscientious individuals are known to refrain from gambling, tend to diligently manage their finances, and take fewer financial risks in general ([Kausel et al., 2016; Letkiewicz & Fox, 2014; Oehler & Wedlich, 2018](#)), which may partly explain why their betting behavior was less affected by the previous dynamics of wins and losses.

People in general tend to experience potential losses as emotionally more severe than equivalent gains ([Kahneman & Tversky, 1979](#)). The mental accounting view of the house money effect suggests that mentally segregating funds into one's "personal" money and the "house" money may alleviate general emotional aversion towards losses ([Thaler & Johnson, 1990](#)). Moreover, loss-aversion has also been shown to be more pronounced for those with high conscientiousness ([Boyce et al., 2016](#)), but less pronounced for those with high extraversion ([Durand et al., 2019](#)). In terms of our current findings, reduced loss-aversion in the house money effect may be countered by trait conscientiousness and exacerbated by trait extraversion. It is also possible that, in our study, the similar moderating influence of IQ and conscientiousness on the house money effect was due to different underlying reasons. In a meta-analysis, cognitive ability was found to be linked with decreased risk aversion in the domain of gains ([Lilleholt, 2019](#)). Thus, the similar moderating effects of IQ and conscientiousness in our current study could indicate that high IQ is associated with a general reduced bias susceptibility, while high conscientiousness mitigates the house money effect via increased loss aversion. However, more work is needed to further explore this possibility.

4.1. Limitations, future work, and conclusions

While personality traits and IQ are quite stable across time, our results may nonetheless be diluted by the time gap (of 16 to 35 years) between the trait- and behavioral (betting) measurements. However, having observed *any* significant effects after such a time gap shows that trait measures like IQ, conscientiousness and extraversion are highly robust constructs with discernible effects on real life behavior. Our results on the interaction between the trait variables and the dichotomous winner variable (i.e., the house money effect) generalize only to males of a relatively narrow age range (36–54), although the house money effect

itself was robust after including both sexes in the analysis (see the [Supplementary Materials](#)) – implying some level of human universality.

Meta-analytic evidence shows typical effect sizes in psychological science are relatively modest ([Gignac & Szodorai, 2016; Richard et al., 2003](#)). While the effects sizes in our current study are not large by conventional standards, small effects can have significant consequences in cumulative decision-making environments ([Palomäki et al., 2020](#)). Moreover, [Kühberger \(2014\)](#) showed that effect sizes and sample sizes in psychological studies were strongly negatively correlated ($r = -0.45$), which may indicate that large sample sizes yield results closer to the truth.

Most people make financial decisions daily, and many of these decisions involve a chance of gain or loss. This is evident specifically in investing or gambling, and consequently the house money effect has been almost exclusively studied in the context of decisions that involve monetary payoffs. However, the effect, and its moderators, may also be relevant in decision-making more generally. Future work could draw insights from studies of consumer behavior, particularly post-purchase behavior, where emotional states such as delight, satisfaction, or dissatisfaction increase complementing or complaining ([Santos & Boote, 2003](#)). Few studies have, however, investigated how psychological traits moderate these effects. While there is a difference between being "satisfied" or "delighted" in one's purchase decision, and winning money after making a bet, a good purchase decision may nonetheless feel like a "win". The house money effect may thus be analogous to post-purchase behavior when the purchase is considered particularly successful and satisfying.

Moreover, given that we evaluated betting behavior only within a constrained domain, horse-betting, our results may not generalize across decision-making domains and should thus be interpreted with caution. While our results are in line with previous research, there is no single existing framework that clearly stands out as the "best explanation" to our findings. Earlier work ([Heath & Tversky, 1991](#)) suggests that perceived competence reduces ambiguity aversion, and in our data, winning may have made bettors feel more competent and thus increased their willingness to continue betting. It is also possible that individuals with high IQ are not merely less affected by the house money effect, but also differently affected, whereby a previous day's win shift their preference towards more complex games. Overall, the effect of monetary wins (as well as losses) on subsequent behavior warrants further work to better understand their relevance to cognitive biases.

