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Childhood gambling experiences and adult problem gambling

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Non-technical summary

Many countries are now increasing regulation of the gambling industry. A cornerstone of these regulatory efforts is the protection of children. Gambling is generally viewed as an age-inappropriate activity for children and there is an assumption that exposure to gambling as a child increases the risk of problem gambling (PG) in later in life. PG is when a person's gambling is disruptive and damaging to their lives, with negative repercussions on their finances, wellbeing and social circles.

Such regulation may reduce the profitability of a sector that generates considerable revenue and employment. It is therefore important that regulation is grounded in evidence from high-quality research on the impact of exposing children to gambling. In this study we test if adults who were more exposed to gambling as children are more likely to have PG. We do this using an online survey with a nationally representative sample of 1,663 adults in Ireland. The survey measured participants' PG and asked them if they had gambled before the age of 18, how much their parents gambled while they were growing up, and what was their parents' general attitude towards gambling.

Almost two-in-three adults (64%) report having gambled before turning 18. Playing slot machines was the most common form of gambling for money as a child (33%). This was followed by scratch cards (31%), horse or dog betting (27%), gambling amongst friends (23%), bingo (20%), and lotteries (20%). We find some differences between age cohorts: scratch cards, sports betting and loot boxes in video games were more prevalent forms of childhood gambling among the under 40s, while slots were more prevalent for those aged 40 plus.

Regarding our primary research question, we find strong links between childhood experiences of gambling and PG in adulthood. Those who gambled before the age of 18 are almost twice as likely to have PG, as are those who had a parent who gambled with high intensity during the person's childhood. Those whose parents had a more positive attitude towards gambling are also at an increased risk of having PG.

Having had one parent who gambled is linked to an increased chance of PG of about a third, relative to having no parent who gambled. This link is much stronger among those aged 40 or more, compared to the under 40s. Having had two parents who gambled is not linked to an increased chance of PG in the full sample, but is among the 40 plus age group. This weakening of the link between family-related factors and PG in the younger cohort may indicate changes to the sources of exposure to gambling among younger cohorts. Given the expansion of the gambling industry and growth of online gambling and advertising in particular, under 40s have been exposed to a much greater level of gambling accessibility and marketing during childhood than the 40 plus age group. The upshot may be that while parental gambling behaviour was previously a crucial factor in determining if a child will develop PG in adulthood, other factors have become more important.

Our study has implications for policy. The findings add to the weight of evidence for a link between childhood experiences of gambling and PG in adulthood. This in turn supports regulatory measures to minimise the exposure of children to gambling in order to reduce their risk of developing PG. These may include bans on children gambling or even entering a gambling premises, website or app. Strict, immediate age-verification safeguards may be warranted for digital gambling platforms. Assuming that advertising is at least to some degree effective, our findings also imply that the future level of PG may be reduced by minimising the exposure of children to gambling marketing, using measures such as a watershed ban on TV advertising, the prohibition of gambling advertisements that may be particularly attractive to children, and restrictions on sponsorship of events or clubs

where children are involved. Additionally, measures that protect parents from PG may indirectly help to reduce the risk of their children developing PG, given the links we find between parental gambling and later-life PG. One needs to bear in mind, however, that the influence of parents on PG risk appears to be weakening in younger age cohorts. This suggests that a focus on regulations that reduce the extra-familial exposure of children to gambling, such as regulation on accessibility and marketing, may be taking on greater importance.

The growing importance of extra-familial factors also has implications for PG treatment. It may mean that the profile of those seeking treatment is changing, with more people with no family history of gambling or PG presenting for treatment. Given this, future research on the changing profiles of PG treatment patients is warranted.

Abstract

Many countries are strengthening their regulation of the gambling industry. Measures to protect children from exposure to gambling are often an important component of regulation, as childhood exposure to gambling is thought to lead to problem gambling (PG) in adulthood. We report a pre-registered analysis of survey data from a nationally representative sample of adults in Ireland (N = 1,663). Almost two-in-three adults (64%) report having gambled before turning 18 and doing so is associated with an almost doubling of the risk of later-life PG. Having a parent who gambled and having parents with more positive attitudes towards gambling are also associated with increased risk of PG. Those who had a parent that gambled a lot are almost twice as likely to have PG. However, the relationship between parental behaviour and PG is weaker among younger age groups. Our findings support child-focused regulatory measures to restrict access and exposure to gambling for children.

Introduction

Problem gambling (PG) is gambling that is disruptive and damaging to a person's life, with negative repercussions on their finances, wellbeing and social circles. PG is an important public health issue in many countries (Reith et al., 2019; Wardle et al., 2021). For instance, the prevalence of PG in Ireland has been estimated at 3.3%, and at 2.5% in the UK (Ó Ceallaigh et al., 2023; UK Gambling Commission, 2023). The threat of PG has been exacerbated in recent years by the rapid growth in online gambling, the ubiquity of gambling advertising, and the development of new high-speed gambling products (Newall et al., 2019; Wardle et al., 2021). Policymakers have, in general, been slow to respond (Ukhova et al., 2023).

In an attempt to catch-up with these developments, many countries are now increasing regulation of the gambling industry. A cornerstone of many of these regulatory efforts is the protection of children. Gambling is generally viewed as an age-inappropriate activity for children and there is an assumption that exposure to gambling as a child increases the risk of PG later in life. While most countries prohibit children from gambling, regulation often further seeks to minimise the exposure of children to gambling marketing, or to ban gambling products or gambling-like activities (e.g. loot boxes in video games) that are particularly attractive to children. For instance, the UK has banned celebrities who may be of particular appeal to young people from appearing in gambling advertisements (Woodhouse, 2024), while proposed legislation in Ireland seeks to introduce a

watershed preventing gambling advertisements on TV and radio between 5.30am and 9.00pm (Houses of the Oireachtas, 2022).

Such regulation may have negative economic effects on a sector that generates considerable revenue and employment. It is therefore important that regulation is grounded in high-quality evidence on the impact of exposing children to gambling. Here, we test for a relationship between childhood experiences of gambling and adult PG, using an online survey with a nationally representative sample of 1,663 adults in Ireland. We measure participants' PG and their recall of childhood experiences of gambling. In particular, we ask participants about their experience of gambling before the age of 18, how much their parents gambled while they were growing up, and what was their parents' general attitude towards gambling. Using this data, we seek to answer the following confirmatory research question: are childhood experiences with gambling linked to increased risk of PG in later life? We also carry out additional exploratory analysis where we examine the links between childhood experiences and two other adult outcomes: gambling spend and attitudes towards gambling.

The remainder of this paper is structured as follows. The next section briefly reviews relevant international literature. This is followed by a brief overview of the gambling landscape in Ireland. We then describe our data and analysis plan before presenting the results and discussing the implications for policy.

Literature Review

Previous research suggests a link between starting to gamble in childhood and PG in later life, although the evidence is not conclusive. Cross-sectional studies from the US and UK show that, among adults with PG, starting to gamble earlier in life is associated with increased severity of PG (Burge et al., 2004, 2006; Sharman et al., 2019). Similarly, a large US general population study reports a link between early onset of gambling behaviour and likelihood of developing PG (Volberg, 1994). However, a different survey of young adult gamblers in the US finds no significant association between early onset of gambling behaviour and PG (Lynch et al., 2004).

The evidence from longitudinal studies is also mixed, although studies to date have been limited to assessing PG outcomes in adolescents and young adults. One meta-analysis of longitudinal studies reports that starting to gamble earlier in life is not significantly associated with PG (Dowling, Merkouris, et al., 2017). The estimated meta-correlation between the two variables is 0.13 with a 95% confidence interval of (−0.01, 0.28), indicating that this null finding is not conclusive. Indeed, of the studies included in the meta-analysis, half record a significant association between early gambling and later PG.

As to whether parental gambling behaviour increases the risk of PG, the existing evidence strongly suggests that this is the case. Cross-sectional studies from Australia, the UK, the USA and Canada find that adults that had a parent who had PG or who gambled frequently during the participant's childhood are more likely themselves to have PG (Delfabbro & Thrupp, 2003; Dowling et al., 2010, 2018; Oei & Raylu, 2004; Wardle, 2007; Wickwire et al., 2007; R. J. Williams et al., 2023). Children whose parents had PG have also been shown to be more likely to themselves have PG in studies from Italy, Australia, and Canada (Donati et al., 2023; Dowling et al., 2010; Dowling, Shandley, et al., 2017; Vachon et al., 2004; Vitaro et al., 2008). These findings are supported by a longitudinal study from the US that tracks its sample from adolescence to young adulthood (Winters et al., 2002). Nevertheless, one recent Australian study among adults who had at least one parent that gambled does not find a link between their PG and that of their parents (Suomi et al., 2024).

The evidence base for the link between PG and parents' attitudes towards gambling is not as well developed as that for the abovementioned relationships. A study from the US found that adolescents whose parents disapproved of gambling were less likely to have PG (Wickwire et al., 2007). In contrast, another US study and an Australian study find no significant relationship between adolescent PG and parents' attitudes towards gambling (Delfabbro & Thrupp, 2003; Leeman et al., 2014). These two studies do find, however, that adolescents gamble more frequently if their parents are more approving of gambling. These studies all focus on adolescent outcomes; there is a dearth of evidence on the link between PG in adulthood and parental attitudes.

This brief summary of the existing research highlights gaps in the evidence base on childhood gambling experiences and PG that our study seeks to address. Firstly, the bulk of the existing evidence comes from unrepresentative samples – less than a fifth of the studies cited above use representative general population samples. Secondly, the vast majority of previous research has been carried out using in-person or telephone survey methods, whereas our survey is carried out online. Measuring PG online, as opposed to face-to-face or over the phone, has considerable advantages because it mitigates social desirability bias (Ó Ceallaigh et al., 2023). Social desirability bias occurs when survey respondents provide answers they think will be viewed positively by others, and is particularly problematic for sensitive topics like PG (Nederhof, 1985). People may be more willing to divulge the full extent of their PG online, rather than in-person or over the phone, as an online survey gives greater anonymity (Krumpal, 2013).

