GAMBLING AND PROBLEM GAMBLING AMONG YOUNG ADULTS: INSIGHTS FROM A LONGITUDINAL STUDY OF PARENTS AND CHILDREN

by

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August, 2018

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ACKNOWLEGEMENTS

Like other researchers who have used the resource, we are extremely grateful to all the families who took part in this study, the midwives for their help in recruiting them, and the whole ALSPAC team, which includes interviewers, computer and laboratory technicians, clerical workers, research scientists, volunteers, managers, receptionists and nurses.

ETHICAL APPROVAL

Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees.

FUNDING

The UK Medical Research Council and Wellcome (Grant ref: 102215/2/13/2) and the University of Bristol provide core support for ALSPAC. This publication is the work of the authors and Professors David Forrest and Ian G. McHale will serve as guarantors for the contents of this paper.

A comprehensive list of grants funding is available on the ALSPAC website (http://www.bristol.ac.uk/alspac/external/documents/grant-acknowledgements.pdf); collection of data on gambling by young people was specifically funded by the Responsible Gambling Trust and its successor body, GambleAware.

ABBREVIATIONS FREQUENTLY USED IN THE TEXT

PGSI: Problem Gambling Severity Index

MPPG: an individual who likely has moderate harm from gambling or is a problem gambler (according to conventional classifications of scores on the PGSI)

SOGS: South Oaks Gambling Screen (for problem gambling)

ALSPAC: The Avon Longitudinal Study of Parents and Children

EXECUTIVE SUMMARY

1. Several thousand children born in the Bristol region of England in the early 1990s have been tracked throughout their lives by the Avon Longitudinal Study of Parents and Children. GambleAware commissioned surveys about the young persons' gambling activities when they were about 17 years and nine months and again when they were 20. These surveys included administration of problem gambling screens.

2. At age 17, 1.4% of the young people were experiencing at least a moderate level of harm, according to their scores on the PGSI screen. By age 20, about two-thirds of these were registering lower PGSI scores and about one-quarter seemed to show no sign of gambling problems (PGSI score=0). This is consistent with earlier literature which finds that problem gambling is often a transient state with a high propensity to self-recovery. That is not to say that significant long-term harm has not been caused in the meantime.

3. Notwithstanding that the majority of those who had reported moderate or greater harm at age 17 had recovered by age 20, the prevalence-rate of moderate harm or problem gambling (defined by PGSI score) in the group more than tripled to 4.6% between the two surveys. This suggests a very high incidence (new onset) of problem gambling between 17 and 20. More than half of the moderate harm/ problem gamblers observed at age 20 had shown no signs at age 17 that would have given cause for concern. At 17 they had not been regular gamblers and they had had a PGSI score of 0.

4. The evidence suggests therefore that risk of developing gambling problems is high during the early years of exposure to the full range of legal gambling opportunities. Associated harm may be lasting because early adulthood is the critical stage at which education and training defines career paths for the future and often it is also the time for forming long-term relationships.

5. Because so many problem cases appear in a short time from age 18, there is a case for operators, when monitoring players, to adopt lower thresholds to trigger intervention where the customer is under 21. Regulators might introduce additional provisions to Codes of Practice to require operators to be particularly rigorous in their duty of care to young customers. Legislators and regulators might even consider differential access to products for the young, analogous to recent measures to address the high fatality rate among new drivers.

6. The principal focus of the Report is on the data collected when the young person was 20. At age 20, a little more than 10% of those surveyed were regular (weekly-or-more) gamblers. Apart from National Lottery products, online betting was the most common 'regular' activity. About 4% of the whole sample and about one-quarter of regular gamblers had PGSI scores of 3 or more. For males only, there were strong correlations between problems with alcohol (as indicated by results of the AUDIT screen for alcohol use disorder) and both regular gambling and problem gambling.

7. We had access to the children's SATS (national test) scores at Key Stage 3 (age 14-15). For males especially, maths score proved to be a strong positive predictor of regular gambling and English a strong negative predictor of regular gambling (whether or not defined to include lotto play). In the case of problem gambling, there was again a positive relationship with maths score and a negative relationship with English score but the correlations were statistically weak in this case.

8. Employing logistic regression models, we explored the association between regular and problem gambling at age 20 and family background. Family background included levels of education achieved by each parent, each parent's level of engagement with gambling (e.g. number of gambling activities when the child was 6), each parent's score on the SOGS problem gambling screen when the child was 6, and other potential indicators of lifestyle and attitudes in the parental home at various time points during his or her childhood. Such indicators included, for example, parents' religiosity, smoking status, dietary habits and body mass index figures.

9. Higher levels of parental education tended to predict a lower probability that the child would be a regular gambler at age 20 though the relationship weakened when other indicators of family lifestyle were included in models. Parental education may be serving as a proxy for social class.

10. For 20 year old males, the probability of regular gambling at age 20 was elevated where the father had had a gambling problem (as captured by SOGS score at child age 6). However, the father's engagement in gambling, measured by number of gambling activities, had no significant independent effect. By contrast, regular gambling in young (male) adulthood was positively associated with the mother's level of engagement with gambling.

11. For 20 year old females, there was no evidence from multivariate modelling of a link between regular gambling and either parent's gambling behaviour at child age 6. However, regular gambling at 20 was strongly associated with a number of indicators of general parental lifestyle such as parental smoking, mother's frequency of eating fried food and mother's body mass index. Thus, for females, while there is correlation with parental gambling in the raw data, it is general household attitudes towards health and risky activities that predicts regular gambling rather than parental gambling per se.

12. Our brief included a requirement to investigate transmission of problem gambling between generations. Problem gambling at age 20 was measured by PGSI score and parental problem gambling by SOGS score at child age 6. We found evidence of such transmission but only cross-gender: male problem gambling status at age 20 was linked only to mother's SOGS score and female problem gambling status at age 20 was linked only to father's SOGS score. The relationships were strongly statistically significant in each case whereas tests for same-gender transmission indicated that any links were very far from statistically significant. In the case of females only, significant problem gambling risk factors included other aspects of mother's lifestyle (smoking, diet, weight) indicative of tolerance of risky and stigmatised behaviours.

13. We examined data from the survey administered when the child was 17. We found the same pattern as in the data for 20 year olds (even though there was little overlap between the set of problem

gamblers at age 20 and the set of problem gamblers at age 17): transmission of problem gambling was only cross-gender.

14. This pattern limits the extent to which problem gambling in one generation feeds into the pool of problem gambling in the following generation. There is strong evidence in our Report that maternal problem gambling raises risk for their sons. However, problem gambling among women is relatively rare and the number of sons affected therefore relatively low. Thus transmission between mothers and sons is capable of accounting for only a small part of the pool of young problem gamblers. Similarly, paternal problem gambling is a strong individual risk factor for young women but the proportionate increase in risk is applied to a low base level of risk in the case of females. Transmission between fathers and daughters therefore fails to account for a large proportion of the set of young people with gambling problems. A caveat is that we observed parental problem gambling scores at only one point in childhood. Given that problem gambling can be a transient state, many more of the young people in our sample may have been affected by parental problem gambling than those we were able to observe.

15. GambleAware commissioned a third sweep to survey gambling behaviour of ALSPAC participants at age 25 but the results were not yet available at the time of our analysis.

1 Introduction

1.1 Background

The Avon Longitudinal Study of Parents and Children (ALSPAC), also known as "Children of the 90s", is an ambitious cohort study of children born in Avon (the county centred on Bristol), England, in 1991-2. More than 14,000 prospective mothers were recruited during pregnancy (details of the recruitment of the sample and of sample numbers are presented in Box 1.1) and parents and children have been followed up intensively ever since through both clinics and questionnaires self-completed by mothers, their partners and (from age 5) the children themselves. The rich data generated have been used as the basis for more than 1,500 papers[1], many in the medical field, with subjects ranging "from policy-changing health advice for pregnant women and young children to the discovery of genetic factors involved in foetal growth, obesity, allergies and bone density"[2].

To date, gambling behaviour has featured four times in the data collection exercises. First, at child age 6, mothers and fathers[3], in separate "lifestyle questionnaires", provided information on their own participation in named gambling activities and completed a problem gambling screen. Then, at approximately ages 17, 20 and 25[4], the children in the study, now young adults, were asked about their gambling and, if they had gambled, were asked to take both the PGSI and DSM-IV screens for problem gambling.

We had access to the parents' responses to the gambling questions at child age 6 (and to a selection of other parental surveys on diverse topics at various dates) and to the young persons' gambling responses at ages 17 and 20. We also had linked administrative data in the form of measures of children's school grades at approximately age 15.[5] At the time of our study, information on the third wave of gambling data pertaining to young adulthood had not yet become available.[6]

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[1] http://www.bristol.ac.uk/alspac/researchers/publications/

[2] *Nature*, April 11, 2012

[3] ALSPAC, questionnaires are completed by the birth mothers and by their partners. The latter will not always be the biological fathers of the children in the study. Nevertheless, we will usually refer to "fathers" rather than to "partners". Essentially this is to avoid confusion when referring to inter-generational influences. For example, there would be ambiguity in listing "partner influences on the child age 20" since 'partner' could refer to the mother's partner or to the child's own partner. For the sake of clarity, we prefer to use "father's influence on the child" even if 'father' is being used loosely in this case.

[4] The exact age at which individuals participate in a particular exercise varies. For example, when we refer to results for subjects at age 17, there is rounding involved: the median age at which the questions were answered was 17 years and 9 months

[5] Please note that the study website contains details of all the data that are available through a fully searchable data dictionary: http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary/

[6] GambleAware, which funded the inclusion of the questions, has commissioned work to analyse the results of the third sweep, see https://about.gambleaware.org/research/research-projects/

Box 1.1 Recruitment of the ALSPAC sample

ALSPAC recruited 14,541 pregnant women resident in Avon, UK with expected dates of delivery 1st April 1991 to 31st December 1992. 14,541 is the initial number of pregnancies for which the mother enrolled in the ALSPAC study and had either returned at least one questionnaire or attended a "Children in Focus" clinic by 19/07/99. Of these initial pregnancies, there was a total of 14,676 foetuses, resulting in 14,062 live births and 13,988 children who were alive at 1 year of age. When the oldest children were approximately 7 years of age, an attempt was made to bolster the initial sample with eligible cases who had failed to join the study originally. As a result, when considering variables collected from the age of seven onwards (and potentially abstracted from obstetric notes) there are data available for more than the 14,541 pregnancies mentioned above. The number of new pregnancies not in the initial sample (known as Phase I enrolment) that are currently represented on the built files and reflecting enrolment status at the age of 18 is 706 (452 and 254 recruited during Phases II and III respectively), resulting in an additional 713 children being enrolled. The phases of enrolment are described in more detail in papers noted below*. The total sample size for analyses using any data collected after the age of seven is therefore 15,247 pregnancies, resulting in 15,458 foetuses. Of this total sample of 15,458 foetuses, 14,775 were live births and 14,701 were alive at 1 year of age. A 10% sample of the ALSPAC cohort, known as the Children in Focus (CiF) group, attended clinics at the University of Bristol at various time intervals between 4 to 61 months of age. The CiF group were chosen at random from the last 6 months of ALSPAC births (1432 families attended at least one clinic). Excluded were those mothers who had moved out of the area or were lost to follow-up, and those partaking in another study of infant *development* in Avon.