In conclusion, our results shed light on the statistical relevance of well-known psychometric traits as moderators of decision-making in a real-life environment. Personality traits and IQ, despite being measured a significant time ago, are robust tools in describing and modelling human behavior. Our work also highlights the benefits of using "naturally occurring laboratories" such as online betting in behavioral economics and personality psychology.

Data availability

Due to the Finnish law on personal privacy, the data cannot be made publicly available. The reasons for this are: i) the administrative registry data set from Statistics Finland contains sensitive information on adult Finnish citizens, ii) the IQ data set from the Finnish Defence Forces includes cognitive ability test scores for most of the male population and iii) the betting data set from Veikkaus Ltd. contains sensitive information on individuals' gambling habits. For these reasons access to the data sets is restricted. Eligible researchers must apply for a permit from the owner of the data set. All estimations and data handling must be carried out at a secure server of Statistics Finland, which can only be accessed in Finland. It should also be noted that Statistics Finland reviews all output before it hands it over to researchers.

The authors of this study are willing to send all codes used to derive their results for a review. To replicate the results, however, there are three options. First, a researcher who wishes to replicate our results may send us the codes. We will make estimations and send the results back to the researcher. Second, a party wishing to replicate our results contacts

Statistics Finland and provides them with the codes. The staff at Statistics Finland will carry out estimations and after reviewing the results submits them to the party. Third, a researcher may come to Finland and apply for the permits to use the data sets. The researcher can visit the Finnish authors' institution in which the data access will be set up for him or her and replications can be carried out.

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Ethics statement

This study was approved by the University of Eastern Finland's Committee on Research Ethics.

CRedit authorship contribution statement

Jussi Palomäki: Writing – review & editing, Writing – original draft, Visualization, Validation, Investigation, Conceptualization. **Michael Laakasuo:** Writing – review & editing, Writing – original draft, Validation, Investigation, Conceptualization. **Sari Castrén:** Writing – review & editing, Investigation. **Tuomo Kainulainen:** Writing – review & editing, Validation, Investigation, Formal analysis, Data curation, Conceptualization. **Jani Saastamoinen:** Writing – review & editing, Validation, Investigation, Conceptualization. **Niko Suhonen:** Writing – review & editing, Validation, Resources, Project administration, Investigation, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jrp.2025.104669>.

Data availability

The data that has been used is confidential.

References

- Acciarini, C., Brunetta, F., & Boccardelli, P. (2021). Cognitive biases and decision-making strategies in times of change: A systematic literature review. *Management Decision*, 59(3), 638–652.
- Ahmad, F. (2020). Personality traits as predictor of cognitive biases: Moderating role of risk-attitude. *Qualitative Research in Financial Markets*, 12(4), 465–484.
- American Psychological Association. (2013). 2013. Text Revision: Diagnostic and statistical manual of mental disorders. <https://cir.nii.ac.jp/crid/1573950399819987840>.