Thirdly, as noted already, there are conflicting findings, particularly as regards the importance of early gambling and parental attitudes. More evidence is needed to resolve these conflicts, something that this study provides. Indeed, in the case of parental attitudes, there is a clear lack of evidence. Furthermore, it is possible that the discrepancies in findings in previous research are in part driven by the sampling and social desirability bias issues just discussed. Therefore, the evidence we provide takes on particular importance, given that our sample and survey design goes a long way towards addressing these issues.

The gambling landscape in Ireland

Gambling is a large industry in Ireland. In 2019, total revenue in Ireland from gambling (before winnings are subtracted) was estimated at €6-8 billion (Inter-Departmental Working Group on Future Licensing and Regulation of Gambling, 2019). This represented about 2% of GDP (Central Statistics Office, 2020). While land-based casinos are for the most part banned in Ireland,[1] all of the other main forms of land-based gambling are legal. Online gambling is also legal, including online casino gambling.

Around three-quarters of adults in Ireland report engaging in some form gambling in the previous month, with just under two thirds doing so through in-person means, and over a third doing so online (Ó Ceallaigh et al., 2023). The most widely played in-person forms of gambling are, in order of popularity: lotteries, scratch cards, horse and dog-betting, sports betting, slot machines and bingo. As for online, sports betting is the most popular form, followed by horse and dog betting, slots, lotteries, scratch cards, bingo and casino gambling.

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[1] At the time of writing, casinos that are open to the public are prohibited in Ireland. However, a loophole in the existing legislation, the Gaming & Lotteries Act, 1956 (Houses of the Oireachtas, 1956), allows for casinos to operate as private members clubs.

An estimated 3.3% of adults in Ireland have PG (Ó Ceallaigh et al., 2023). Another 7.1% suffer from multiple negative gambling experiences and behaviours, but are below the threshold to be classified as having PG. A new Gambling Regulation Bill is currently going through the Irish legislative process, and represents the first major overhaul of gambling laws in Ireland since 1956 (Houses of the Oireachtas, 2022). This Bill proposes to strengthen regulation of gambling in Ireland considerably, and contains provisions that directly target the protection of children. These include the prohibition of sponsorship of organisations, such as sports teams, in which children are members, as well as the previously mentioned watershed ban on gambling advertising on TV and radio.

Only a small number of studies have examined childhood gambling in Ireland. 23% of 16 year-olds have gambled for money in the previous 12 months, while 3% show signs of excessive gambling (McAvoy et al., 2023).[2] Among young males, those who play team sports are more likely to gamble regularly and to gamble online (Duggan & Mohan, 2022). Half of adults entering treatment for PG in Ireland began gambling before the age of 17, and a fifth lived with dependent children (Condron et al., 2022).

Methods

Our analysis plan was pre-registered on the OSF website at https://osf.io/us459/.

Sample and recruitment

The data for this study come from an online survey of a nationally representative sample of 3,000 adults in Ireland in July and August 2023 (Ó Ceallaigh et al. 2023). The survey included measures of gambling activity, PG, childhood experiences and perceptions of gambling. Participants were recruited through three online panels managed by leading market research agencies in Ireland. Ó Ceallaigh et al. (2023) carried out multiple checks that demonstrated the representativeness of the sample and the reliability of the PG and gambling activity survey measures.

Participants from one of the panels received a shortened version of the survey that did not measure all of the variables needed for the present study. Therefore, we focus on the data for the 2,000 participants from the other two panels. These participants were paid €3 for participating in the survey. Of these 2,000 participants, we exclude 116 participants who failed an attention check within the survey. We also exclude a further 221 participants for whom we have incomplete data, leaving a sample size for analysis of 1,663.

Measures

The survey questions used to measure the dependent and explanatory variables are shown in the Appendix section "Survey questions".

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[2] 'Excessive gambling' was measured in this study using an adapted version of the three-item Consumption Screen for Problem Gambling (Rockloff, 2012). This asked participants about their gambling behaviour over the previous year. Specifically, it asked how often they had gambled, how much time they spent gambling on a typical day on which they gambled, and how often they spent two or more hours gambling at a time.

Dependent variables

PG

PG is the main dependent variable that we use in our analysis. We measured PG using the Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001), which is the current international standard for measuring PG in general population samples (Abbott & Volberg, 2006; Caler et al., 2016). Participants rated how often nine different gambling behaviours and experiences applied to them over the previous 12 months, using a four-point Likert scale: "never", "sometimes", "most of the time", "almost always". In accordance with convention, we calculate a score for each participant based on their responses, with each "never" answer contributing zero to the score, each "sometimes" contributing one, "most of the time" contributing two, and "almost always" contributing three. We then use a participant's aggregate score to categorise them into one of four categories as is the standard in research using the PGSI: "no evidence of PG" (PGSI score = 0), "some evidence of PG" (1-2), "moderate evidence of PG" (3-7), have PG (8 or more). This gives us an ordered four-category variable for analysis.

Note that our labels for these categories are slightly different from the standard labels used in gambling research. The two middle categories are usually labelled "low risk" and "moderate risk" in studies using the PGSI. However, we relabel them "some evidence of PG" and "moderate evidence of PG". This is because describing a person as "low risk" or "moderate risk" may be misinterpreted as implying that the person is currently free of problematic gambling behaviour and experiences, but is *at risk* of developing problematic gambling in the future (Ó Ceallaigh et al., 2023). However, a person who scores one or more on the PGSI is by definition currently reporting at least some problematic gambling behaviour or some negative experiences associated with gambling.

Gambling spend

We also use gambling spend per week as a dependent variable in some exploratory analysis. We asked participants how much money on average they spent on gambling per week over the previous month. Those who did not gamble in the previous month are given a zero for this variable.

Attitudes towards gambling

We measured a participant's attitudes towards gambling using the Attitudes Towards Gambling-8 scale (Canale et al., 2016; Orford et al., 2009)**.** The participant rated their agreement, on a five-point rating scale, with eight statements such as "people should have the right to gamble whenever they want" and "there are too many opportunities for gambling nowadays". Statements such as the latter that imply a negative attitude towards gambling are reverse-coded, and the mean rating across the eight items is then calculated. A higher mean rating implies a more positive attitude towards gambling. We standardize this mean rating for use in our regression analysis.

Explanatory variables

Childhood gambling

We asked participants what forms of gambling they had spent money on before the age of eighteen. Participants chose from a list of 12 different forms of gambling such as lottery, bingo, and sports betting. In our main confirmatory analysis, we use a binary indicator variable equal to one if the

participant reported engaging in any form of gambling before eighteen, and equal to zero if not. In exploratory analysis we additionally use a set of 12 binary indicator variables – one for each different form of childhood gambling.

Number of parents who gambled

We asked participants how many, if any, of their parents gambled during their childhood. In our analysis, we use a binary indicator variable equal to one if exactly one parent gambled and equal to zero otherwise, and another binary indicator variable equal to one if two parents gambled. The reference category in analysis is having no parents that gambled.

Intensity of parent gambling

Participants with one parent who gambled rated how often their parent gambled on a seven-point rating scale from 1 "Very rarely" to 7 "Always". They also rated how often their parent gambled relative to the average person on a seven-point scale from 1 "A lot less" to 7 "A lot more". If a participant had two parents who gambled, we instructed them to respond to these questions for the parent who gambled the most.

For each participant for whom at least one parent gambled, we calculate the mean of the ratings the participant gave for the two single-item scales described in the previous paragraph. As pre-registered, we then categorise participants according to that rating. Those whose mean rating is less than or equal to the sample median are categorised as having a parent whose gambling intensity was low. Those with a mean rating above the median are categorised as having a parent whose gambling intensity was high. In our main analysis, we use a binary indicator variable for having a low-intensity gambling parent, and a binary indicator variable for having a high-intensity gambling parent. The reference category is having no parent who gambled.

Parental attitudes towards gambling

Participants rated their agreement with the statement "while I was growing up, my parents/guardians approved of gambling" on a seven-point rating scale from 1 "Strongly disagree" to 7 "Strongly agree".[3] We standardize this score for use in our regression analysis.

Control variables

We control for the following sociodemographic variables in our regression analyses: gender, age, education, born in Ireland or not, ethnicity, living in an urban or rural area, region of residence.

Statistical analysis

Confirmatory analysis

Our main confirmatory analysis tests for relationships between PG, as the dependent variable, and the explanatory variables listed above. Given that PG is an ordered categorical variable, the conventional approach would be to use an ordered logistic regression. This model estimates how the odds of being at or above a given threshold category of the dependent variable change as the value of a given explanatory variable changes. For instance, it can tell us how the odds of having at least moderate evidence of PG, relative to having some or no evidence of PG, change as age increases.

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[3] Participants also had the option to select "don't know" or "not applicable" for this question.

This model assumes proportional odds; the estimated change in odds for a given change in an explanatory variable is assumed to be the same for all thresholds. In our case, this means that the change in the odds of a person having at least moderate evidence of PG when an explanatory variable increases by one unit is assumed to be the same as the change in odds of having at least some evidence of PG, or the change in odds of having PG, when the same explanatory variable increases by one unit.

However, this proportional odds assumption is not satisfied for all explanatory variables in our data. For this reason, our analysis is carried out using a generalised ordered logistic/partial proportional odds regression model (Peterson & Harrell Jr, 1990; R. Williams, 2006). This is a generalisation of the ordered logistic model that allows for the proportional odds assumption to be violated for some or all of the explanatory variables. For explanatory variables for which the assumption is satisfied, the model constrains estimates of the change in odds for that variable to be the same across different thresholds of the dependent variable. When the assumption is not satisfied, the estimated change in odds is allowed to vary.