*A. Boyd, J. Golding, J. Macleod, D.A. Lawlor, A. Fraser, J. Henderson, L. Molloy, A. Ness, S. Ring, & G. Davey Smith, 'Cohort Profile: The 'Children of the 90s'; the index offspring of The Avon Longitudinal Study of Parents and Children (ALSPAC)'. *International Journal of Epidemiology*, 2013; 42: 111-127.

A. Fraser A, C. Macdonald-Wallis, K. Tilling, A. Boyd, J. Golding, G. Davey Smith, J. Henderson, J. Macleod, L. Molloy, A. Ness A, S. Ring, S.M. Nelson & D.A. Lawlor, 'Cohort Profile: The Avon Longitudinal Study of Parents and Children: ALSPAC mothers cohort. International Journal of Epidemiology 2013; 42:97- 110.

1.2 Prior studies of ALSPAC gambling data

Kretschmer et al.[7] delved deep into the childhood archives of the ALSPAC study to examine the extent to which early conduct problems predicted eleven different negative outcomes, ranging from smoking and cannabis use to depression and anxiety, at the onset of adulthood. Early conduct problems proved very strongly significant in ten cases; but problem gambling (defined by them as any positive points score on the PGSI) was the exception and was not a statistical predictor. This is suggestive that, in general, findings about other problematic

[7] T. Kretschmer, M. Hickman, R. Doerner, A. Emond, G. Lewis, J. Macleod, B. Maughan, M. R. Munafò, & J. Heron, 'Outcomes of childhood conduct problem trajectories in early adulthood: Findings from the ALSPAC study', *European Child & Adolescent Psychiatry*, 2014, 23(7): 539-549.

behaviours should not be presumed necessarily to be able to be carried over to the study of problem gambling. However, it should be noted that the failure to uncover a relationship between the behaviour of the young child and the problem gambler status of the 17/18-year-old could be just an issue of statistical power given the relative rarity of problem gamblers in the sample, even if 'gambling problems' were generously defined in the study.

In a more focused paper[8], Emond et al. sought to identify risk factors[9] for regular participation in gambling and for signs of problematic gambling in the ALSPAC age 17 sample. Many significant correlates were found but only a limited number survived multivariate modelling.[10] Independent predictors of regular gambling included male gender, mother with low level of education, current smoking and binge drinking, and high scores on a sensation-seeking assessment. Independent predictors of problem or at-risk gambling (defined by PGSI score) included male gender, low IQ as measured during primary school, and current binge drinking. There was a weak positive association between problematic gambling at age 17 and the mother having reported gambling problems at child age 6; but there was no apparent association with the father's gambling.

Given that there has been some previous analysis of the first wave of gambling questions, we will present detailed analysis of gambling and problem gambling as reported by ALSPAC participants in the second wave at age 20. However, we will include summaries of results from our models applied to the age 17 sample.

One difference between our study and the two preceding ones cited above is that we will present separate models of the gambling outcomes for young men and young women. The preceding papers pooled together data for males and females. Emond et al. do address gender but only by including a dummy variable in each multivariate logistic regression model (which in this case will, for example, have lowered the estimated odds that a female with the same

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[8] A. Emond, R. Doerner & M.D. Griffiths, 'Gambling behaviour in adolescents aged 17 years: Final Report to the Responsible Gambling Fund', 2011, http://www.academia.edu/1118506/Emond_A._Doerner_R._and_Griffiths_M.D._2012_._Gambling_behaviour_in_adolescents_aged_17_years._Report_to_the_Responsible_Gambling_Fund_UK_

[9] In the literature, 'risk factors' are commonly defined as "conditions that are associated with an increase in the likelihood of problem gambling" or predictors "able to predict problem gambling after adjustment for other known influences" (N.A, Dowling, S.S. Merkouris, C.J. Greenwood, E. Oldenhof, J.W. Toumbourou & G.J. Youssef, 'Early risk and protective factors for *problem* gambling: A systematic review and meta-analysis of longitudinal studies', *Clinical Psychology Review*, 2017, 51: 109-124). Note particularly that usage of 'risk factor' in the gambling studies field does not imply causation from the predictor to the outcome.

[10] This appears to be a common feature of results on young persons' gambling. In an Australian longitudinal study, "numerous predictors [from adolescence] associated with the family, school and peer-individual were statistically significant in analyses adjusted for gender and age" but only female gender was associated with reduced risk of young adult problem gambling once a multivariate model was estimated: K.E. Scholes-Balog, S.A. Hemphill, N.A. Dowling & J.W. Toumbourou, 'A prospective study of adolescent risk and protective factors for problem gambling among young adults', *Journal of Adolescence*, 2014, 215-224.

characteristics as a male will be a problem gambler). However, this does not allow separate evaluation of the influence of each covariate on the outcome of interest according to gender. Given that the extent of problem gambling is so much greater in the male population than the female, it is plausible that the etiology is different in each case. Potentially, a given factor in an individual's background may have a different effect on behaviour depending on whether the subject is male or female. For example, Homel and Warren[11] reported that binge drinking by fathers raised the probability that their adolescent daughters would consume alcohol but had no significant effect on their sons. This underlines that separate modelling by gender may generate additional insights. In the case of the study of problem gamblers, pooling all the data seems particularly risky given that the number of male problem gamblers is very much greater than the number of female problem gamblers. Results from pooled data will then be driven by the male observations and findings will potentially be relevant only for males rather than showing an averaging of 'hidden' male and female models.

1.3 Scope of the present study

Our brief was to examine the link between young persons' gambling behaviour and potential influences from childhood. An obvious issue to be examined was whether there is transmission of gambling behaviour, and of gambling disorder in particular, from one generation to the next.

It hardly needs scientific verification to expect a correlation between parents' choice of leisure pursuits and the behaviour of their children as adults. For example, one might reasonably expect the offspring of golf-playing parents to be disproportionately likely themselves to be playing golf in adulthood: their parents will have 'modelled' a lifestyle in which golf seemed a commonplace activity and may well have introduced their children to the game. It is plausible that the same is true of gambling. And indeed "there is an extensive and very convincing body of international evidence dating back nearly 40 years which demonstrates the role of parents in introducing children to gambling".[12]

But golf and gambling are different. Notwithstanding the phenomenon of the 'golf widow', gambling is distinctive from golf in having the potential to generate significant harm among a significant minority of its players and their families and associates. The possible role of parents in increasing the risk of future harm to their children by their own engagement with gambling is therefore a legitimate issue for public concern and one from which policy implications may follow. For example, if heavy engagement in gambling by parents (even without it being 'problem gambling') leads to risk of future harm to their children, then

[11] J. Homel & D. Warren, *The Longitudinal Study of Australian Children: Annual Statistical Report*, 2016, www.growingupinaustralia.gov.au/pubs/asr/2016d.html

[12] G. Valentine, p. 35 of *Children and young People's Gambling: Research Review*, London: The Responsible Gambling Trust, 2016 (https://about.gambleaware.org/media/1274/1-june-update-children-young-people-literature-review.pdf).

public health campaigns could aim to inform parents of the danger or encourage appropriate discussion with their children. And, if problem gambling is transmitted across the generations, the benefits of using resources to address problem gambling today are magnified because of the presence of a sort of 'multiplier effect'.

However, a problem with identifying correlation is that the policy implications may be spurious because of the presence of confounding factors. For example, suppose having parents who gamble regularly is shown, statistically, to be a risk factor for problem gambling. This may reflect a direct impact from parents' gambling. Alternatively it could be that the association is generated by parental gambling standing as a proxy for being brought up in a household where there is general tolerance of risky or stigmatised behaviours (such as smoking, drinking and unhealthy diet). If that were the case, it might not be that a direct effect is flowing from the parental gambling itself (hence removing it would not mitigate problem gambling risk for the children) but from the broader culture inherent in the family background.

Hence we devote much of the Report to exploring the influence of parental behaviour during childhood (including, but not restricted to, gambling behaviour) on the probability that a child will be (i) a 'regular gambler' or (ii) a 'problem gambler' at age 20. The intention is to isolate as far as possible any direct transmission of gambling behaviour between parents and children.

The definitions of outcomes observed at age 20 are as follows. A 'regular gambler' is one who self-reports gambling at least weekly[13] on at least one of sixteen named gambling activities (for example, scratchcards, slots, online betting, online casino) over the past twelve months. A 'moderate problem or problem gambler' (hereafter MPPG) records a score of 3 or more on the PGSI screen.[14]

Other issues covered in our analysis include the effect of the child's academic ability on gambling outcomes at age 20 and the fluidity of problem gambling status between ages 17 and 20.

[13] The menu of choices available to the respondent next to each gambling activity comprised: not within the last 12 months; within last 12 months; every week; every day/almost every day.

[14] A score of 3-7 is generally classified as 'moderate level of problems' and a score of 8 or more as 'problem gambling'. There are too few respondents with a score of 8 or more to permit meaningful modelling of the risk of falling within that latter category. For example, we had more than 2,000 cases where there was information on both the young person's gambling at age 20 and the mother's gambling at child age 6. Of these, only ten of the young people had a PGSI score of 8 or greater (and had we adopted the DSM-IV definition of problem gambler there would have been only six). Combining the 'level 2' and 'level 3' PGSI categories (giving 83 cases) was therefore a necessity. But we argue that it would be sensible in any case. It is plausible that the harm from gambling arises at least as much from those with 'moderate problems' as from those who meet the full criteria for 'problem gambling' simply because there are so many more of them in the population.

Our principal modelling tool will be logistic regression, which is appropriate for contexts where the variable to be modelled is binary (either the outcome occurs or it doesn't). For each of our principal empirical exercises, we will provide tables of results from estimation with logistic regression. Readers unfamiliar with the presentation of regression results will be able to skip these as the text will always give a verbal account and interpretation of the contents of the table.

We note that none of the models includes predictors reflecting ethnicity. It is very common for researchers to report an influence of cultural background on gambling participation and on problem gambling status, including in the case of young people in Great Britain. For example, Forrest & McHale[15] reported that British adolescents with a South Asian background were much less likely than their 'white British' counterparts to engage in gambling but much more likely to be experiencing gambling problems. The omission here of variables representing ethnic minority status therefore calls for explanation. The problem was lack of diversity in the ALSPAC sample, resulting in too few numbers in minority categories to obtain the required statistical power. In turn, this lack of diversity largely reflects the composition of the local population in the study area in 1991-2, when the initial recruitment took place. A caveat to our analysis is therefore that findings are likely driven by the dominant white British group in the sample and therefore may not necessarily be generalisable to other communities.