- Aspara, J., Luo, X., & 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., & Wittkowski, K. (2019). Sharing-dominant logic? Quantifying the association between consumer intelligence and choice of social access modes. *Journal of Consumer Research*, 46(2), 201–222.
- Bagby, R. M., Vachon, D. D., Bulmash, E. L., Toneatto, T., Quilty, L. C., & Costa, P. T. (2007). Pathological gambling and the five-factor model of personality. *Personality and Individual Differences*, 43(4), 873–880.
- Banerjee, N., Chen, Z., Clark, L., & Noël, X. (2023). Behavioural expressions of loss-chasing in gambling: A systematic scoping review. *Neuroscience & Biobehavioral Reviews*, 153, Article 105377.
- Boyce, C. J., Wood, A. M., & Ferguson, E. (2016). Individual differences in loss Aversion: Conscientiousness Predicts how Life Satisfaction Responds to losses Versus gains in Income. *Personality and Social Psychology Bulletin*, 42(4), 471–484. <https://doi.org/10.1177/0146167216634060>
- Breuer, W., Rennerken, T., & Salzmann, A. J. (2022). Measuring risk-taking and patience in financial decision making. *Review of Financial Economics*, 40(1), 97–114. <https://doi.org/10.1002/rfe.1142>
- Brunborg, G. S., Hanss, D., Mentzoni, R. A., Molde, H., & Pallesen, S. (2016). Problem gambling and the five-factor model of personality: A large population-based study. *Addiction*, 111(8), 1428–1435. <https://doi.org/10.1111/add.13388>
- Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: Methods and applications*. Cambridge University Press.
- Cárdenas, J. C., De Roux, N., Jaramillo, C. R., & Martínez, L. R. (2014). Is it my money or not? an experiment on risk aversion and the house-money effect. *Experimental Economics*, 17(1), 47–60. <https://doi.org/10.1007/s10683-013-9356-x>
- Chen, Y., Spagna, A., Wu, T., Kim, T. H., Wu, Q., Chen, C., Wu, Y., & Fan, J. (2019). Testing a cognitive control model of human intelligence. *Scientific Reports*, 9(1), 2898.
- Demaree, H. A., Burns, K. J., DeDonno, M. A., Agarwala, E. K., & Everhart, D. E. (2012). Risk dishabituation: In repeated gambling, risk is reduced following low-probability “surprising” events (wins or losses). *Emotion*, 12(3), 495.
- Depue, R. A., & Collins, P. F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioral and Brain Sciences*, 22(3), 491–517.
- Dhar, R., & Zhu, N. (2006). Up Close and personal: Investor Sophistication and the Disposition effect. *Management Science*, 52(5), 726–740. <https://doi.org/10.1287/mnsc.1040.0473>
- Durand, R. B., Fung, L., & Limkriangkrai, M. (2019). Myopic loss Aversion, Personality, and Gender. *Journal of Behavioral Finance*, 20(3), 339–353. <https://doi.org/10.1080/15427560.2018.1511562>
- Enke, B., Gneezy, U., Hall, B., Martin, D., Nelidov, V., Offerman, T., & Van De Ven, J. (2023). Cognitive biases: Mistakes or missing stakes? *Review of Economics and Statistics*, 105(4), 818–832.
- Fisher, R. J. (1993). Social desirability bias and the validity of indirect questioning. *Journal of Consumer Research*, 20(2), 303–315.
- Fishman, I., Ng, R., & Bellugi, U. (2011). Do extraverts process social stimuli differently from introverts? *Cognitive Neuroscience*, 2(2), 67–73. <https://doi.org/10.1080/17588928.2010.527434>
- Fleming, K. A., Heintzelman, S. J., & Bartholow, B. D. (2016). Specifying Associations between Conscientiousness and Executive Functioning: Mental Set Shifting, not Prepotent Response Inhibition or Working memory Updating. *Journal of Personality*, 84(3), 348–360. <https://doi.org/10.1111/jopy.12163>
- Flepp, R., & Rüdiger, M. (2019). Revisiting the house money effect in the field: Evidence from casino jackpots. *Economics Letters*, 181, 146–148.
- Frino, A., Grant, J., & Johnstone, D. (2008). The house money effect and local traders on the Sydney Futures Exchange. *Pacific-Basin Finance Journal*, 16(1–2), 8–25.
- Gignac, G. E., & Szodorai, E. T. (2016). Effect size guidelines for individual differences researchers. *Personality and Individual Differences*, 102, 74–78.
- Gilovich, T., Griffin, D., & Kahneman, D. (2002). *Heuristics and biases: The psychology of intuitive judgment*. Cambridge University Press.
- Goyal, P., Gupta, P., & Yadav, V. (2023). Antecedents to heuristics: Decoding the role of herding and prospect theory for Indian millennial investors. *Review of Behavioral Finance*, 15(1), 79–102.
- Grinblatt, M., Ikäheimo, S., Keloharju, M., & Knüpfer, S. (2016). IQ and Mutual Fund Choice. *Management Science*, 62(4), 924–944. <https://doi.org/10.1287/mnsc.2015.2166>
- Grinblatt, M., & Keloharju, M. (2009). Sensation seeking, Overconfidence, and trading activity. *The Journal of Finance*, 64(2), 549–578. <https://doi.org/10.1111/j.1540-6261.2009.01443.x>
- Grinblatt, M., Keloharju, M., & Linnainmaa, J. (2011). IQ and Stock Market Participation. *The Journal of Finance*, 66(6), 2121–2164. <https://doi.org/10.1111/j.1540-6261.2011.01701.x>
- Grinblatt, M., Keloharju, M., & Linnainmaa, J. T. (2012). IQ, trading behavior, and performance. *Journal of Financial Economics*, 104(2), 339–362.
- Hackinger, J. (2016). Not all income is the same to everyone: Cognitive ability and the house money effect in public goods games. Available at SSRN 2786603. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2786603.
- Heath, C., & Tversky, A. (1991). Preference and belief: Ambiguity and competence in choice under uncertainty. *Journal of Risk and Uncertainty*, 4(1), 5–28.
- Häusler, A. N., Kühnen, C. M., Rudolf, S., & Weber, B. (2018). Preferences and beliefs about financial risk taking mediate the association between anterior insula activation and self-reported real-life stock trading. *Scientific Reports*, 8(1), 11207.
- Hsu, Y.-L., & Chow, E. H. (2013). The house money effect on investment risk taking: Evidence from Taiwan. *Pacific-Basin Finance Journal*, 21(1), 1102–1115.