A drawback of using partial proportional odds regression, and indeed of other forms of logistic regression, is that the effect sizes can be difficult to interpret. To aid interpretation, we therefore present average marginal effects derived from the partial proportional odds regression. The average marginal effect is the change in the probability that a person is in a given category of the dependent variable when there is a one-unit change in a given explanatory variable. As an example, the marginal effect of age on the "some evidence of PG" category is the increase/decrease in probability that a person is in that category if their age increases by one year. For a binary indicator variable, the marginal effect is the change in probability when the value of the binary indicator variable goes from zero to one (e.g. from "didn't gamble before turning 18" to "gambled before turning 18").

We also present marginal effects as a percentage of the baseline probability of being in a given PG category.[4] In our context, the baseline probability is the probability that a person is in a given PG category when the explanatory variable of interest is "turned off" or set to zero.[5] For example, the baseline probability used for the variable "gambled before 18" at the PG category "some evidence" is the probability that a person shows some evidence of PG if they had not gambled before the age of 18. The probability that a person shows some evidence of PG if they *had* gambled before 18 is then simply the sum of the baseline probability and the marginal effect.

Our confirmatory analysis uses the partial proportional odds regression to test several different hypotheses regarding the relationship between PG category and each of the explanatory variables listed previously. Testing several hypotheses simultaneously increases the risk of a type I error, or a false positive, in any one of the tests (Shaffer, 1995). In confirmatory analysis, it is necessary to adjust p-values (Bender & Lange, 2001). Therefore, in determining statistical significance in this confirmatory regression analysis, we correct for "multiple hypothesis testing" using the False Discovery Rate method (Benjamini et al., 2006; Benjamini & Hochberg, 1995).

Exploratory analysis

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[4] When we say the "probability of being in a given PG category", we mean the average adjusted prediction or average adjusted margin related to that category. We use the former terminology for ease of exposition.
[5] For our continuous explanatory variable, parental attitudes, we use the mean as the baseline value. This is zero as we standardize the variable.

We carry out several pre-registered exploratory analyses where we further analyse the relationship between PG category and possible explanatory variables. We use the same model in these analyses as we do in our confirmatory analysis – partial proportional odds regression.

We also carry out an exploratory analysis with gambling spend as the dependent variable. Here we need to use a different regression model as gambling spend in our data is a count variable.[6] Additionally, there are a large proportion of zeros; in other words, people who spent no money on gambling. The large proportion of people with a zero gambling spend can be categorised into two types: those who never gamble, and those that gamble but did not do so in the month before our survey. Though we do not have explicit data to distinguish between these two types, we can use a zero-inflated Poisson regression to model gambling spend as a two-stage process: (1) whether a person never gambles, and (2) given that a person gambles, how much they spend (Lambert, 1992). We present average marginal effects derived from this model.

Finally, we carry out an exploratory analysis with a person's attitudes towards gambling as the dependent variable. Here we use an OLS regression.

In addition to these pre-registered exploratory analyses, we also carry out some additional exploratory analyses that were not pre-registered. This is done where doing so allows for greater insight into the results obtained from the pre-registered analyses.

Results

Descriptives

Table 1 shows descriptive statistics for each of the variables used in our regression analyses. 17% of our sample show some evidence of PG, 8% show moderate evidence and 4% have PG.[7] About two thirds reported gambling before the age of 18. 40% had at least one parent who gambled, with 30% having one parent and 10% having two parents who gambled.

Table 1: Descriptive statistics for the sample

Dependent variables	
PGSI category	
- No evidence	70%
- Some evidence	17%
- Moderate evidence	8%
- PG	4%
Spend per week (mean in €)	30.62

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[6] Participants told us their average gambling spend per week to the nearest Euro.

[7] The PG prevalence of 4% is marginally higher than the PG prevalence of 3.3% estimated by Ó Ceallaigh et al. (2023), but is within the 95% confidence interval of this latter estimate. We deem this 3.3% estimate to be the best estimate of PG prevalence in Ireland.

Attitude towards gambling (mean on 5-point scale)	2.47
Explanatory variables	
Gambled before 18	65%
1 parent gambled, but not 2	30%
2 parents gambled	10%
Parent gambling – low	23%
Parent gambling – high	17%
Parental attitude towards gambling (mean on 7-point scale)	2.94
Control variables	
Male	48%
Female	52%
Age	
- Under 40	35%
- 40-59	39%
- 60+	26%
Highest education	
- High school or less	29%
- Tertiary qualification less than a degree	29%
- Degree or higher	42%
Born in Ireland	84%
Ethnicity	
- White Irish	86%
- Other white	10%
- Other	4%
Live in urban area	66%
Region of residence	
- Dublin	28%
- Rest of Leinster	27%
- Munster	28%
- Connacht/Ulster	17%

Notes: N=1,663. Unweighted estimates. Shows proportion of sample satisfying a given criteria unless otherwise indicated.

Appendix Table A 1 compares the composition of our sample against the last census of population carried out in 2022 (Central Statistics Office, 2023). Our sample is nationally representative in terms of gender and age. Those with a high school education or less are a little underrepresented in our sample, while those with a degree or more are a little overrepresented. In the descriptive analysis that follows, we use sample weights to improve representativeness. Weights are calculated using the raking method with population statistics on age, gender and education from the 2022 census (Deming & Stephan, 1940; Deville & Särndal, 1992).

Figure 1 shows the proportion of our sample who engaged in various forms of gambling before the age of 18. Slots was the form of gambling that most people had played for money before 18 (33%). This was followed by scratch cards (31%), horse or dog betting (27%), gambling amongst friends (23%), bingo (20%), and lotteries (20%).

In Ireland, PG is much more prevalent among those under 40 years of age than those aged 40 or older (Ó Ceallaigh et al., 2023). This may be either an age effect or a cohort effect. An age effect

implies that as people get older, they become less susceptible to PG. A cohort effect, on the other hand, implies that younger generations are more susceptible to PG, perhaps due to increased gambling accessibility and marketing during their formative years. With this in mind, Figure 1 also shows the proportion of people in each of these age cohorts who had engaged in each form of underage gambling. Overall, we find no difference between cohorts in the proportion who reported gambling as a child, although scratch cards, sports betting and loot boxes are more prevalent forms of childhood gambling among the under 40s, while slots are more prevalent for those aged 40 plus.

Figure 1: Proportion of people who gambled before turning 18 – by form of gambling
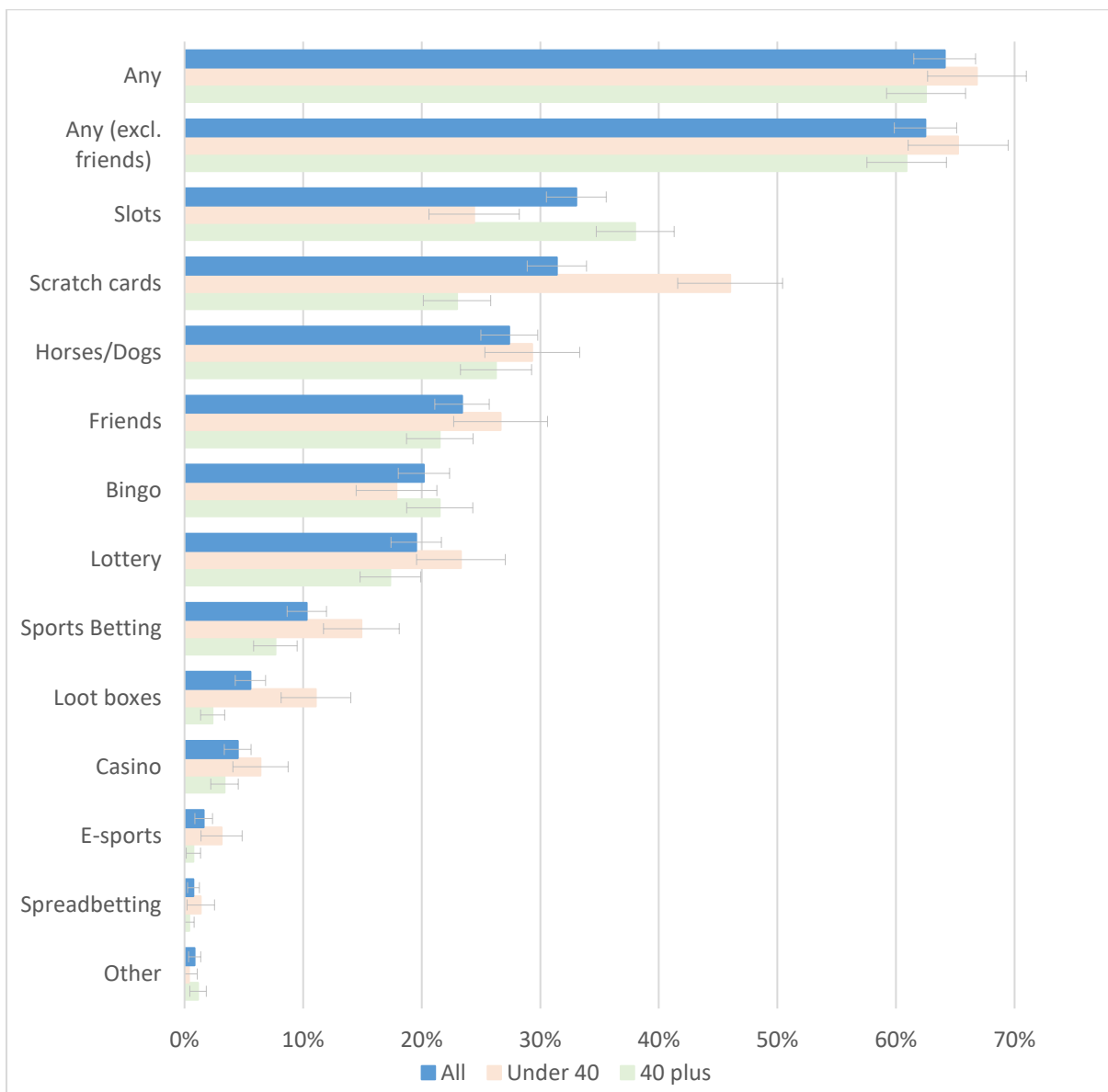
Notes: N=1,663. Under 40 N=583, 40 plus N=1080. 95% confidence intervals shown. Weighted estimates. Note that the presentation of the descriptives by age cohort was not pre-registered.