1.4 Our samples

The principal sources of information for the study came from three questionnaires: one completed by young adults at age 20, one completed by mothers at child age 6 and one completed by fathers at child age 6. But, for many respondents who supplied information on their gambling at 20, either or both of the mother and father questionnaires had not been filled in when they were six. In particular, there was a relatively large number of 'missing' questionnaires from fathers.

One way of dealing with this situation would have been to discard all cases where the young adult information was not matched by information from both parents. However, this would have meant discarding a large body of data, relating to more than 1,000 individuals for whom there were observations of gambling behaviour at age 20. Therefore we chose instead to undertake separate analyses of two samples. First, we analyse a sample comprising all 2,125 cases where there was information from both the child at age 20 and the mother at child age 6. Necessarily, modelling these data restricts age 6 self-report data to those provided by the mother (we still use some 'father' variables reported by the mother rather than self-reported, but these do not include gambling variables). Then, similarly, we analyse a sample comprising all 1,064 cases where there was information from both the child at age 20 and the

[15] D. Forrest & I.G. McHale, 'Gambling and problem gambling amongst young adolescents in Great Britain', *Journal of Gambling Studies*, 2012, 28:607-622.

father at age 6. The overlap between the two samples was 1,033, confirming that it was typically the father's information that was absent rather than the mother's. Sample sizes suggest of course that it may be easier to draw inference concerning influence from the mother rather than from the father.

In each case, the sample of young adults with which we were to work was quite severely biased towards females. For example, the child at 20/ mother sample was 40.3% male (856 cases) and 59.7% female (1,269 cases). This will need to be borne in mind when considering any contrast in results across gender as an 'inconclusive' result for males might result from lack of statistical power rather than from there being no 'true' relationship. On the other hand, regular gamblers and MPPGs are more numerous in the male samples, as in the population, and this might make it more realistic to establish patterns in the data which might be associated with gambling outcomes.

At the end of the Report, we will consider transition in gambling behaviour between ages 17 and 20. Here we had 1,349 cases where relevant information from the young person was present for both ages.

2 The child at 20/ mother sample

2.1 Descriptive statistics: the children at age 20

2.1.1 Participation in gambling at age 20

There were 2,125 individuals in this sample (i.e. all those who had provided information on their own gambling at age 20 and for whose mothers there was gambling information at child age 6). Table 1 shows their participation-rates at different frequencies of play for each of sixteen gambling activities.

Table 1. Frequency of play in sixteen gambling activities at age 20 (percentages)

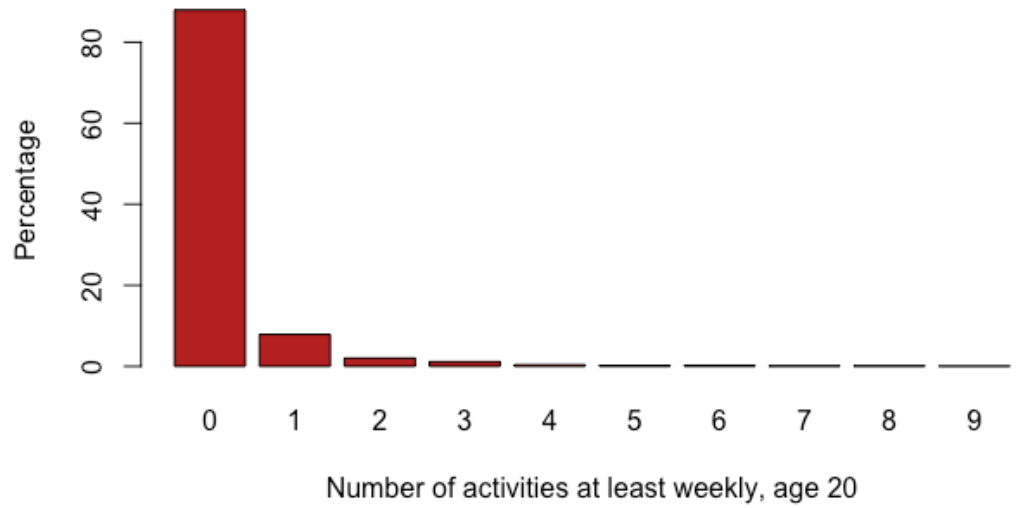
Activity	No Response	Every day/almost every day	Every week	Within last 12 months	Not within last 12 months
Lotto	0.89		3.91	38.40	56.80
Scratchcards	0.80	0.28	3.53	34.26	61.13
Other lottery	0.94		0.56	14.68	83.81
Pools	0.85	0.19	2.07	6.31	90.59
Bingo	0.89		0.66	11.95	86.49
Slots	0.94		1.13	14.02	83.91
FOBTs	0.66		0.94	11.15	87.25
Tables Games	1.36		0.85	15.58	82.21
Online Casino	0.94	0.19	1.18	8.85	88.85
Online Betting	0.85	0.47	2.45	7.48	88.75
Betting Exchange	1.04		0.38	3.06	95.53
Horses	1.04		0.38	15.15	83.44
Sports Bets	1.18		0.61	4.56	93.65
Spread Bets	0.99		0.09	1.51	97.41
Cards	1.18		0.80	17.84	80.19
Other Gambling	1.41		0.33	2.12	96.14

Note that the responses were mutually exclusive. For example, 38.40% had played lotto in the preceding twelve months and *another* 3.91% indicated that they played every week (but not every day). Therefore, altogether, 43.31% of the sample had played lotto at least once over a twelve month period.

As in the general population, gambling activities provided by the National Lottery- lotto games and scratchcards- had far the highest take-up rate among the young adults in the ALSPAC sample whether measured by weekly or 'past twelve months' statistics. Apart from the pools, the next most common activities attracting weekly or more-than-weekly participation were online casinos and online betting; but on an 'ever in the last twelve months' basis, participation was highest for card games, table games, 'other lotteries' and horse betting, all land-based and each drawing more than 15% of the sample.

Our focus will be on the 'regular gambler' defined by having indicated weekly or every day/ almost-every-day participation in at least one of the activities. **11.2% of the sample were regular gamblers** on this definition. Most of these were regular gamblers in only one activity but a small number engaged in each of multiple activities on a weekly-or-more basis (Figure 1).

Figure 1. Number of activities engaged in weekly or more often: proportions of the sample



2.1.2 Problem gambling at age 20

Table 2 shows the distribution of PGSI scores across the sample. The first category includes those who did not complete the screen because they had not gambled in the preceding twelve months.

Table 2. PGSI scores.

	males	females
not applicable	270 (31.5%)	536 (42.2%)
non-problem gambling (PGSI=0)	372 (43.5%)	581 (45.8%)
low level of problems (PGSI=1-2)	152 (17.8%)	131 (10.3%)
moderate level of problems (PGSI=3-7)	47 (5.5%)	20 (1.6%)
problem gambling (PGSI=8 or more)	15 (1.7%)	< 5

Note: conditions for using ALSPAC data include that exact numbers in cells referring to fewer than five observations may not be reported.

We will explore risk factors for MPPG defined by a PGSI score of 3 or more. On this definition, 3.9% of the whole sample (and 6.3% of those who had gambled in the preceding twelve months and 24.7% of weekly-or-more gamblers) **were classified as MPPGs.**

The ALSPAC sample was not designed to be representative of the whole population of Great Britain. Further, all longitudinal studies, but particularly those which attempt to follow participants over several years, are likely to be subject to attrition bias. Those who drop out or with whom the researchers lose touch may, as a group, have different observable or non-observable characteristics from the group which continues to cooperate with the study. This creates a risk that conclusions from evidence about those who are present at a particular time point will be biased by the absence of those who have exited the sample.

We have no means of mitigating or indeed of quantifying this risk. However, a degree of reassurance might be sought by checking whether the prevalence of problem gambling, the principal focus of our study, is similar in the sample as in the general population.

Prevalence of problem gambling has been estimated from nationally representative surveys in various years from 1999. The closest in date to that of the ALSPAC age 20 sampling was in 2012 when the relevant data were collected within the *Health Surveys for England* and *Scotland*. The results from the English and Scottish surveys were grouped together in an analysis for the Gambling Commission.[16] There, PGSI scores are reported by age and gender, where ages are grouped and 16-24 provides the basis for comparison with ALSPAC.

In the national sample, the proportion of males with the highest risk rating (PGSI≥8) was 1.7% and, for females, the figure was 0.1%. In the ALSPAC sample, the corresponding figures were also 1.7% and 0.1%

For moderate levels of harm (PGSI=3-7), prevalence for females was 1.5% in the national sample and 1.6% in the ALSPAC sample. Again, the ALSPAC sample almost exactly mirrors the figure from the *Health Surveys*. However, prevalence of moderate problems among males was somewhat higher in the ALSPAC group (5.5%) than in the national sample (3.0%). Still, overall, there is surprisingly little discrepancy compared with what might be expected given the scope for sampling error and the fact that the age group in the Health Surveys is much wider and includes 16-17 year olds for whom most commercial gambling activities are not easily accessed because of age restrictions. This encourages us to the extent that the

[16] *Gambling behaviour in England and Scotland: Findings from the Health Survey for England 2012 and Scottish Health Survey 2012*, London: NatCen Social Research, 2014. (http://www.gamblingcommission.gov.uk/PDF/survey-data/Gambling-behaviour-in-England-and-Scotland-Findings-from-the-Health-Survey-for-England-2012-and-Scottish-Health-Survey-2012.pdf).

phenomenon to be explained (problem gambling) presents a similar pattern in our data set as in a nationally representative data set.[17]

The PGSI score depends on responses to nine items where, for each item, the individual can choose from the options almost always/ most of the time/ sometimes/ never. Table 3 displays the distribution (in the child at 20/ mother sample) of responses to each individual PGSI item. Loss chasing is endorsed by many more respondents than any other item and indeed there are only three items to attract any "almost always" answers. The high proportion of no responses reflects that those who had not gambled did not have to complete the PGSI part of the questionnaire.

Table 3. Responses to individual PGSI items (percentages)

PGSI question	No Response	Almost always	Most of the time	Sometimes	Never
Loss Chasing	36.00	0.40	1.80	13.30	48.60
More than could afford	35.90	0.10	0.40	3.20	60.40
Larger amounts of money	36.00		0.50	2.70	60.90
Borrowed to gamble	36.00			0.80	63.20
Think have a problem	36.10		0.20	1.70	61.90
Caused health problems	36.10		0.10	0.60	63.20
People criticised my gambling	36.20		0.40	1.70	61.60
Financial problems from gambling	36.20		0.10	0.70	63.10
Felt guilty about gambling	36.20	0.10	0.20	2.90	60.60

2.1.3 Other behaviours at age 20

It is a common finding that participation in gambling and a propensity to problem gambling are each correlated with consumption or abuse of other risky products. For example, a study of the child at 17 ALSPAC data set[18] found that members of a group identified as at high risk of gambling harm were reported to be disproportionately likely to be daily smokers, to have used cannabis and to have engaged in binge drinking.