- Jain, R., Sharma, D., Behl, A., & Tiwari, A. K. (2023). Investor personality as a predictor of investment intention—mediating role of overconfidence bias and financial literacy. *International Journal of Emerging Markets*, 18(12), 5680–5706.
- Jokela, M., Pekkarinen, T., Sarvimäki, M., Terviö, M., & Uusitalo, R. (2017). Secular rise in economically valuable personality traits. *Proceedings of the National Academy of Sciences*, 114(25), 6527–6532. <https://doi.org/10.1073/pnas.1609994114>
- Kahneman, D. (2003). Maps of Bounded Rationality: Psychology for Behavioral Economics. *American Economic Review*, 93(5), 1449–1475. <https://doi.org/10.1257/000282803322655392>
- Kahneman, D., & Klein, G. (2009). Conditions for intuitive expertise: A failure to disagree. *American Psychologist*, 64(6), 515.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 363–391.
- Kausel, E. E., Hansen, E., & Tapia, P. (2016). Responsible Personal Finance: The Role of Conscientiousness in Bank and Pension Savings in Chile. *International Review of Finance*, 16(1), 161–167. <https://doi.org/10.1111/irfi.12069>
- Kühberger, A., Fritz, A., & Scherndl, T. (2014). Publication bias in psychology: A diagnosis based on the correlation between effect size and sample size. *PLoS One*, 9(9), Article e105825.
- Letkiewicz, J. C., & Fox, J. J. (2014). Conscientiousness, Financial Literacy, and Asset Accumulation of Young adults. *Journal of Consumer Affairs*, 48(2), 274–300. <https://doi.org/10.1111/joca.12040>
- Lilleholt, L. (2019). Cognitive ability and risk aversion: A systematic review and meta analysis. *Judgment and Decision Making*, 14(3), 234–279.
- Ma, X., Kim, S. H., & Kim, S. S. (2014). Online Gambling Behavior: The Impacts of Cumulative Outcomes, recent Outcomes, and prior use. *Information Systems Research*, 25(3), 511–527. <https://doi.org/10.1287/isre.2014.0517>
- MacLaren, V. V., Fugelsang, J. A., Harrigan, K. A., & Dixon, M. J. (2011). The personality of pathological gamblers: A meta-analysis. *Clinical Psychology Review*, 31(6), 1057–1067.
- McGrath, D. S., Neilson, T., Lee, K., Rash, C. L., & Rad, M. (2018). Associations between the HEXACO model of personality and gambling involvement, motivations to gamble, and gambling severity in young adult gamblers. *Journal of Behavioral Addictions*, 7(2), 392–400.
- Mittal, S. K. (2022). Behavior biases and investment decision: Theoretical and research framework. *Qualitative Research in Financial Markets*, 14(2), 213–228.
- Oehler, A., & Wedlich, F. (2018). The relationship of extraversion and neuroticism with risk attitude, risk perception, and return expectations. *Journal of Neuroscience, Psychology, and Economics*, 11(2), 63.
- Palomäki, J., Laakasuo, M., Castrén, S., Saastamoinen, J., Kainulainen, T., & Suhonen, N. (2021). Online betting intensity is linked with Extraversion and Conscientiousness. *Journal of Personality*, 89(5), 1081–1094. <https://doi.org/10.1111/jopy.12637>
- Palomäki, J., Laakasuo, M., Cowley, B. U., & Lappi, O. (2020). Poker as a domain of expertise. *Journal of Expertise*, 3(2), 66–87.