Appendix Figure A 1 shows the proportion of people who gambled before turning 18 by present income bracket. Overall, we see little to suggest here that those with lower incomes are more or less likely to have gambled before 18. Appendix Figure A 2 shows the distribution of the sample based on how many forms of gambling they had engaged in before 18. Almost half of the sample had engaged in two or more forms, while a tenth had engaged in 5 or more. Overall, there are no differences between age cohorts in the number of forms engaged in.

Confirmatory analysis

The results of the regression analysis of the relationship between PG category and our explanatory variables of interest are shown in Tables 2 and 3. We pre-registered a single regression to analyse all of these relationships. However, collinearity between the "one parent gambled" indicator and the "parent gambling – high" indicator in our data means that we need to analyse these two variables separately. Thus, we run two separate regressions, one with the "number of parents who gambled" indicator variables (Table 2) and another with the "intensity of parent gambling" indicator variables (Table 3). We include both the "gambled before 18" and "parental attitudes towards gambling" variables in each regression, as well as the control variables, to isolate independent associations for each of the explanatory variables of interest, to the extent possible.

Table 2: Marginal effects on PG of childhood gambling, number of parents who gambled, and parental attitudes towards gambling.

	Problem Gambling Category			
	No evidence	Some evidence	Moderate evidence	PG
Gambled when under 18	-0.118***	0.056***	0.039***	0.023***
	[-0.163,-0.074]	[0.033,0.079]	[0.024,0.055]	[0.014,0.032]
	-15%	*41%*	*67%*	*83%*
One parent gambled	-0.059**	0.026**	0.021**	0.013**
	[-0.109,-0.009]	[0.004,0.047]	[0.003,0.038]	[0.002,0.024]
	-8%	*16%*	*26%*	*33%*
Two parents gambled	0.005	-0.002	-0.002	-0.001
	[-0.067,0.077]	[-0.034,0.030]	[-0.026,0.023]	[-0.016,0.014]
	1%	*-1%*	*-2%*	*-2%*
Parental attitudes	-0.022**	0.012	-0.005	0.016***
	[-0.045,0.000]	[-0.006,0.030]	[-0.018,0.008]	[0.006,0.025]
	-3%	*7%*	*-6%*	*40%*
N	1663	1663	1663	1663

Table shows average marginal effects obtained from generalised ordered logit/partial proportional odds regression analysis. Regression model includes controls listed in the Methods section. 95% confidence interval for each average marginal effect in square brackets. The average marginal effect as a percentage of the baseline probability (i.e. adjusted margin when the explanatory variable is set to zero) is shown in italics below each confidence interval. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. P-values adjusted for multiple testing using the FDR method.

Table 3: Marginal effects on PG of each of childhood gambling, intensity of parent gambling, and parental attitudes towards gambling.

	PG Category			
	No evidence	Some evidence	Moderate evidence	PG
Gambled when under 18	-0.123***	0.059***	0.041***	0.024***
	[-0.168,-0.079]	[0.036,0.081]	[0.026,0.056]	[0.015,0.033]
	-16%	*44%*	*71%*	*87%*
Parent gambling – low	-0.011	0.048**	-0.021	-0.016*
	[-0.065,0.042]	[0.003,0.094]	[-0.051,0.010]	[-0.037,0.005]
	-2%	*30%*	*-23%*	*-34%*
Parent gambling – high	-0.128***	0.053***	0.046***	0.029***
	[-0.195,-0.061]	[0.027,0.078]	[0.020,0.073]	[0.012,0.047]
	-18%	*32%*	*60%*	*80%*
Parental attitudes	-0.007	0.005	-0.01*	0.012**
	[-0.031,0.017]	[-0.013,0.023]	[-0.023,0.003]	[0.003,0.022]
	-1%	*3%*	*-11%*	*31%*
N	1663	1663	1663	1663

Table shows average marginal effects obtained from generalised ordered logit/partial proportional odds regression analysis. Regression model includes controls listed in the Methods section. 95% confidence interval for each average marginal effect in square brackets. The average marginal effect as a percentage of the baseline probability (i.e. adjusted margin when the explanatory variable is set to zero) is shown in italics below each confidence interval. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. P-values adjusted for multiple testing using the FDR method.

PG and having gambled before 18: The results for the relationship between PG and having gambled before 18 are almost identical in both regressions. For ease of exposition, we focus on the first regression (Table 2).

The first marginal effect that we see in Table 2 is that of having gambled before 18 on the "no evidence of PG" category. This marginal effect of -0.118 means that having gambled before 18 reduces the probability of a person showing no evidence of PG by 11.8 percentage points (ppt). This reduction equates to the difference between two probabilities derived from the regression model: the probability that a person shows no evidence of PG if they have not gambled before 18, and the probability if they *have*. The former probability is 77.8%. We call this the *baseline probability.* The latter probability is 66.0%. The difference is a reduction of 11.8 ppt, which is our marginal effect. Table 2 also shows, in italics, each marginal effect as a percentage of the baseline probability. In this case, the marginal effect is -15% when expressed as a percentage of the baseline probability (i.e. -11.8/77.8). For ease of exposition, in the text that follows we refer to marginal effects expressed in this way (i.e. as a percentage of the baseline probability).

Having gambled before 18 is associated with an increased probability of a person being in each of the other three categories of PG. Gambling before 18 increases the probability of having some evidence

of PG by 41%, increases the probability of having moderate evidence by 67%, and increases the probability of having PG by 83%. All of these effects are statistically significant.

In sum, having gambled before 18 is associated with an increase in the probability that a person shows some or moderate evidence of PG, and almost doubles their probability of having PG.

Number of parents who gambled: The effects of having one parent who gambled, relative to having no parents who gambled, are all statistically significant (Table 2). These effects are in the same direction as the effects of having gambled before 18, but are smaller. Relative to having no parent who gambled, having one gambling parent increases the probability of some evidence of PG by 16%, moderate evidence by 26%, and PG by 33%.

In contrast, the effect of having two gambling parents on PG category, relative to having no parents who gambled, is not statistically significant. There are three possibilities here. Firstly, there may truly be no relationship between having two parents who gambled and PG. Alternatively, a relationship may exist but we may be underpowered to detect it in our analysis, given that only 10% of our sample had two parents who gambled. Finally, collinearity between having two parents that gambled and underage gambling or parental attitudes may attenuate the estimated effect of having two parents that gambled. However, when we run the regression model without the underage gambling or parental attitudes variables, we still find no significant relationship between having two parents that gambled and PG.

Intensity of parent gambling: We find little support for a link between PG and having a parent who gambled with low intensity (Table 3). Only one of the effects is significant – having a parent who gambled with low intensity increases the probability of having some evidence of PG by 30%, relative to having no parents who gambled.

In contrast, we find strong support for a link between PG and having a parent who gambled with high intensity. The effects on PG are almost identical to those of having gambled before 18, both in direction and magnitude. Relative to having no parent who gambled, having a parent who gambled with high intensity increases the probability of having some evidence of PG by 32%, moderate evidence by 60%, and PG by 80%. All of these effects are statistically significant.

Parental attitude towards gambling: The marginal effects for the parental attitudes variable need to be interpreted slightly differently than the marginal effects of the other explanatory variables we have analysed. This is because parental attitudes is a standardised continuous variable, whereas the other variables are all binary. In the case of parental attitudes, the marginal effect is the change in probability when parental attitude goes from its average value to being one standard deviation above average.

A one standard deviation increase in parental attitude from its average increases the probability of having PG by 40% in regression 1 (Table 2). It has a similar effect on having PG in the second regression (Table 3: 31%). In both cases this effect is significant. Parental attitude does not have a significant effect on the probability of having some or moderate evidence of PG.

Robustness check: As a robustness check, we reran these regression analyses excluding participants who had not gambled in the previous month. This left us with a sample of 1270 participants who had gambled in the previous month. This produced no substantive difference in results.

Exploratory analysis

We analysed the relationship between PG and engaging in various forms of underage gambling. The results are shown in Table 4, where the forms of gambling are listed in order of popularity, from the form with the highest proportion of people engaging in it before 18 (slots) to the form with the lowest proportion (spread betting). Gambling with friends, sports betting, casino gambling and e-sports betting are all significantly associated with a reduced probability of having no evidence of PG, and in turn are significantly associated with an increased probability of showing some evidence, moderate evidence and PG. Loot boxes and spread betting are also associated with a decreased probability of no evidence and an increased probability of some evidence, as well as an increased probability of moderate evidence in the case of loot boxes.

Interestingly, the forms of gambling that have a lower proportion of people engaging in them before 18 seem to be those most strongly associated with PG. Given that the number of people who engaged in several of these forms is very low, these results need to be interpreted with caution. However, the results raise the possibility that these low-prevalence forms of underage gambling are the most harmful in terms of increasing the risk of PG in adulthood. Alternatively, these forms of gambling may act as mediators between more popular forms of gambling and PG. According to this line of thinking, the higher prevalence forms of gambling may act as a "gateway", giving lots of children their first experience of gambling. Some of these children then progress onto the more niche, lower prevalence forms of gambling, which we find are linked to susceptibility to PG in adulthood. If so, the coefficient estimates for the higher prevalence forms might be underestimated in our analysis. To check this, we run a mediation analysis as per Baron & Kenny (1986).[8] We find evidence that low prevalence gambling forms may act as a mediator between high prevalence forms and PG, consistent with the "gateway" hypothesis. See Appendix section "Mediation Analysis – forms of gambling" for further details of this analysis.