[17] However, we should note that past-year participation tended to be higher in the ALSPAC data than in the national data, even for products which were legally available at all ages in the 16-24 band. For example, 43% of ALSPAC respondents had played lotto in the preceding twelve months but only 32% of the national sample. Part of the discrepancy may be accounted for by the considerable under-representation of minority ethnic groups in the ALSPAC sample. Data on frequency of gambling were not collected in the *Health Surveys*. The relative popularity of different gambling activities was similar in the two data sets.

[18] see reference at footnote 7 above.

In the following sections, we will explore co-morbidities as risk factors for regular gambling and problem gambling. Modelling will use:

(i) number of cigarettes smoked per day.

(ii) AUDIT score. AUDIT is a widely used Alcohol Use Disorder Identification Test which was administered to the child at 20 sample. A score of 8-15 is usually categorised as 'increasing risk' and 16-19 as 'higher risk' while 20 is the threshold for 'possible dependence'.

(iii) CAST score. CAST is a Cannabis Abuse Screening Test which was administered to the child at 20 sample. It is a six item screen and 6 is the maximum score in the version used in the ALSPAC questionnaire.

(iv) self-reported number of illegal drugs used in the preceding three months.

The pattern of responses under each of these headings is summarised in Figures 2-5. In subsequent modelling, because the number of respondents who had used more than one illegal drug was very small, we represented the data in Figure 5 by a dummy (binary) variable set equal to 1 if the individual had reported any drug use and to 0 otherwise.

Figure 2. Cigarette consumption at 20

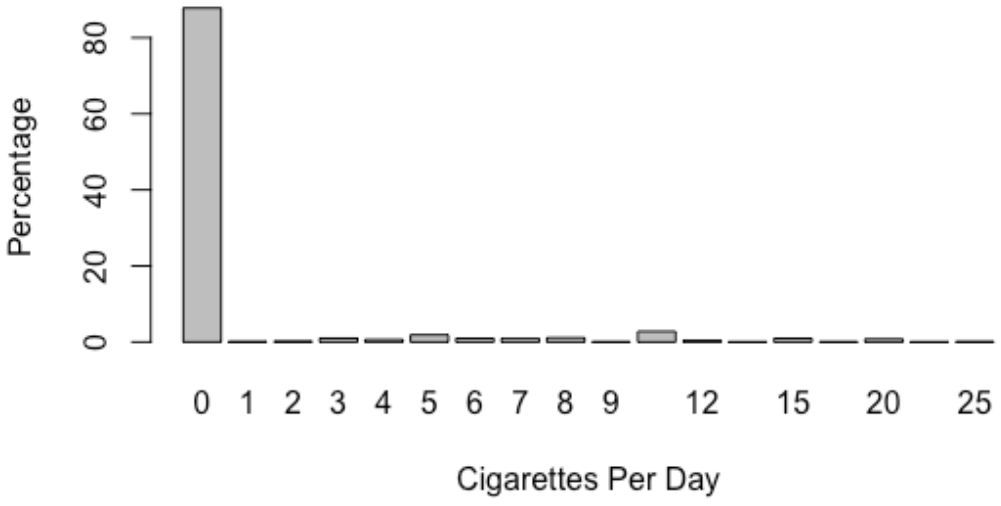


Figure 3. Scores on the Alcohol Use Disorder Identification Test

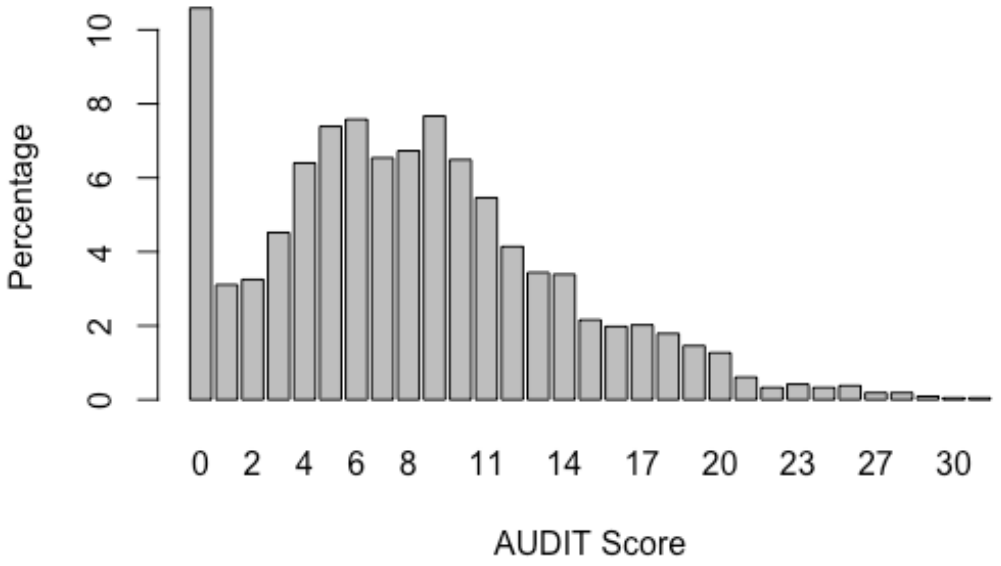


Figure 4. Scores on the Cannabis Abuse Screening Test

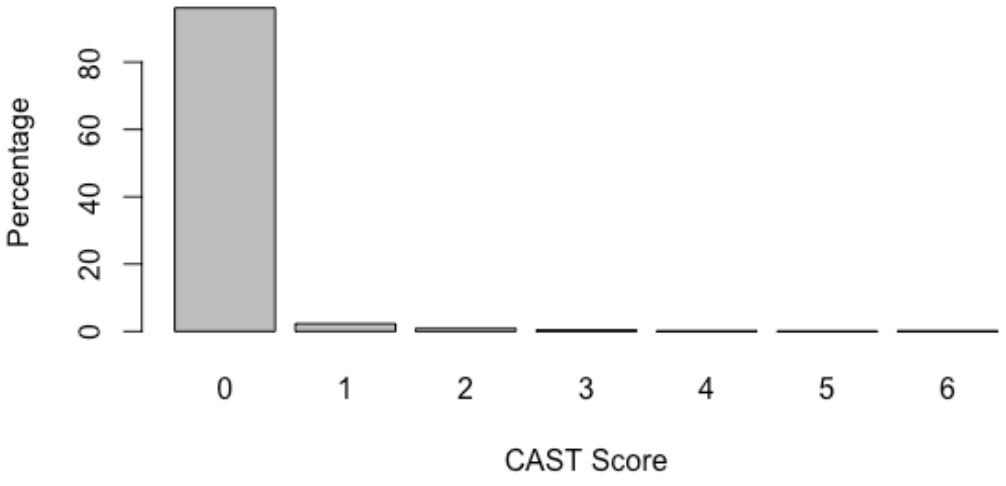
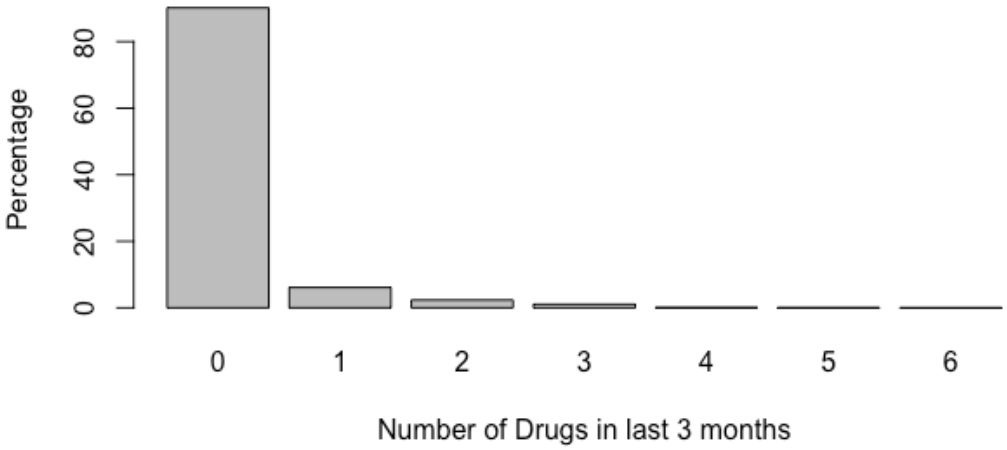


Figure 5. Number of drugs used in the preceding three months



2.2 Modelling 'regular gambler': relationship with other contemporaneous behaviours and with academic performance at secondary school

We now begin reporting results from statistical modelling of the data in the child at 20/ mother sample. Results are presented in the form of estimated logistic regression equations.[19] In all results tables, p-values measure the strength of statistical significance and three, two and one asterisks indicate significance at the 1%, 5% and 10% levels respectively. For example, where there are three asterisks ($p<.01$), one can be very confident that there is a 'true' relationship between the probability of the outcome (e.g. regular gambler) and the named variable (though this does not necessarily establish the direction of causation).

Coefficient estimates which are positive indicate that the named variable raises the probability that the outcome occurs and those which are negative tend to lower the probability.[20]

Consider first the results from models 1 and 2 in Table 4. In model 1, we explore the relationship between the probability of an individual being a regular gambler and his/ her use of cigarettes, alcohol and cannabis and other illegal drugs. As additional predictors, we add dummy variables to reflect

[19] In many models, covariate values were missing for some observations. In these cases, we used a dummy variable to represent missing values, for example 'cigarette use unknown'. Though such dummies were included in modelling, we do not report the coefficient estimates in the tables of results.

[20] In some literature, results tables for logistic regression present 'odds ratios'. These may be calculated from the coefficient estimates of the underlying model. Where the underlying model has a positive (negative) coefficient estimate, this will give an odds ratio greater (less) than 1. Significance tests give the same result whether the null hypothesis is that the true coefficient is 0 or that the true odds ratio is 1.

whether the young person at 20 is already a biological parent (59 individuals, 2.8% of the sample) or a step-parent (6 individuals, 0.3% of the sample).

In model 2, we repeat the analysis but now defining 'regular gambler' as an individual who engages weekly or more often in at least one gambling activity *other than lotto games*. We estimate this second model because of the risk that conclusions drawn from model (1) will be excessively driven by lottery play, which is the most common gambling activity in the sample and in the general population. Many consider lottery play as 'soft' gambling or not even gambling at all and engagement in it may not be perceived as abnormal behaviour (in the way some may regard, for example, the playing of roulette). And indeed, while the results from models 1 and 2 are qualitatively similar, lower p-values in model 2 indicate a more precisely estimated model and a sharper relationship between regular (non-lotto) gambling and the behaviours represented on the right hand side of the equation.

Still, the models tell broadly the same story:

(i) **For both genders, there is a statistically strong relationship between the probability of 'regular gambler' and smoking behaviour: heavier smokers are more likely to be regular gamblers**.

(ii) **Among the young men, there is also a strong correlation between regular gambling and risky drinking (as captured by the AUDIT screen); but no correlation is found for females**.