- Quigley, L., Yakovenko, I., Hodgins, D. C., Dobson, K. S., el-Guebaly, N., Casey, D. M., Currie, S. R., Smith, G. J., Williams, R. J., & Schopflocher, D. P. (2015). Comorbid Problem Gambling and Major Depression in a Community Sample. *Journal of Gambling Studies*, 31(4), 1135–1152. <https://doi.org/10.1007/s10899-014-9488-8>
- Richard, F. D., Bond, C. F., & Stokes-Zoota, J. J. (2003). One Hundred Years of Social Psychology Quantitatively Described. *Review of General Psychology*, 7(4), 331–363. <https://doi.org/10.1037/1089-2680.7.4.331>
- Rüdisser, M., Flepp, R., & Franck, E. (2017). Do casinos pay their customers to become risk-averse? revising the house money effect in a field experiment. *Experimental Economics*, 20(3), 736–754. <https://doi.org/10.1007/s10683-016-9509-9>
- Rueter, A. R., Abram, S. V., MacDonald, A. W., Rustichini, A., & DeYoung, C. G. (2018). The goal priority network as a neural substrate of Conscientiousness. *Human Brain Mapping*, 39(9), 3574–3585. <https://doi.org/10.1002/hbm.24195>
- Santos, J., & Boote, J. (2003). A theoretical exploration and model of consumer expectations, post-purchase affective states and affective behaviour. *Journal of Consumer Behaviour*, 3(2), 142–156. <https://doi.org/10.1002/cb.129>
- Skatova, A., Chan, P. A., & Daw, N. D. (2013). Extraversion differentiates between model-based and model-free strategies in a reinforcement learning task. *Frontiers in Human Neuroscience*, 7, 525.
- Smillie, L. D. (2013). Extraversion and Reward Processing. *Current Directions in Psychological Science*, 22(3), 167–172. <https://doi.org/10.1177/0963721412470133>
- Smillie, L. D., Jach, H. K., Hughes, D. M., Wacker, J., Cooper, A. J., & Pickering, A. D. (2019). Extraversion and reward-processing: Consolidating evidence from an electroencephalographic index of reward-prediction-error. *Biological Psychology*, 146, Article 107735.
- Suhonen, N., & Saastamoinen, J. (2018). How do prior gains and losses Affect subsequent risk taking? New evidence from Individual-Level Horse race bets. *Management Science*, 64(6), 2797–2808. <https://doi.org/10.1287/mnsc.2016.2679>
- Suhonen, N., Saastamoinen, J., Forrest, D., & Kainulainen, T. (2023). Does IQ predict engagement with skill-based gambling? Large-scale evidence from horserace betting. *Journal of Behavioral Decision Making*, 36(2), e2300.
- Thaler, R. H., & Johnson, E. J. (1990). Gambling with the House Money and trying to break even: The Effects of prior Outcomes on Risky Choice. *Management Science*, 36(6), 643–660. <https://doi.org/10.1287/mnsc.36.6.643>
- Vaarmets, T., Liivamägi, K., & Talpsepp, T. (2019). How does learning and education help to overcome the disposition effect? *Review of Finance*, 23(4), 801–830.
- Zhang, K., & Clark, L. (2020). Loss-chasing in gambling behaviour: Neurocognitive and behavioural economic perspectives. *Current Opinion in Behavioral Sciences*, 31, 1–7.
- Zhang, K., Rights, J. D., Deng, X., Lesch, T., & Clark, L. (2024). Between-session chasing of losses and wins in an online eCasino. *Journal of Behavioral Addictions*, 13(2), 665–675.
- Zhao, K., & Smillie, L. D. (2015). The Role of Interpersonal Traits in Social Decision making: Exploring sources of Behavioral Heterogeneity in Economic Games. *Personality and Social Psychology Review*, 19(3), 277–302. <https://doi.org/10.1177/1088868314553709>