Table 4: Marginal effects on PG of various forms of childhood gambling.

	PG Category			
	No evidence	Some evidence	Moderate evidence	PG
Slots	-0.028	0.013	0.009	0.006
	[-0.075,0.019]	[-0.008,0.034]	[-0.006,0.025]	[-0.004,0.016]
	-4%	*8%*	*11%*	*14%*
Scratch cards	0.012	-0.006	-0.004	-0.003
	[-0.043,0.068]	[-0.031,0.020]	[-0.022,0.014]	[-0.014,0.009]
	2%	*-3%*	*-5%*	*-6%*
Horses/Dogs	-0.002	0.001	0.001	0.000
	[-0.051,0.048]	[-0.022,0.023]	[-0.016,0.017]	[-0.010,0.011]

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[8] This mediation analysis is exploratory and was not pre-registered, but was deemed appropriate to run to delve further into the findings from our pre-registered analysis.

	0%	0%	1%	1%
Friends	-0.088***	0.040***	0.030***	0.018***
	[-0.142,-0.033]	[0.015,0.064]	[0.010,0.049]	[0.006,0.030]
	-12%	*24%*	*39%*	*49%*
Bingo	-0.017	0.008	0.006	0.004
	[-0.070,0.035]	[-0.016,0.032]	[-0.012,0.024]	[-0.007,0.015]
	-2%	*5%*	*7%*	*9%*
Lottery	-0.049	0.022	0.017	0.01
	[-0.115,0.016]	[-0.007,0.051]	[-0.006,0.039]	[-0.004,0.024]
	-7%	*13%*	*21%*	*25%*
Sports Betting	-0.158***	0.065***	0.057***	0.036***
	[-0.235,-0.081]	[0.036,0.094]	[0.026,0.087]	[0.015,0.057]
	-22%	*39%*	*72%*	*97%*
Loot boxes	-0.110**	0.046**	0.039**	0.025*
	[-0.210,-0.011]	[0.009,0.084]	[0.002,0.076]	[-0.000,0.051]
	-16%	*27%*	*47%*	*61%*
Casino	-0.126**	0.052***	0.045**	0.030**
	[-0.228,-0.025]	[0.015,0.089]	[0.006,0.084]	[0.002,0.058]
	-18%	*30%*	*54%*	*72%*
E-sports betting	-0.288***	0.090***	0.110**	0.088**
	[-0.481,-0.095]	[0.062,0.118]	[0.026,0.194]	[0.002,0.175]
	-41%	*52%*	*131%*	*215%*
Spread betting	-0.261**	0.086***	0.098*	0.077
	[-0.510,-0.011]	[0.042,0.129]	[-0.007,0.203]	[-0.028,0.182]
	-37%	*49%*	*116%*	*181%*
Other	0.235***	-0.129***	-0.069***	-0.037***
	[0.145,0.325]	[-0.186,-0.072]	[-0.094,-0.045]	[-0.050,-0.024]
	34%	*-74%*	*-81%*	*-83%*
N	1663	1663	1663	1663

Table shows average marginal effects obtained from generalised ordered logit/partial proportional odds regression analysis. Regression model includes as controls number of parents that gambled and parent attitudes towards gambling, as well as the controls listed in the Methods section. 95% confidence interval for each average marginal effect in square brackets. The average marginal effect as a percentage of the baseline probability (i.e. adjusted margin when the explanatory variable is set to zero) is shown in italics below each confidence interval. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

To gain further insight into the role of various forms of gambling on PG, we carried out additional exploratory analysis that had not been pre-registered. We looked at the link between PG and the number of different forms of gambling engaged in before 18. We find that engaging in more forms of gambling increases the risk of later life PG (Appendix Table A 2). We looked at the link with PG of having engaged in what could be categorised as "emerging" forms of gambling (e-sports betting, spread betting, loot boxes) as well as the link of PG with having engaged in more established forms (all other forms). Appendix Table A 3 shows that both forms are significantly associated with PG, but that the effect size is larger for emerging forms. We also looked at the link between having engaged in forms of gambling with a particularly high speed of play pre-18 (slots, casino gambling; Appendix Table A 4). We find that having played a fast form is significantly associated with an increased risk of having some evidence of PG, moderate evidence of PG, or PG. Having played another form is associated with an increased risk of some evidence and moderate evidence of PG, but not PG.

To analyse if the relationship between PG and childhood experiences is different for the under 40 age cohort compared to the 40 plus age cohort, we ran a pre-registered exploratory regression analysis where we interacted age cohort with the childhood experiences variables (Appendix Tables A 5 and A 6). There is no significant difference between cohorts in how PG relates to each of having gambled before 18, having a parent that gambled with high intensity, and parental attitudes. However, we see differences between cohorts in the effects of other parental gambling variables on PG. Having either one or two parents who gambled significantly increases the risk of PG for those 40 plus, but has no significant effect for the under 40s. Additionally, having a parent who gambled with low intensity is protective against PG for under 40s, but not for those aged 40 plus.

We also carried out a pre-registered analysis of the relationship between childhood experiences and gambling spend. We used a zero-inflated Poisson regression here. We find that gambling before 18 and more positive parental attitudes towards gambling both reduce the probability that a person never gambles (Appendix Tables A 7 and A 8). However, only gambling intensity is related to how much someone spends on gambling, given that they gamble. Having a parent who gambled with high intensity is associated with increased gambling spend, relative to those who gamble but whose parents did not.

Finally, in a pre-registered OLS analysis, we find that a person's attitudes towards gambling at least in part reflect their parents' attitude (Appendix Table A 9). Having parents who had a more positive attitude towards gambling is associated with a person themselves having a more positive gambling attitude.

Discussion

We find strong links between childhood experiences of gambling and PG in adulthood. Gambling before the age of 18 almost doubles the probability of having PG, after controlling for parental factors and a broad range of sociodemographic factors. We find a similar effect for having had a parent who gambled with high intensity during a person's childhood. More positive parental attitudes towards gambling also increase the probability of PG – a one standard deviation increase in the parental attitude measure raises the probability of PG by around a third.

Having one parent who gambled increases the probability of PG by about a third as well, relative to having no parent who gambled. This result is driven by those aged 40 or more. Having had two parents that gambled does not increase the probability of PG in the full sample, but does among the

40 plus age group. This weakening of the link between family-related factors and PG in the younger cohort may indicate changes to the sources of exposure to gambling among younger cohorts. Given the expansion of the gambling industry and growth of online gambling and advertising in particular, under 40s have been exposed to a much greater level of gambling accessibility and marketing during childhood than the 40 plus age group (Thomas et al., 2012). Additionally, this growth in online gambling may mean that the gambling of a parent was less salient for the under 40s than the over 40s, as online gambling is less visible than in-person forms. The upshot may be that while parental gambling behaviour was previously a primary predictor of adult PG, other factors have now become the main predictors.

The forms of underage gambling most strongly associated with PG are: gambling among friends, sports betting, casino gambling, e-sports betting, loot boxes and spread betting. We note that these are, for the most part, also the least popular forms of underage gambling. Additional exploratory analysis gives some support to these low prevalence forms of gambling being mediators for the relationship between high prevalence forms, such as slots and scratch cards, and PG. That is to say, the high prevalence forms might act as a gateway – some children progress from these gateway forms onto the more niche low prevalence forms, and are then more likely to have PG in adulthood. This would imply that both high and low prevalence forms of underage gambling may increase risk of later PG. Some caution is needed here, however, as the numbers engaging in low prevalence underage activities in our sample is quite small, particularly the very low prevalence forms (casino gambling, e-sports betting, loot boxes and spread betting). Establishing whether such a gateway effect exists therefore requires more research, preferably with a large youth sample and longitudinal data.

This study has several strengths that support its contribution to knowledge on the relationship between childhood experiences of gambling and adult PG. It is run with a large, nationally representative sample. It is deployed online and so overcomes some of the social desirability bias issues that arise with in-person or telephone surveys. The analysis employs the state-of-the-art in scientific best practice by being pre-registered and by employing a correction for multiple hypothesis testing. Pre-registration of studies and correcting for multiple hypothesis testing are two actions that have been strongly recommended in order to improve reproducibility in empirical social science (Shrout & Rodgers, 2018).

Limitations

This study also has some important limitations. Here we consider three. First, our findings imply an association between childhood experiences and PG, but cannot be definitively interpreted as causal. Unobserved factors could explain this relationship, for example by predicting propensity for both childhood gambling and later life PG. Having said that, our analyses control for standard sociodemographic background factors. Factors such as gender, age and educational attainment are hence not driving the relationships we find. Given the ethical challenges of conducting experimental research on childhood gambling, our findings would benefit from testing via longitudinal surveys. From a public health perspective, however, it may be too costly to wait for better data that is likely to take years to collect. Even if we cannot be sure that the effects are causal, the strong associations that we report between childhood experiences of gambling and PG in later life add weight to the case for stronger regulation.

Second, our childhood gambling experiences variables may be subject to some recall bias. This could be problematic if any resulting measurement error is correlated with PG category. To reduce

measurement error in these responses, survey questions were designed to be simple; they recorded merely whether the participant recalled engaging in specific forms of gambling, rather than requesting estimates of frequency or spend. As such, most of the childhood gambling experiences we recorded could be reasonably expected to be remembered accurately.

Third, many forms of regulation that seek to protect children focus on preventing exposure to advertising, given existing bans on most forms of gambling for children. Our analysis did not test the link between advertising exposure and PG, as recall of advertising seen in childhood is unlikely to be reliable in later life. However, given the high rate of underage gambling reported, with two-thirds of adults recalling some form of gambling before turning 18, the findings suggest that current regulations have not achieved their aim of preventing children from gambling. Moreover, the weakening association between familial exposure to gambling and later PG is consistent with an effect of increased extra-familial exposure. As such, the findings support increasing the stringency of regulations that seek to minimise this exposure.