(iii) **For neither gender was there any convincing evidence of an association between regular gambling and use/ abuse of illegal drugs**.

(iv) **Controlling for other behaviours, young fathers were disproportionately likely to be regular gamblers; further the effect size was large[21]. However, there was no apparent effect on the probability of being a regular gambler from being a young mother.**[22]

Next, we add to the models measures of academic ability. In the gambling studies literature, academic performance has mainly featured in cross-sectional studies of youth problem gambling, with a relationship between problem gambling and failed courses at school/ college often noted.[23] In such

[21] According to the estimated male model, an individual who was a biological father was 3.66 times as likely to be a regular gambler on non-lotto products compared with a non-parent, holding constant the values of other predictors. This is the 'odds ratio' calculated from the coefficient estimate.

[22] The rarity of step-parents in the sample made it unlikely that step-parent status could be identified as a risk factor, so the non-significance of the variable should not be interpreted as evidence that there is no relationship in the population.

[23] For an early example study using a large sample of teenagers in Québec, see R. Ladouceur, N. Boudreault, C. Jacques & F. Vitaro, 'Pathological gambling and related problems among adolescents', *Journal of Child & Adolescent Substance Abuse*, 1999, 8(4):55-68.

cross-sectional studies, the causation could be in either direction. In a longitudinal Australian study, albeit one with only 305 participants, poor school performance (defined as self-reporting at age 16 that the individual had got "mostly C's, D's and F's" in the past year) was a risk-factor for the highest classification of problem gambling at (approximate) age 24.[24] In the present study we relate gambling behaviour in young adulthood to *past* academic performance (in mid-adolescence) and, further, we do not rely on self-reported grades and we are able to distinguish between academic performance in different school subjects.

Table 4. Logistic regression results: 'regular gambler' with co-morbidities and school test scores

MALES

	(1)		(2)		(3)		(4)	
	regular gambler		regular gambler (not lotto)		regular gambler		regular gambler (not lotto)	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-2.113***	<.001	-2.438***	<.001	-1.845***	<.001	-2.108***	<.001
cigarettes per day	0.050**	.037	0.061**	.011	0.041*	.091	0.053**	.031
AUDIT score	0.050***	.002	0.065***	<.001	0.064***	<.001	0.077***	<.001
CAST score	0.057	.772	0.084	.526	0.042	.796	0.070	.669
used drugs in past 3 months	-.0.539*	.095	-0.589*	.080	-0.509	.118	-0.551	.279
biological parent	1.163**	.047	1.299**	.027	0.996*	.092	1.145*	.053
step parent	1.021	.698	0.980	.505	0.445	.756	0.448	.310
maths score					0.006***	.004	0.006***	.005
English score					-0.020***	<.001	-0.019***	.001

FEMALES

	(1)		(2)		(3)		(4)	
	regular gambler		regular gambler (not lotto)		regular gambler		regular gambler (not lotto)	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-2.741***	<.001	-3.208***	<.001	-2.519***	<.001	-2.869***	<.001
cigarettes per day	0.075***	.005	0.094***	.001	0.063**	.021	0.081***	.006
AUDIT score	-0.017	.460	-0.015	.555	-0.012	.593	-0.011	.687
CAST score	0.256	.326	0.090	.801	0.222	.392	0.059	.868
used drugs in past 3 months	-0.132	.767	0.85	.103	-0.078	.863	0.146	.767
biological parent	0.272	.544	0.345*	.534	0.148	.768	0.219	.694
step parent	-13.377**	.019	-13.247	.985	-13.602	.985	-13.485	.985
maths score					0.005*	.064	0.005	.114
English score					-0.013*	.056	-0.015*	.052

We had access to linked data which showed SATS scores for children in the ALSPAC sample. These were from compulsory national tests (since abolished) taken at the end of Key Stage 3 (age 14-15) in schools in England and Wales. The maths test was scored out of 140 and the English test out of 110, reflecting weights of subjects in the National Curriculum. For children in the ALSPAC sample, there was mild negative correlations between maths and English scores (correlation coefficient= -0.166).

[24] K.C. Winters, R.D. Stinchfield, A. Botzet & N. Anderson, 'A prospective study of youth gambling behaviors', *Psychology of Addictive Behaviors*, 2002, 16(1):3-9.

Models 3 and 4 in Table 4 are logistic regressions as before with maths and English scores added to the set of predictors. The pattern of results on smoking, alcohol risk and drug use are broadly unaffected by the presence of the additional variables. For males, maths score proves to be a strong positive predictor of regular gambling and English a strong negative predictor of regular gambling (whether or not defined to include lotto play). In the female models, directions of effect are the same but the results are more marginal in terms of statistical significance.

The novelty of these results led us to probe further. First, we wondered whether some additional influence of maths scores on propensity to gamble might be mediated through the other behavioural variables such that, for example, high performance in maths had a negative effect on use of cigarettes, thereby providing, through the smoking variable, an offset to the apparent direct effect of maths on gambling behaviour. Second, we wondered whether the influence of test scores had an influence only on propensity to engage in particular gambling activities, for example those where skill with numbers could contribute to success in the game.

To address both issues, we estimated a series of univariate logistic regressions in which maths score was the only predictor variable. In each equation, regular gambling in a named activity was the dependent variable. Separate models were again estimated for males and females, giving 32 models in all.

In the male models, maths score was positive and statistically significant at at least the 5% level for lotto, scratchcards and pools. For females, maths score was statistically significant only for scratchcards. However, it would have been optimistic to expect statistical significance to have been achieved in many cases because the absolute number of regular gamblers in any given activity is typically small. However, we note that 28 of the 32 coefficient estimates in the exercise were signed positive, indicating that the effects of maths score is likely to be positive in the typical case notwithstanding that most coefficient estimates were individually non-significant.

It therefore appears not to be the case that maths score predicts regular gambling only for skill based games and indeed statistical significance was achieved for lotto games and scratchcards which are games of pure chance.[25] Further, the general pattern of coefficient estimates remains one of positive signs even in the absence of variables describing engagement in other problematic behaviours. This again points to a 'pure' link between school maths score and propensity to regular gambling in young adulthood.

Performance in school tests does not of course reflect only natural aptitude in the subject. Other influences such as effort and the priority given to educational achievement in the home are also likely to be relevant. But these latter influences would be expected to push scores in maths and English in the same direction. The fact that maths and English scores have opposite effects on the probability of becoming a regular gambler therefore suggests that the results are genuine reflections of how

[25] The results appear to be inconsistent with the aphorism that "the lottery is a voluntary tax for the mathematically challenged" (used for example in comments at news.bbc.co.uk/1/hi/world/europe/3148337.stm).
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participation in gambling is linked to a child's aptitude rather than merely reflections of conscientiousness or home background. Hence we draw at least a preliminary conclusion that, **particularly for males, aptitude in maths makes it more likely that an individual will be a regular gambler and aptitude in English makes it less likely that an individual will be a regular gambler.**

It is possible only to speculate on the reasons for these findings. Certainly many gambling games involve numbers, whether on the entry form for a lotto draw or on a roulette wheel or in the odds quoted by a bookmaker. It is possible that those drawn to gambling tend to be relatively comfortable with numbers while those whose aptitude lies more in the direction of words tend more often to choose other leisure pursuits.[26]

2.3 Descriptive statistics: the mothers at child age 6

2.3.1 Mothers' engagement with gambling

In the next empirical exercises we will examine links between children's gambling in young adulthood and home background, with specific emphasis on their mothers' gambling behaviour, captured in the data set at child age 6.

In the questionnaire at child age 6, mothers were asked about the frequency of participation in eleven categories of gambling, which included 'stocks and shares' but (given the date of the survey) no online activities. Scratchcards also failed to make the list even though they had recently (1995) become available. Responses are summarised in Table 5. Lotto was overwhelmingly the most popular activity (at the time of the survey, national lottery sales were at their historic peak, from which they have declined inexorably ever since) though significant numbers of women were either playing currently or reported past experience of slots and bingo. Regular play was rare for any activity apart from lotto, with bingo the most likely were a mother a regular non-lotto gambler.

In terms of the number of activities engaged in weekly or more often by the mother, 0 (58.82%) and 1 (40.47%) were the most common by far. Only 0.68% (15 individuals) took part regularly in two or more activities. The variable *number of gambling activities, mother* will be included in modelling as one indicator of the importance of gambling in a child's background.

We also considered the amount of money mothers had been willing to put at risk. The questionnaire asked mothers what had been their largest size of bet in a single day. The distribution of responses is shown in Table 6 and we created a dummy variable *mother bet more than £10*, set equal to 1 for all

[26] In supplementary analysis, we experimented with a quadratic specification (including the squares of maths score and English score as additional covariates in relevant equations) in case there was a tendency for, for example, regular gambling to be most associated with middling maths scores rather than top or bottom maths scores. However, this proved not to be the case and the straightforward linear specification was appropriate.

responses from £10 up (6.54% of the whole sample) to serve as an indicator of participation in relatively heavy play.[27]

Mothers who gambled were also asked to complete (a subset of questions from) the South Oaks Gambling Screen for problem gambling (SOGS) and the distribution of scores across the whole sample (current non-gamblers were assigned a score of 0) is shown at Table 7.

Table 5. Mother's frequency of gambling in different activities (percentages)

	No Response	Once a week/more	Less than once a week	In past only	Rarely/not at all	NA
Cards	0.33	0.09	0.56	6.92	92.09	
Horses	0.38		1.51	8.80	89.32	
Sports Bets	0.71	0.05	0.42	2.87	95.95	
Dice	0.66		0.19	0.71	98.45	
Casino	1.13		0.28	4.66	93.93	
Lotto	0.19	40.75	22.31	8.19	28.56	
Bingo	0.75	0.52	3.06	12.52	83.15	
Stocks and Shares	0.89		1.18	1.98	95.95	
Slots	0.19	0.09	6.26	22.64	70.82	
Other Games	0.56		0.14	0.94	98.35	
Other Gambling	25.79	0.47	0.47	0.33	72.89	0.05

Table 6. Mother's largest bet size on one day

Amount	%
No response	0.56
£1000 - £10,000	0.14
£100 - £999	0.09
£25 - £99	1.41
£10 - £24	4.89
£1 - £9	56.33
<£1	10.68
Never gambled	25.88

[27] Adjusting by reference to the Retail Prices Index, £10 then was equivalent to about £17.20 at 2017 prices. Regional female median weekly earnings *before tax* at that time were £242 (from Office of National Statistics, Annual Survey of Hours and Statistics, accessed through https://statswales.gov.wales/Catalogue/Business-Economy-and-Labour-Market/People-and-Work/Earnings/averageweeklyearnings-by-ukcountryenglishregion-year)

Table 7. Mother's SOGS scores (percentages)

0	1	2	3	4	5
90.35	7.95	1.32	0.19	0.14	0.05

Note: on the full SOGS screen, which has twenty items, it is usual to take 5 as the threshold for classification as a probable problem or pathological gambler (with 1-4 signifying some problems with gambling). However, ALSPAC used a reduced version of SOGS, with only twelve items. It included a question on whether the respondent had ever borrowed money for gambling but omitted follow-up questions on the source of borrowing (which can generate further points in the full SOGS screen). The version of SOGS used by ALSPAC was very similar to that used in the almost contemporaneous British Gambling Prevalence Survey, 1999.