Implications and Conclusion

Our study has implications for both research and policy. The findings add to the weight of evidence for a link between childhood experiences of gambling and PG in adulthood. This in turn supports regulatory measures to minimise the exposure of children to gambling in order to reduce their risk of developing PG. These may include bans on children gambling or even entering a gambling premises, website or app. Strict safeguards may be required on digital platforms to ensure rapid age-verification before any engagement with gambling activities. Assuming that advertising is at least to some degree effective, our findings also imply that the future level of PG may be reduced by minimising the exposure of children to gambling marketing, using measures such as a watershed ban on TV advertising, the prohibition of gambling advertisements that may be particularly attractive to children, and restrictions on sponsorship of events or clubs where children are involved. Where other evidence suggests that certain gambling products have a particular appeal to children, these would be reasonable targets for stronger regulation also. Additionally, measures that protect parents from PG may indirectly help to reduce the risk of their children developing PG, given the links we find between parental gambling and later-life PG. One needs to bear in mind, however, that the influence of parents on PG risk appears to be weakening in younger age cohorts. This suggests that a focus on regulations that reduce the extra-familial exposure of children to gambling, such as regulation on accessibility and marketing, may be taking on greater importance.

The growing importance of extra-familial factors also has implications for PG treatment. It may mean that the profile of those seeking treatment is changing, with more people with no family history of gambling or PG presenting for treatment. Given this, future research on the changing profiles of PG treatment patients is warranted.

Several countries, such as the UK and Italy, have introduced increased regulatory measures to protect children in the last few years. A next step in research on this topic is to evaluate the effectiveness of such measures. Evaluation studies are of crucial importance to inform the future introduction and modification of regulatory measures. Additionally, such studies can help to establish the causal nature of the relationships between factors such as gambling at a young age and later-life PG.

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Appendix

Additional tables

Table A 1: National representativeness of the sample on gender, age and education

	Sample	Census 2022	Difference
Gender			
Female	51.5%	51.1%	0.4ppt
Male	48.3%	48.9%	-0.5ppt
Age			
Under 40	35.1%	36.9%	-1.8ppt
40-59	38.6%	36.4%	2.2ppt
60+	26.3%	26.7%	-0.3ppt
Education			
High school or less	29.2%	43.9%	-14.8ppt
Tertiary qualification less than a degree	28.8%	28.6%	0.2ppt
Degree or higher	42.0%	27.5%	14.6ppt

Table A 2: Marginal effects for relationship between PG and number of forms of gambling engaged in pre-18

	PG Category		
No evidence	Some evidence	Moderate evidence	PG

Number of forms of gambling engaged in pre-18	-0.046***	0.020***	0.016***	0.010***
	[-0.056,-0.036]	[0.016,0.025]	[0.012,0.020]	[0.007,0.013]
	-6%	*13%*	*23%*	*33%*
N	1663	1663	1663	1663

Table shows average marginal effects obtained from generalised ordered logit/partial proportional odds regression analysis. Regression model includes as controls number of parents that gambled, parent attitudes towards gambling, and the controls listed in the Methods section. 95% confidence interval for each average marginal effect in square brackets. The average marginal effect as a percentage of the baseline probability (i.e. adjusted margin when the number of forms of gambling is set to one) is shown in italics below each confidence interval. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A 3: Marginal effects for relationship between PG and having engaged in (1) established forms of gambling and (2) emerging forms, pre-18.

	PG category			
	No evidence	Some evidence	Moderate evidence	PG
Gambled u18 on emerging forms	-0.218***	0.077***	0.083***	0.058***
	[-0.311,-0.124]	[0.051,0.102]	[0.042,0.124]	[0.025,0.091]
	-31%	*45%*	*105%*	*152%*
Gambled u18 on established forms	-0.102***	0.049***	0.034***	0.020***
	[-0.148,-0.057]	[0.026,0.072]	[0.019,0.050]	[0.011,0.029]
	-13%	*35%*	*55%*	*69%*
	1663	1663	1663	1663

Table shows average marginal effects obtained from generalised ordered logit/partial proportional odds regression analysis. Regression model includes as controls number of parents that gambled, parent attitudes towards gambling, and the controls listed in the Methods section. 95% confidence interval for each odds ratio in square brackets. The average marginal effect as a percentage of the baseline probability (i.e. adjusted margin when the explanatory variable is set to zero) is shown in italics below each confidence interval. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A 4: Marginal effects for relationship between PG and having engaged in fast forms of gambling pre-18.

	PG category			
	No evidence	Some evidence	Moderate evidence	PG
Gambled u18 on a fast form	-0.067***	0.029***	0.023***	0.014***
	[-0.112,-0.022]	[0.009,0.049]	[0.007,0.039]	[0.004,0.025]
	-9%	*18%*	*30%*	*61%*
Gambled u18 on another form	-0.133***	0.075***	0.054***	0.004
	[-0.180,-0.086]	[0.038,0.112]	[0.028,0.079]	[-0.016,0.024]
	-17%	*58%*	*105%*	*10%*

Table shows average marginal effects obtained from generalised ordered logit/partial proportional odds regression analysis. Regression model includes as controls number of parents that gambled, parent attitudes towards gambling, and the controls listed in the Methods section. 95% confidence interval for each odds ratio in square brackets. The average marginal effect as a percentage of the baseline probability (i.e. adjusted margin when the explanatory variable is set to zero) is shown in italics below each confidence interval. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A 5: Odds ratios for analysis of interaction between age cohort and each of underage gambling, number of parents that gambled, and parental attitudes towards gambling

	PGSI category		
	At least some evidence	At least moderate evidence	PG
	Odds ratio	*Odds ratio*	*Odds ratio*
Being <u>under 40</u> interacted with childhood experiences			
Gambled u18	1.633***	1.633***	1.633***
	[1.190,2.242]	[1.190,2.242]	[1.190,2.242]
Gambled u18 x Age u40	1.457	1.457	1.457
	[0.872,2.434]	[0.872,2.434]	[0.872,2.434]
One parent gambled	1.690***	1.690***	1.690***
	[1.218,2.345]	[1.218,2.345]	[1.218,2.345]
One parent gambled x Age u40	0.581**	0.581**	0.581**
	[0.348,0.969]	[0.348,0.969]	[0.348,0.969]
Two parents gambled	1.721**	1.721**	1.721**
	[1.004,2.949]	[1.004,2.949]	[1.004,2.949]
Two parents gambled x Age u40	0.361***	0.361***	0.361***
	[0.169,0.771]	[0.169,0.771]	[0.169,0.771]
Parental attitudes	1.053	1.021	1.356**
	[0.904,1.227]	[0.848,1.230]	[1.047,1.757]
Parental attitudes x Age u40	1.227*	1.227*	1.227*
	[0.965,1.559]	[0.965,1.559]	[0.965,1.559]
Age u40	1.865***	1.865***	1.865***
	[1.165,2.984]	[1.165,2.984]	[1.165,2.984]
Being <u>40 plus</u> interacted with childhood experiences			
Gambled u18	2.380***	2.380***	2.380***
	[1.584,3.578]	[1.584,3.578]	[1.584,3.578]
Gambled u18 x Age 40 plus	0.686	0.686	0.686
	[0.411,1.146]	[0.411,1.146]	[0.411,1.146]
One parent gambled	0.982	0.982	0.982
	[0.662,1.457]	[0.662,1.457]	[0.662,1.457]
One parent gambled x Age 40 plus	1.721**	1.721**	1.721**
	[1.032,2.870]	[1.032,2.870]	[1.032,2.870]
Two parents gambled	0.621*	0.621*	0.621*
	[0.364,1.060]	[0.364,1.060]	[0.364,1.060]
Two parents gambled x Age 40 plus	2.770***	2.770***	2.770***
	[1.296,5.919]	[1.296,5.919]	[1.296,5.919]
Parental attitudes	1.292***	1.253**	1.664***

	[1.070,1.559]	[1.019,1.540]	[1.271,2.177]
Parental attitudes x Age 40 plus	0.815*	0.815*	0.815*
	[0.641,1.036]	[0.641,1.036]	[0.641,1.036]
Age 40 plus	0.536***	0.536***	0.536***
	[0.335,0.858]	[0.335,0.858]	[0.335,0.858]
N	1663	1663	1663

Table shows odds ratios obtained from generalised ordered logit/partial proportional odds regression analyses. We present odds ratios rather than average marginal effects as the former are more appropriate for interaction effects. Panel 1 includes results from a regression with interactions between an indicator for being under 40 and childhood experiences. Panel 2 shows results from a regression with interactions between an indicator for being 40 plus and childhood experiences. Regression models include controls listed in the Methods section. 95% confidence interval for each odds ratio in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Where the odds ratios for a particular variable are the same in all three columns, this means that the variable satisfies the proportional odds assumption.