2.3.2 Other mother and household characteristics

In modelling, we will relate the probability of the young adult being a regular gambler to both the mother's gambling behaviour at child age 6 and to other measures that we hope capture the culture of the home background. These were gathered from mother surveys at child ages 8, 10 and 12. They reflect: consumption of risky goods in the household (mother's smoking, father's smoking as reported by the mother, mother's drinking, frequency of eating fried food, mother's BMI (body mass index)); the mother's religiosity and faith group; whether the mother lived with a partner; whether she believed that her partner loved the child; whether she reported emotional problems; and self-reported frequency of arguments with her partner. We add variables to capture the mother's level of education and also the level of education of the father (as reported by the mother).

The variables are listed in Table 8 together with basic information on the pattern of data for each variable. Figures 6 and 7 provide supporting information on mothers' BMI statistics and on responses to the religiosity questions.

The inclusion in the model of many of these variables is motivated by recognition of the possibility that *any* indication that a child was brought up in a household where there was little emphasis on health issues and on the dangers from risky behaviour might predict adult engagement with any named risky behaviour in adulthood. For example, a study across thirteen European countries found that parental smoking at child age 10 was a significant predictor of the adult's subsequent obesity at age 50.[28] There is no plausible mechanism for a direct effect on adult weight from exposure to smoking in the childhood home, so it may well be that the association arises because parental smoking is an effective proxy for attitudes to health and risky consumption in an individual's childhood home environment. We recognise the possibility that univariate modelling of the relationship between adult regular/ problem gambling and parental gambling might similarly yield results that would be spurious if interpreted as measuring a direct effect. Hence, after noting results which reflect correlations in the raw data, we report results from multivariate analysis which includes measures of parental gambling but also other measures from childhood which capture parental behaviour likely to reflect general attitudes in the childhood home.[29]

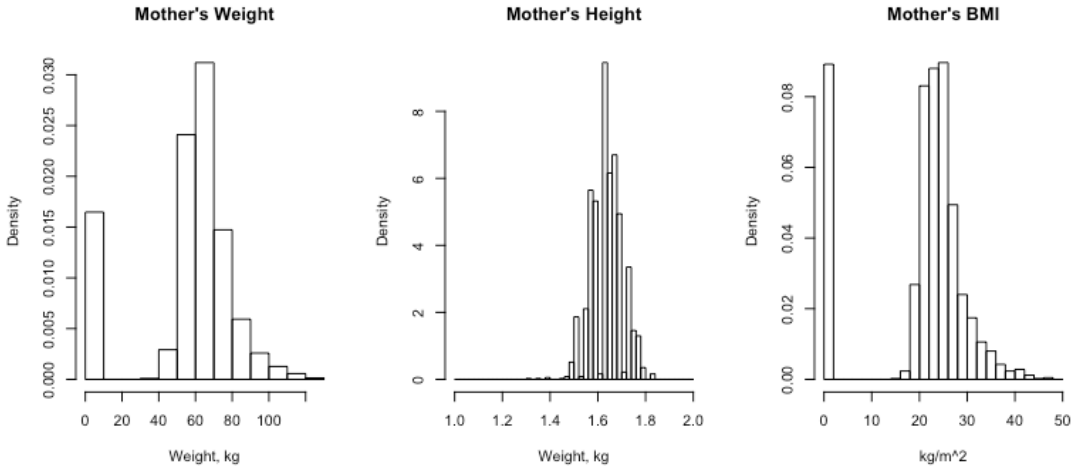
[28] S. Tubuef**,** 'Your parents' lifestyles can determine your health – even as an adult'*, The Conversation*, November 27, 2017 (https://theconversation.com/your-parents-lifestyles-can-determine-your-health-even-as-an-adult-86879). The reference contains a popular account of the research with links to the scientific publication underpinning the narrative.

Table 8. Variables representing mother and household behaviour

	source of data	variables	description of data
mother's smoking	mothers survey at child age 12	*mother smoker* (dummy variable) (smoked one or more cigarettes/ day)	12.71% were classified as smokers
father's smoking	mothers survey at child age 12	*father smoker* (dummy variable) (defined as for mother)	12.75% were classified as smokers
mother's drinking	mothers survey at child age 12	*mother moderate or heavy drinker* (dummy variable)	heavy drinkers (14 or more drinks/ wk.) accounted for 12.8% of responses and moderate drinkers (5-13 drinks/ wk.) for 34.7%.
frequency of eating fried food	mothers survey at child age 12	*fried food* (dummy variable) (fried food at least weekly)	59.2% of the sample had fried food "never or rarely" and 28.7% "once in two weeks". The dummy variable is switched on for respondents answering "1-3 times/wk. "(10.8%) or "4-7 times/ wk."(0.4%) or "more than 7 times/ wk." (0.1%)
mother's Body Mass Index	mothers survey at child age 12	*mother's BMI* calculated from reported weight and height	see Figure 6; median BMI was 24.08
mother's religion	mothers survey at child age 8	*mother's religiosity*: number of items (from 11) endorsed in a standard instrument for measuring religiosity	mother's religiosity: see Figure 7
		mother fundamentalist (dummy variable covering Christian Scientists, Jehovah's Witnesses, mormons, Methodists, Baptists and 'other Christians')	12..6% were covered by the dummy variable where the name of the variable is chosen not to reflect theology but to signify churches with an anti-gambling tradition; the most frequent responses were Church of England (60.0%) and 'none' (14.5%).
		mother new to faith (dummy variable if respondent had joined her faith in the previous five years)	2.1% were new to their faith
mother lived with a partner	mothers survey at child age 12	*mother lived with partner* (dummy variable)	88% reported living with a partner, 4% not living with a partner (8% made no response)
whether mother believes that the father loves the child	mothers survey at child age 12	*doubted father loved the child* (dummy variable)	mothers were asked whether they felt that the partner loved the subject child. 10.4% gave no response, 78.1% indicated that they always felt this, 9.9% that they sometimes felt this and 1.5% that they never felt this. The dummy variable equals one if either of the last two answers was given
emotional problems	mothers survey at child age 12	*mother emotional problems* (dummy variable)	dummy variable is 1 where the response was "quite a lot" (9.8%) or "a great deal" (4.1%); otherwise 0.5% gave no response, 25.6% "not at all", 26.5% "hardly ever" and 33.4% "quite a lot"
arguments with partner	mothers survey at child age 12	*arguments at home* (dummy variable)	mothers were asked how many arguments they had had with their partner over the preceding three months. The dummy variable is 1 the response was 4 or more (27.6% of the sample)
mother's education	mothers survey at child age 12	dummy variables: *mother no qualifications*; *mother A-levels or higher*	"no qualifications" means nothing as high as GCSE (national examinations usually taken around age 16) (2.1% of the sample); "A-levels or higher" covers A-levels (national examinations usually taken on completing secondary school around age 18) and equivalent vocational qualifications and also degree and other higher education diplomas (39.2% of the sample)
father's education	mothers survey at child age 12	dummy variables: *father no qualifications*; *father A-levels or higher*	definitions as for mother; 4.1% had no qualification and 35.7% had A-levels or higher. Note that information was provided by the mother (non-response rate 2.5%)

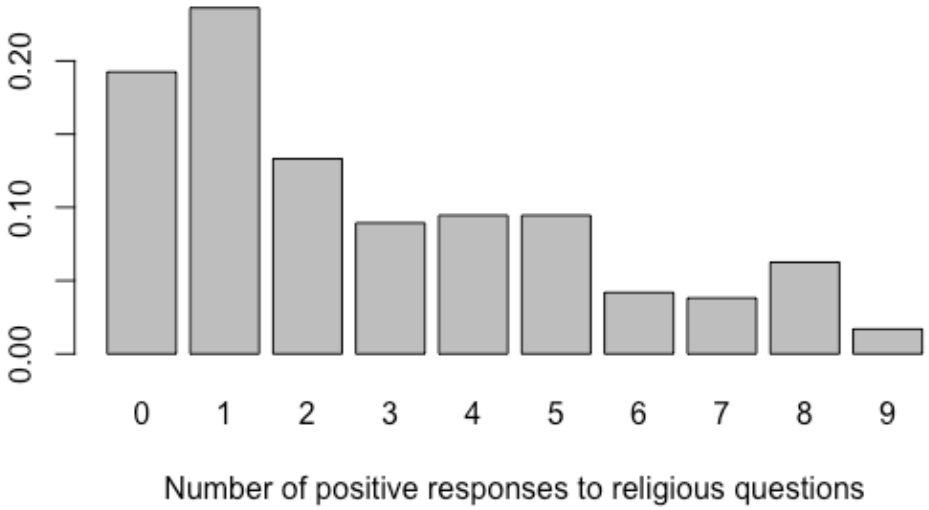
[29] Mindful of the risks of collinearity, we checked the correlations between each pair of covariates and found that all fell within the bounds of acceptability for econometric modelling.

Figure 6. Weight, height and BMI of mothers at child age 6



note: a BMI of 25-30 is often considered as indicating that an individual is 'overweight' and a BMI of greater than 30 is often used to define 'obese'

Figure 7. Mother's religiosity at child age 8



2.4 Modelling 'regular gambler': relationship with mother's gambling, parents' levels of education and other behaviours in the childhood home

Table 9 sets out the estimates from a model which includes as predictors only our three indicators of mothers' gambling. Results from models with additional controls are displayed in Table 10.

Table 9. Logistic regression results: 'regular gambler' as a function of variables representing mothers' gambling at child age 6

	MALES				FEMALES			
	(1)		(2)		(3)		(4)	
	regular gambler		regular gambler (not lotto)		regular gambler		regular gambler (not lotto)	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-1.867***	<.001	-1.938***	<.001	-2.698***	<.001	-3001***	.012
number of gambling activities, mother	0.565***	.001	0.583***	.030	0.208	.325	0.266**	.281
mother bet more than £10	0.244	.481	-0.059	.878	0.524	.166	-0.036	.947
mother's SOGS score	0.25	.249	0.211	.292	-0.321	..324	-0574	.222

Table 9 reflects **strongly significant correlation in the raw data between mothers' gambling, measured by number of regular gambling activities at child age 6, and regular gambling by their sons at age 20. However, there is no such statistically significant relationship identified between mothers' gambling and the propensity of their daughters to be 'regular gamblers'.**

This is already suggestive that there is an extent to which there is transmission of gambling behaviour between mothers and sons. But the correlation could be driven by mothers' gambling serving as a proxy for parental education and lifestyle and so, in the models for which results are reported in Table 10, we introduce first parental education variables and then mothers' lifestyle variables.