Table A 6: Odds ratios for analysis of interaction between age cohort and each of underage gambling, intensity of parent gambling, and parental attitudes towards gambling

	PGSI category		
	At least some evidence	At least moderate evidence	PG
	Odds ratio	*Odds ratio*	*Odds ratio*
Being <u>under 40</u> interacted with childhood experiences			
Gambled u18	1.679***	1.679***	1.679***
	[1.222,2.307]	[1.222,2.307]	[1.222,2.307]
Gambled u18 x Age u40	1.495	1.495	1.495
	[0.894,2.502]	[0.894,2.502]	[0.894,2.502]
Parent gambling - low	1.409*	1.409*	1.409*
	[0.984,2.020]	[0.984,2.020]	[0.984,2.020]
Parent gambling - low x Age u40	0.523**	0.266***	0.063***
	[0.299,0.916]	[0.126,0.559]	[0.008,0.475]
Parent gambling - high	2.307***	2.307***	2.307***
	[1.522,3.496]	[1.522,3.496]	[1.522,3.496]
Parent gambling - high x Age u40	0.604	0.604	0.604
	[0.317,1.150]	[0.317,1.150]	[0.317,1.150]
Parental attitudes	0.996	0.955	1.269*
	[0.847,1.172]	[0.788,1.158]	[0.978,1.646]
Parental attitudes x Age u40	1.183	1.183	1.183
	[0.917,1.526]	[0.917,1.526]	[0.917,1.526]
Age u40	1.788**	1.788**	1.788**
	[1.112,2.876]	[1.112,2.876]	[1.112,2.876]
Being <u>40 plus</u> interacted with childhood experiences			

Gambled u18	2.523***	2.523***	2.523***
	[1.675,3.800]	[1.675,3.800]	[1.675,3.800]
Gambled u18 x Age 40 plus	0.669	0.669	0.669
	[0.400,1.121]	[0.400,1.121]	[0.400,1.121]
Parent gambling - low	0.650**	0.650**	0.650**
	[0.428,0.988]	[0.428,0.988]	[0.428,0.988]
Parent gambling - low x Age 40 plus	2.171***	2.171***	2.171***
	[1.250,3.770]	[1.250,3.770]	[1.250,3.770]
Parent gambling - high	1.405	1.405	1.405
	[0.856,2.306]	[0.856,2.306]	[0.856,2.306]
Parent gambling - high x Age 40 plus	1.656	1.656	1.656
	[0.868,3.158]	[0.868,3.158]	[0.868,3.158]
Parental attitudes	1.175	1.134	1.501***
	[0.963,1.434]	[0.913,1.409]	[1.137,1.981]
Parental attitudes x Age 40 plus	0.847	0.847	0.847
	[0.657,1.092]	[0.657,1.092]	[0.657,1.092]
Age 40 plus	0.554**	0.554**	0.554**
	[0.344,0.891]	[0.344,0.891]	[0.344,0.891]
N	1663	1663	1663

Table shows odds ratios obtained from generalised ordered logit/partial proportional odds regression analyses. We present odds rations rather than average marginal effects as the former are more appropriate for interaction effects. Panel 1 includes results from a regression with interactions between being an indicator for under 40 and childhood experiences. Panel 2 shows results from a regression with interactions between an indicator for being 40 plus and childhood experiences. Regression models include controls listed in the Methods section. 95% confidence interval for each odds ratio in square brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Where the odds ratios for a particular variable are the same in all three columns, this means that the variable satisfies the proportional odds assumption.

Table A 7: Marginal effects for relationships between gambling spend and each of underage gambling, number of parents who gambled, and parental attitudes towards gambling

	(1) Never gamble? Binary Logit Model	(2) If gamble, how much spend on gambling? Poisson Model
Gambled when under 18	-0.063*** [-0.105,-0.021]	7.101 [-5.073,19.275]
One parent gambled	-0.018 [-0.068,0.032]	4.779 [-5.558,15.115]
Two parents gambled	0.006 [-0.067,0.078]	-7.725 [-19.553,4.103]
Parental attitudes	-0.025** [-0.048,-0.001]	1.732 [-4.100,7.564]
N	1663	1663

Table shows results obtained from zero-inflated Poisson regression analysis. The first column shows the average marginal effects from the binary logit element of this analysis that models excess zeros. The second column shows the average marginal effects from the Poisson regression element of the model. Regression models include controls listed in the Methods section. 95% confidence interval for in square brackets. Robust standard errors used. $^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$.

Table A 8: Marginal effects for relationships between gambling spend and each of underage gambling, intensity of parent gambling, and parental attitudes towards gambling

	(1) Never gamble? Binary Logit Model	(2) If gamble, how much spend on gambling? Poisson Model
Gambled when under 18	-0.062*** [-0.104,-0.020]	7.816 [-4.543,20.174]
Parent gambling - low	-0.023 [-0.076,0.030]	-8.770* [-18.988,1.447]
Parent gambling - high	0.008 [-0.056,0.072]	16.684** [1.909,31.458]
Parental attitudes	-0.028** [-0.052,-0.004]	-1.218 [-7.813,5.377]
N	1663	1663

Table shows results obtained from zero-inflated Poisson regression analysis. The first column shows the average marginal effects from the binary logit element of this analysis that models excess zeros. The second column shows the average marginal effects from the Poisson regression element of the model. Regression models include controls listed in the Methods section. 95% confidence interval for in square brackets. Robust standard errors used. $^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$.

*Table A 9: Results for relationship between a person's attitudes towards gambling and that of their parents*

	(2) Own attitudes towards gambling

Parental attitudes	0.216***
	[0.164,0.269]
N	1663

Table shows results obtained from OLS regression analysis. Both the parental attitudes and own attitudes variables are standardised. Regression model includes controls listed in the Methods section. 95% confidence interval for in square brackets. Robust standard errors used. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
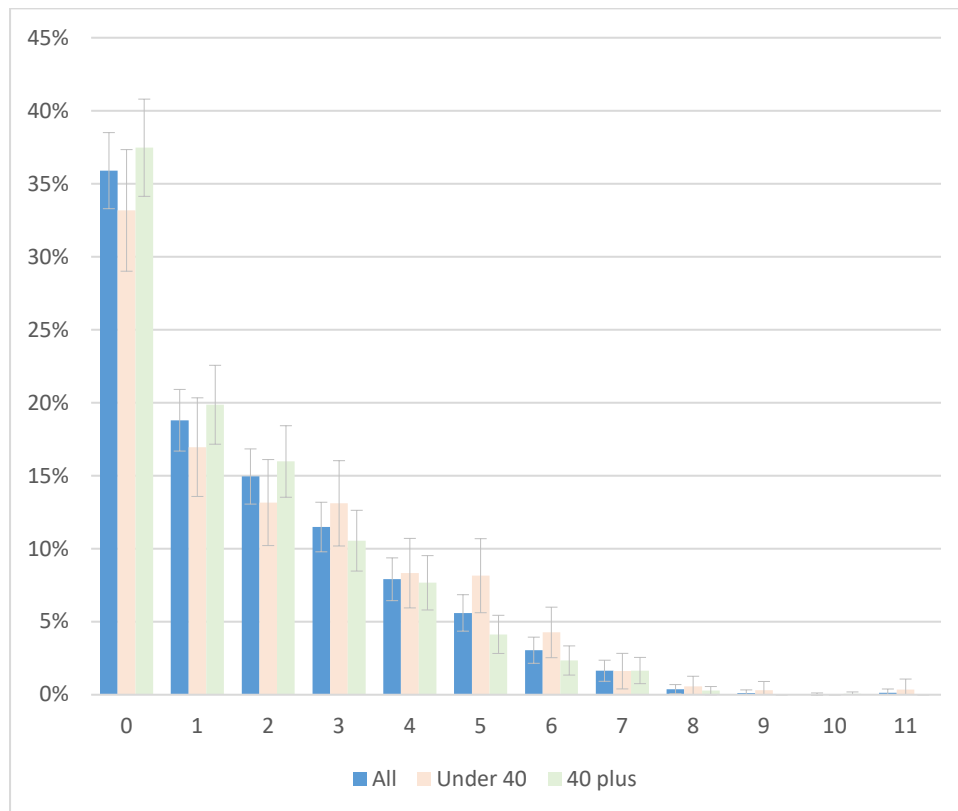
Additional figures

Figure A 1: Proportion of people who gambled before turning 18 – by income bracket
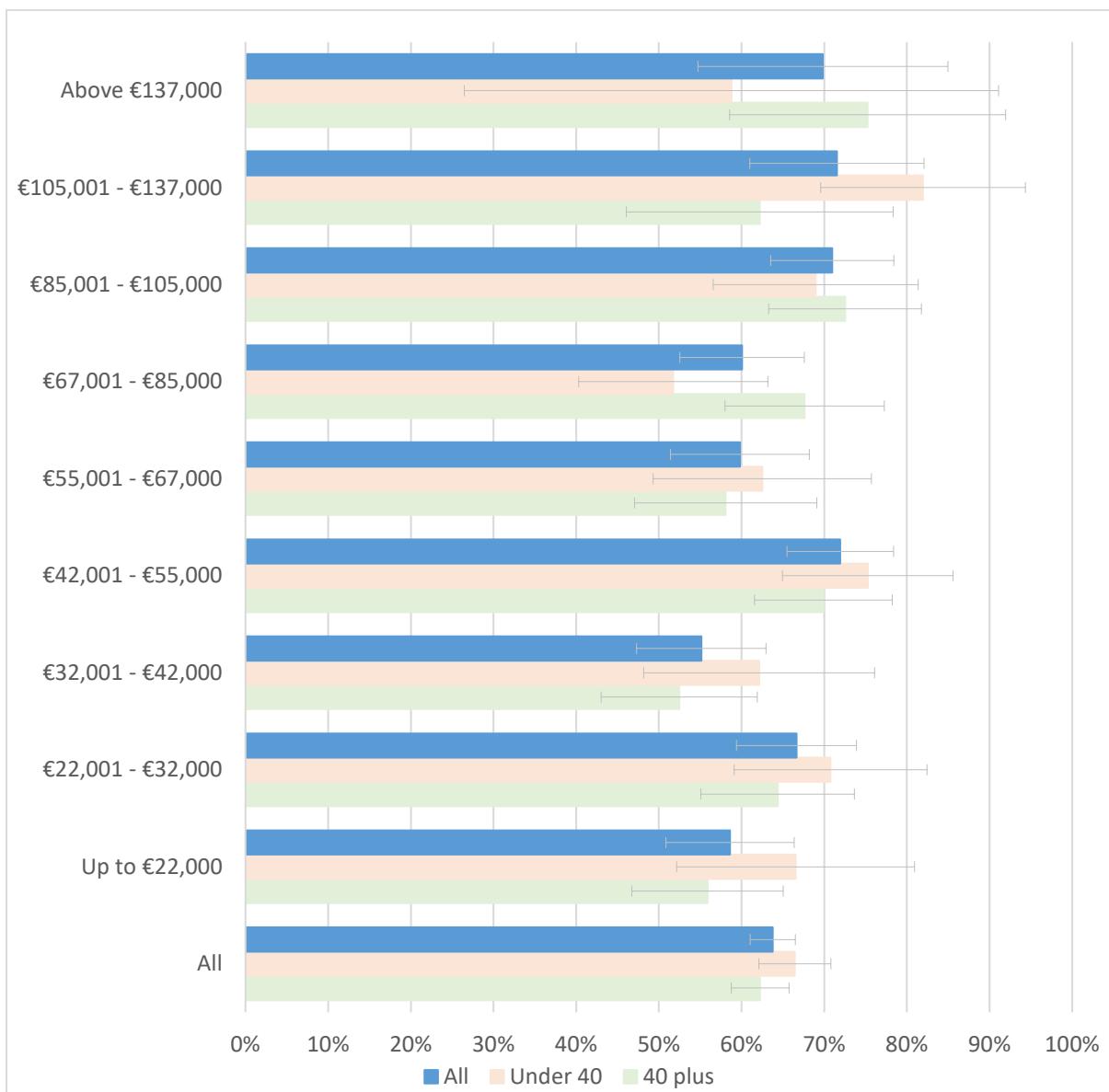
Notes: N=1,516 (income data is missing for 147 participants). 95% confidence intervals shown. Weighted estimates.