In models (1) and (2) in Table 10, we explore the relationship between regular gambling at age 20 (either including or excluding lotto play) and mothers' gambling history and the levels of education achieved by each parent. The influence of parental education is captured by dummy variables for 'no qualifications' and 'A-levels or higher'. The effect on predicted probability of each of these variables is relative to the parent having reached GCSE level as highest qualification ('GCSE or equivalent' is termed the reference category).

Table 10. Logistic regression results: 'regular gambler' with education and lifestyle variables

MALES

	(1)		(2)		(3)		(4)	
	regular gambler		regular gambler (not lotto)		regular gambler		regular gambler (not lotto)	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-1.463***	<.001	-1.459***	<.001	-1.735**	.037	-2.211**	.012
number of gambling activities, mother	0.408**	.023	0.400**	.030	0.424**	.022	0.399**	.036
mother bet more than £10	0.297	.399	-0.020	.959	0.220	.542	-0.143	.719
mother's SOGS score	0.265	.187	0.280	.181	0.223	.288	0.224	.307
mother smoker					0.058	.843	0.068	.821
father smoker					-0.133	.664	0.036	.906
mother moderate or heavy drinker					0.096	.616	0.166	.403
fried food					-0.127	.700	0.094	.772
mother's BMI					0.007	.777	0.016	.486
mother's religiosity					-0.027	.522	-0.042	.345
mother fundamentalist					0.223	.450	0.145	.645
mother new to faith					-0.904	.417	-0.833	.461
mother lived with partner					0.101	.857	0.274	.653
doubted father loved the child					0.006	.983	-0.083	.788
mother emotional problems					0.080	.772	-0.021	.943
arguments at home					0.120	.578	0.317	.147
mother no qualifications	-0.021	.972	0.165	.780	0.043	.943	0.210	.730
mother A-levels or higher	-.0.651***	.003	-0.696***	.002	-0.650***	.004	-0.670***	.004
father no qualifications	-0.369	.439	-0.854	.129	-0.355	.476	-0.872	.133
father A-levels or higher	-0.301	.178	-0.462*	.050	-0.348	.135	-0.516**	.036

FEMALES

	(1)		(2)		(3)		(4)	
	regular gambler		regular gambler (not lotto)		regular gambler		regular gambler (not lotto)	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-2.284***	<.001	-2.623***	<.001	-3.208***	<.001	-4.897***	<.001
number of gambling activities, mother	0.014	.949	0.077	.755	0.036	.873	0.046	.860
mother bet more than £10	0.549	.153	-0.048	.930	0.480	.222	-0.022	.700
mother's SOGS score	-0.360	.279	-0.619	.195	-0.391	.252	-0.076	.132
mother smoker					0.057	.860	0.066*	.052
father smoker					0.549*	.080	0.061*	.091
mother moderate or heavy drinker					0.182	.433	0.006	.984
fried food					0.086	.806	0.065*	.063
mother's BMI					.041	.117	0.075***	.007
mother's religiosity					-0.023	.657	-0.046	.470
mother fundamentalist					0.145	.690	0.017	.688
mother new to faith					-14.905	.982	-14.65	.982
mother lived with partner					-0.459	.303	-0.024	.663
doubted father loved the child					0.356	.305	0.028	.501
mother emotional problems					0.220	.479	0.028	.430
arguments at home					-0.065	.815	0.034	.283
mother no qualifications	0.642	.267	1.436***	.009	0.615	.307	1.342**	.026
mother A-levels or higher	-0.306	.270	-0.279	.393	-0.251	.375	-0.162	.631
father no qualifications	-0.096	.862	-0.700	.359	-0.173	.758	-0.096	.224
father A-levels or higher	-1.045***	.001	-0.963**	.010	-0.931***	.005	-0.082**	.032

In models (3) and (4), we add to models (1) and (2) a set of control variables representing mothers' behaviour and lifestyle (though there is also some information captured on fathers' smoking). These indicators were obtained mainly from data collected at child age 12. Except in female model (4), these lifestyle variables proved generally to be statistically insignificant but, collectively, they control for the attitudes of the household in which the child grew up.

We summarise the findings from the various models as follows.

(i) **The education level achieved by parents is a strong negative predictor of the child being a regular gambler at age 20.**

(ii) There is, however, a subtle difference between results from male and female models. Among young adult males, the probability of being a regular gambler falls only when the parent's education reaches 'A-level or higher' (i.e. the distinction between no qualification and GCSE is irrelevant). Among young adult females, the propensity to be a regular gambler is also lower once the father's qualification reaches A-level but, on the maternal side, the fall happens when the mother's education reaches GCSE level.

(iii) **Effect sizes from the parental education variables are typically large.** For example, in model (2) the odds ratios calculated from the coefficient estimates on 'father A-level or above' are 0.63 and 0.38 for males and females respectively. This means that, holding other variables constant, the odds that a young man/ woman whose father has 'A-level' or above will be a regular (non-lotto) gambler are only 0.63/ 0.38 times the odds applicable to a young man/ woman whose father reached only GCSE qualification.

(iii) Of the three indicators of mothers' gambling status at child age 6, the only one relevant to predicting offsprings' regular gambling at 20 is number of gambling activities.

(iv) **For young males only, mothers' engagement in gambling during their childhood** (measured by number of different forms of gambling played) **is a significant predictor of regular gambling at 20 whether or not lotto is included in the definition of regular gambling.** This result is robust to the inclusion or not of variables representing a wide range of other mother behaviours during their childhood.

(v) **However, no such link is found in any of the female models.**

(vi) **In the female model, for regular non-lotto gambling only, a number of indicators of having been brought up in a household tolerant of unhealthy behaviours (mother smokes, father smokes, mother overweight, regular fried food) are significant predictors.** That these are not significant in other models might, we speculate, be because regular gambling for young men and regular lotto gambling for young women are relatively common and therefore 'mainstream'. Regular gambling on other than the lottery is, however, rarer among females and may be perceived as questionable behaviour and therefore a more likely outcome for those who had childhood exposure to other stigmatised behaviours. As with education levels of parents, these indicators are likely also to be correlated with, and therefore proxy for, the socio-economic status of the household in which the subjects were raised.

We now illustrate the magnitude of the effect of parents' education and the breadth of a mother's engagement with gambling on the probability that a young adult male will be a regular gambler in at least one activity other than lotto. We define a standard individual (mother in this case) by setting other variables in the model to their means in the case of continuous variables and to zero in the case of dummy variables. Thus, for example, we are estimating probabilities for a 20-year old whose mother didn't smoke at child age 6 and was not a fundamentalist and had average BMI. Table 11 shows the probabilities from male model (4) according to the number of gambling activities of the mother at age 6 and different possible levels of parents' education. The table shows the 'protective'

role of parental education to be very strong and also the considerable extent to which mother's breadth of engagement in gambling transmits to sons (though we remind the reader that no such linkage was found for transmission to daughters).

Table 11. Estimated probabilities of 'regular gambler (not lotto)', calculated from male model (4) in Table 10

	both parents GCSE	both parents A-level or higher
no gambling	0.166	0.057
one activity	0.229	0.083
two activities	0.306	0.119
five activities	0.594	0.309

2.5 Modelling MPPG at 20

We now turn to modelling to identify risk factors for MPPG at age 20 where MPPG includes all those experiencing a 'moderate level of problems' or full-blown 'problem gambling'. The models are similar to those developed in sections 2.2 and 2.3 for 'regular gambler' and therefore can be presented more concisely. Some of the models, particularly for females, proved to be rather uninformative. This may simply be the consequence of there being fewer MPPGs available for study compared with numbers of 'regular gamblers' or it could be the case that there is more 'randomness' over who experiences problems with their gambling.

For Table 12, we modelled the relationship between problem gambler status at age 20 and other behaviours at 20 and also academic test scores at age 15. In this ALSPAC sample, in contrast to many studies of problem gambling, **we found no correlation between MPPG and use of tobacco or illegal drugs but, for males only, there was very strong correlation with a measure of problems with alcohol.**

We noted in our analysis for 'regular gambler' that school maths score was a positive predictor and school English score a negative predictor. Here, for MPPG, the variables are less informative. The signs remain the same but none of the coefficient estimates are statistically significant. However, they are each close to significance in the case of males and therefore we would recommend that, should larger data sets become available, the role of academic aptitude by academic subject be explored further. We know of no preceding study of problematic gambling which breaks school grades down into individual disciplines.

Table 12. Logistic regression results: MPPG

	MALES				FEMALES			
	(1)		(2)		(1)		(2)	
	MPPG		MPPG		MPPG		MPPG	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-3.082***	<.001	-2.924***	<.001	-4.488***	<.001	-4.395***	<.001
cigarettes per day	0.038	.221	0.033	.287	0.071	.148	0.054	.287
AUDIT score	0.060***	.009	0.068***	.003	0.018	.663	0.024	.565
CAST score	-0.071	.751	-0.015	.990	-14.780	.990	-14.65	.990
used drugs in past 3 months	0.134	.721	0.163	.663	0.845	.179	0.090	.158
biological parent	0.204	.847	0.083	.938	0.980	.213	0.089	.256
step parent	2.163	.158	1.786	.235	-16.310	.997	-16.53	.997
maths score			0.005	.113			0.008	.205
English score			-0.012	..109			-0.015	.269

In Table 13, we model the relationship between MPPG and mothers' gambling behaviour at child age 6, with no controls included. This reveals patterns in the raw data. There is strong correlation between sons' problem gambler status at age 20 and mothers' SOGS score when the child was 6 but no such correlation in the case of daughters. For neither gender is there an independent influence from the two measures of mothers' gambling (number of regular activities or betting large stakes).

Table 13. Logistic regression results: MPPG as a function of variables representing mothers' gambling at child age 6

	MALES		FEMALES	
	MPPG		MPPG	
	coeff	p-value	coeff	p-value
intercept	-2.269***	<.001	-4.074	<..001
number of gambling activities, mother	-0.025	.922	-0.194	.661
mother bet more than £10	-0.363	.556	-0.319	.680
mother's SOGS score	0.553**	.014	0.273	.503

In Table 14, we model (1) the relationship between MPPG and mothers' gambling at child age 6, with controls for parental education. In model (2) we add our set of variables representing other aspects of mother and household lifestyle.