Figure A 2: Distribution of the sample by the number of forms of gambling they had engaged in before 18

Notes: N=1663. Note that the presentation of this descriptive chart was not pre-registered. Weighted estimates.

Mediation Analysis – forms of gambling

We generate two binary indicator variables. The first, "Gambled before 18 - high prevalence form", is equal to 1 if the participant engaged before 18 in any of the forms of gambling which were most prevalent in our sample: slots, scratch cards, lotteries, bingo, horse/dog betting, gambling among friends. The second indicator, "Gambled before 18 - low prevalence form", is equal to 1 if the participant engaged in any of the forms of gambling that were of lower prevalence in our sample: sports betting, spread betting, e-sports betting, loot boxes, casino gambling. We then carry out a four step mediation analysis as per Baron & Kenny (1986) to test if gambling on a low prevalence form is a mediator between gambling on a high prevalence form and PG category. Our results support this hypothesis (Table A10). We see that all of the criteria for a mediation relationship are met.

Step 1: gambling on a high prevalence form is a significant explanatory variable for PG category (column 1). This shows that there is a total effect of high prevalence forms on PG.

Step 2: Gambling on a high prevalence form is also a significant explanatory variable for gambling on a low prevalence form (column 2).

Step 3: Gambling on a low prevalence form is a significant explanatory variable for PG category when controlling for gambling on a high prevalence form (column 3). Step 2 and 3 combined show that there is an indirect effect of gambling on a high prevalence form on PG, via gambling on a low

prevalence form.

Step 4: Gambling on a high prevalence form is a significant explanatory variable for PG category, controlling for gambling on a low prevalence form (column 3). This shows that there is a direct effect of high prevalence forms on PG category.

Table A 10: Analysis of gambling before 18 on a low prevalence form as a mediator between gambling before 18 on a high prevalence form and PG category

	(1)	(2)	(3)
	PG category	Gamble before 18 – low prevalence form	PG category
	Ordered logit	Binary logit	Ordered logit
Gambled before 18 - high prevalence form	1.880***	15.554***	1.501***
	[1.464,2.415]	[8.400,28.801]	[1.157,1.947]
Gambled before 18 - low prevalence form			2.709***
			[2.042,3.593]

Table shows odds ratios obtained from generalised ordered logit/partial proportional odds regression analysis (columns 1 and 3) and binary logit regression analysis (column 2). The explanatory variables of interest in generalised ordered logit models satisfied the proportion odds assumption and so a single coefficient estimate is generated. Regression models includes as controls number of parents that gambled and parent attitudes towards gambling, as well as the controls listed in the Methods section. 95% confidence interval for each odds ratio in square brackets. $^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$.

Survey questions

Problem Gambling Severity Index

Some of the next questions may not apply to you, but please try to be as accurate as possible.

THINKING ABOUT THE LAST 12 MONTHS...

1. Have you bet more than you could really afford to lose?

2. Have you needed to gamble with larger amounts of money to get the same feeling of excitement?

3. When you gambled, did you go back another day to try to win back the money you lost?

4. Have you borrowed money or sold anything to get money to gamble?

5. Have you felt that you might have a problem with gambling?

6. Has gambling caused you any health problems, including stress or anxiety?

7. Have people criticized your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?

8. Has your gambling caused any financial problems for you or your household?

9. Have you felt guilty about the way you gamble or what happens when you gamble?

10. To show you are not a bot, please choose "Sometimes" for this question.

Participants responded on a 4-point Likert Scale: Never, Sometimes, Most of the time, Almost always. Participants who failed the attention check in item 10 were not included in our final sample.

Gambling spend

Participants were first asked what forms of gambling they had engaged in over the previous four weeks:

In the last **four weeks**, have you **spent money** on any of the following forms of gambling?

Please do not include any form of gambling that you did not spend money on (e.g., playing card games with friends with no wagers)

   a) Betting on horse or dog races. Y/N

   b) Betting on other sports such as soccer, rugby, GAA, golf. Y/N

   c) Lottery tickets. Y/N

   d) Scratch cards or instant wins. Y/N

   e) Bingo. Y/N

   f) Fruit/slot machine style games online or in a physical location (e.g., an arcade, a casino). Y/N

   g) Roulette, poker, cards or dice online or in a casino. Y/N

   h) Spread betting (e.g., on shares or foreign currencies). Y/N

   i) Bets or gambling between friends. Y/N

   j) Any other form of gambling not described above. Y/N

For each form of gambling they selected, they were then asked if they had spent money on that form online or in-person.

Thinking about each of the activities below, **where** did you spend money on each activity in the last **four weeks**? For each activity, tick all that apply. Again, please only choose places you **spent money**.

   a) Lottery tickets

   ☐   Online

   ☐   In person

   b) Scratch cards or instant wins

   ☐   Online

   ☐   In person

   etc.

They were then asked how much they had spent on each online form they chose, and each in-person form they chose.

Q3. Thinking about each of the activities below, **how often**, on average, did you spend money on each activity in the last **four weeks**? If you're not sure give your best guess.

Lottery tickets

— Online

  o Less than €5 a week

  o €5-€9 a week

  o €10-€20 a week

  o €21-€50 a week

  o €51-€100 a week

  o €101-€200 a week

  o More than €200 a week

Scratch cards or instant wins

— In person

  o Less than €5 a week

  o €5-€9 a week

  o €10-€20 a week

  o €21-€50 a week

  o €51-€100 a week

  o €101-€200 a week

  o More than €200 a week

When a participant selected a category (e.g. €10-€20 a week) a slider appeared asking them to specify the exact amount.

Please specify the exact amount by clicking and dragging on the slider scale below.

Attitudes Towards Gambling Scale-8

Please state the extent to which you agree or disagree with each of the following statements:

1. People should have the right to gamble whenever they want

2. There are too many opportunities for gambling nowadays

3. Gambling should be discouraged

4. Most people who gamble do so sensibly

5. Gambling is dangerous for family life

6. On balance, gambling is good for society

7. Gambling livens up life

8. It would be better if gambling was banned altogether

Participants answered on 5-point rating scale: 1: Strongly disagree, 2, 3, 4, 5: Strongly agree

Gambling before 18

Which of these activities did you spend money on before the age of 18? Tick all that apply. Please do not include any form of gambling that you did not spend money on (e.g., playing card games with friends with no wagers). Adapted from (UK Gambling Commission, 2021)

- ☐ Betting on horse or dog races
- ☐ Betting on other sports such as soccer, rugby, GAA, golf
- ☐ Spread betting (e.g., on shares or foreign currencies)
- ☐ Lottery tickets
- ☐ Scratch cards or instant wins
- ☐ Bingo
- ☐ Fruit/slot machine style games online or in a physical location (e.g., an arcade, a casino)
- ☐ Roulette, poker, cards or dice online or in a casino
- ☐ Bets or gambling between friends
- ☐ Loot boxes in video games
- ☐ Esports betting (i.e. betting on competitive video game tournaments and matches.)
- ☐ Any other form of gambling not described above

Number of parents that gambled

How many of your parents/guardians gambled while you were growing up?

Dropdown options: 0, 1, 2, don't know, not applicable to me

Intensity of parent gambling

If they said that one parent gambled:

For your parent/guardian that gambled, how often did he/she gamble while you were growing up?

Seven-point rating scale: 1: Very rarely, 2, 3, 4, 5, 6, 7: Always

Did he/she gamble less or more than the average person while you were growing up, do you think?

Seven-point rating scale: 1: A lot less, 2, 3, 4, 5, 6, 7: A lot more

If they said that two parents gambled:

Think of your parent/guardian who gambled the most while you were growing up.

How often did he/she gamble while you were growing up?

Seven-point rating scale: 1: Very rarely, 2, 3, 4, 5, 6, 7: Always

Did he/she gamble less or more than the average person while you were growing up, do you think?

Seven-point rating scale: 1: A lot less, 2, 3, 4, 5, 6, 7: A lot more

Parent attitudes towards gambling

To what extent do you agree or disagree with the following statement:

While I was growing up, my parents/guardians approved of gambling.

Seven-point rating scale: 1: Strongly disagree, 2, 3, 4, 5, 6, 7: Strongly agree

Participants also had the option to tick a box "if you don't know or if this is not applicable to you"