Table 14. Logistic regression results: MPPG with education and lifestyle variables

	MALES				FEMALES			
	(1)		(2)		(1)		(2)	
	MPPG		MPPG		MPPG		MPPG	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-2.251***	<.001	-1.822	.108	-4.077***	<.001	-8.600***	<.001
number of gambling activities, mother	-0.116	.667	-0.195	.494	-0.286	.513	-0.325	,499
mother bet more than £10	-0.323	.602	-0.342	.593	0.317	.682	0.027	.975
mother's SOGS score	0.637***	.007	0.589**	.018	0.219	.606	0.113	.792
mother smoker			0.582	.145			1.244**	.032
father smoker			-0.655	.186			-0.099	.886
mother moderate or heavy drinker			0.012	.967			0.632	.198
fried food			0.385	.916			1.044*	.057
mother's BMI			0.011	.740			0.141***	.003
mother's religiosity			-0.081	.189			-0.009	.931
mother fundamentalist			0.943**	.012			0.045	.946
mother new to faith			-0.305	.797			1.959**	.015
mother lived with partner			-0.682	.335			-0.241	.832
doubted father loved the child			0.056	.891			0.972	.148
mother emotional problems			-0.006	.988			-1.197	.159
arguments at home			0.347	.255			-0.076	.898
mother no qualifications	0.228	.776	0.390	.629	1.187**	.030	1.990**	.036
mother A-levels or higher	-0.667	.284	-0.655**	.049	0.765	.119	0.827	.119
father no qualifications	-0.881	.278	-0.933	.259	-0.332	.757	-0.321	.775
father A-levels or higher	-0.159	.616	-0.328	.323	-1.451**	.029	-1.280*	.065

The principal conclusions we draw from the models for which results are presented in Table 14 are as follows.

(i) Parental education plays a role in all models. **For boys, MPPG is less likely in young adulthood if their mother has been educated to the highest level**; there appears to be no difference according to whether the mother has a low or a middle level of education**. For girls, by contrast, although there is a very substantially higher MPPG risk (odds ratio at least 6) if their mother completely lacks educational qualifications, there is no significant difference between middle and advanced levels of maternal education.** It should be noted that only just over 2% of mothers in the data set have no educational qualifications and that therefore this 'risk factor' is not present for many young adults.

(ii) **For males, level of father's education does not predict MPPG risk; for females, there is some tendency towards lower risk where the father is in the highest category of educational qualification.**

(iii) **For males (only), measures of the breadth and scale of a mother's gambling activities are statistically insignificant; but her score on the SOGS gambling screen at child age 6 is a powerful predictor of MPPG when the child is 20.** Thus it appears that it is not the mother's gambling per se that matters but rather whether she experienced problems with gambling.

(iv) Except for the variable representing the mother following a Christian faith with an anti-gambling tradition (where there is some indication of elevated MPPG risk), none of the additional lifestyle variables are significant in male model (2) while the result on mother's SOGS score is unchanged. This suggests that, **for males, there is a direct transmission of propensity to problem gambling from mothers to sons rather than the mother's problem gambling standing just as a proxy for lax attitudes towards stigmatised activities**.

(v) For females, the results are quite different. **For females, neither maternal gambling nor maternal problem gambling at child age 6 predicted child MPPG gambling in young adulthood.** On the other hand, some indicators of a 'lax' maternal lifestyle (smoking, high BMI, regular fried food) were statistically significant correlates of elevated risk of MPPG for the daughter.

Table 15 illustrates the size of the effect on male probability of MPPG at age 20 from different SOGS scores of the mother at child age 6. Calculations are from estimates of male model (2) in Table 14 and are for a mother who engaged in three weekly gambling activities and had bet beyond the threshold of £10 in one day. Otherwise, all variables were set to accord with the standard individual defined in discussion above of 'regular gambler' models. If the mother showed no sign of a gambling problem (SOGS=0), 'problem gambler' risk for the son is 0.017, lower than would be expected for a male chosen randomly from the ALSPAC data set. This nearly doubles if the mother had one endorsement in the SOGS screen and escalates beyond that as SOGS score increases. A caveat is that there are few cases of scores higher than 1 in the data set.

Table 15. Estimated probabilities of MPPG, calculated from male model (2) in Table 14

	probability (MPPG at age 20)
mother SOGS=0	0.166
mother SOGS=1	0.229
mother SOGS=3	0.306
mother SOGS=5	0.594

We believe that even these substantial effects may under-estimate the role of parental problem gambling as a risk factor for the following generation. Lifetime prevalence of problem gambling is much higher than prevalence at any one point in time. We observe parental problem gambling only at child age 6. Because problem gambling can be, indeed typically is, transient, we are essentially

comparing children of a mother who had gambling problems at child age 6 with a mixed group of children some of whom had mothers who never experienced problems and others of whom experienced problems at some other point than age 6 during their children's upbringing. This might be expected to dilute and thus bias downwards the estimated magnitude of the link between gambling problems in young adulthood and a background of familial problem gambling.

We postpone further discussion of transmission of problem gambling between consecutive generations until we have reported, in the following section, on the relationship with fathers' gambling.

3 The child at 20/ father sample

3.1 Descriptive statistics

The second sample to be analysed consisted of all ALSPAC participants for whom there was information on *both* the young adult's gambling/ MPPG status at age 20 *and* his or her father's gambling/problem gambling at child age 6.[30] The sample size is 1,064, only about half that of the first sample we analysed. The reason of course is that, at child age 6, the willingness of mothers to participate in ALSPAC surveys had been much more widespread than the willingness of their partners.

We expected the limited sample size to make modelling challenging in terms of achieving satisfactory explanatory power from modelling. This was anticipated as an issue particularly likely to frustrate successful identification of risk factors for MPPG.

In this sample, the male at 20 prevalence–rate for MPPG (i.e. PGSI≥3) was 7.2%, extremely close to the figure in the 'child at 20/ mother at 6' sample. However, female prevalence in the new sample, (1.7%), appeared to be rather higher than in the first sample (1.1%). But that difference in fact corresponds to only a single individual and so should not be taken too seriously.

The fall in sample size was likely especially to restrict attempts to model MPPG because the sample now had only 33 young males (out of 454) and seven (out of 610) young females in this category, available for study. Given the presence of multiple potential predictors, the low absolute numbers of cases was always likely to strain the ability of the data to allow identification of a set of risk factors, for female MPPG in particular.

Nevertheless, for this Chapter, we estimated models very similar to those for which results have been reported above (though including fewer lifestyle variables in recognition of relatively low sample size). This time we were primarily using data on the young adults (for example, engagement with gambling, drug use and maths scores) and data on the father's gambling at child age 6 and other indicators of father lifestyle.

Since most of the ALSPAC children in this new sample were also part of the child at 20/ mother sample, we expected them to report similar characteristics. We were indeed able to satisfy ourselves that the descriptive statistics were hardly different and therefore we do not report them again here: the characteristics reported for the young adults in chapter 2 are distributed extremely similarly amongst the (smaller) group included in the child at 20/ father sample to be considered now.[31]

[30] Recall again the cautionary note that we use 'father' as a synonym for the mother's partner: but he will not always be the true biological father nor indeed regard himself as necessarily filling the role of a father.

[31] This is partial reassurance that ALSPAC fathers who participated in the child age 6 sample were not self-selected in a way that was reflected in outcomes in the child aged 20.

We do though need to introduce readers to the fathers. In previous models, only fathers' education level and smoking status appeared as explanatory variables and these were as reported by the mother. Now we use fathers' own responses to questions about their gambling and lifestyle.

Table 16 shows the pattern of fathers' responses to a question, put at child age 6, asking them about their participation and frequency of gambling in each of eleven activities. It may be compared with Table 5 above, which relates to mothers' gambling. Almost across the board, fathers were more likely than mothers to participate in, or have past experience of, any named gambling activity. They were particularly more strongly likely to have played cards for money or to have bet on horse races and/ or sports events. The exception was bingo where, at that time, players were predominantly female. For both genders, lotto had the biggest following but was still more commonly played by men than by women.

Table 16. Fathers' frequency of gambling in different activities (percentages)

	Once a week/more	Less than once a week	In past only	Rarely/not at all
Cards	0.47	2.44	27.35	69.36
Horses	1.32	4.89	14.10	79.04
Sports Bets	0.94	4.32	7.61	86.09
Dice		0.47	3.48	95.39
Casino		0.94	8.83	89.25
Lotto	49.72	18.80	6.30	24.91
Bingo		0.94	9.21	88.72
Stocks and Shares	0.66	5.55	6.67	86.28
Slots	1.50	8.93	28.76	60.24
Other Games	1.03	3.01	8.08	87.12
Other Gambling	1.79	0.47	0.75	64.19

Note: for all named activities the non-response rate was around 1%. However, for 'Other Gambling' the non-response rate was 32.7%.

In terms of the number of activities engaged in weekly or more often by the father, 0 (48.59%) was the most common answer; but, still, a slight majority of men *were* regular gamblers. 46.43% of all the fathers participated regularly in one activity (usually lotto), 4.14% in two, 0.73% in three or more. Note that fathers were about seven times as likely to be regular gamblers in more than one activity compared with mothers in the previous sample. The variable *number of gambling activities, father* will be included in modelling as one of the indicators of the father's engagement with gambling when the child was young. Note again that we observe parental gambling only once, at child age 6, and so some of those for whom no or low gambling activity is reported may have been more heavily engaged at other points during the child's upbringing.

We employed the same indicators to capture other aspects of fathers' gambling behaviour as we used in the case of mothers. 29.9% of the fathers had gambled £10 or more in a single day, an appreciably higher proportion than for the mothers. Further, the distribution of their SOGS scores, shown in Table 17, illustrates that many more exhibited signs of problematic gambling.

Table 17. Father's SOGS scores (percentages)

0	1	2	3	4	≥5
75.28	15.23	4.51	2.82	1.13	1.03

Note: on the full SOGS screen, which has twenty items, it is usual to take 5 as the threshold for classification as a probable problem or pathological gambler (with 1-4 signifying some problems with gambling). However, ALSPAC used a reduced version of SOGS, with only twelve items. It included a question on whether the respondent had ever borrowed money for gambling but omitted follow-up questions on the source of borrowing (which can generate further points in the full SOGS screen). The version of SOGS used by ALSPAC was very similar to that used in the almost contemporaneous British Gambling Prevalence Survey, 1999.

We used a similar set of characteristics to capture fathers' lifestyles as were employed in modelling of mothers' influence on child outcomes. We included also two additional dummy variables, one representing that the father had self-assessed himself as *physically fit* (based on responses to a question as to what level of activity he could sustain for two minutes, from 1, slow walking, to 5, fast running- anyone who could at least continue a fast walk for two minutes was deemed fit) and the other to indicate that the father had admitted (in a questionnaire at child age 12) that he had been 'in trouble with the law'. 91.3% reported themselves as 'fit' and 27.2% had been in trouble with the law at some time.

3.2 Modelling 'regular gambler': relationship with other contemporaneous behaviours and with academic performance at secondary school

We began analysing the child at 20/ father data set by reprising the models for which results from the child at 20/ mother sample were presented in Table 4 above. As the present sample is largely a subset of that used in the previous exercise, we did not expect different findings albeit that the smaller sample size was likely to prevent some relationships achieving statistical significance. Therefore we do not present detailed results here. But, in the interests of completeness and transparency, we note the following 'highlights':

(i) When we looked at co-behaviours, AUDIT score was always a predictor of 'regular gambler' among males and was highly significant (p=.001) in the full model (with school marks included) for non-lotto regular gambling. Other significant predictors in the full model for non-lotto regular gambling were school maths mark (a positive predictor, p=.034) and school English mark (a negative predictor, p=.008). Neither smoking behaviour nor drug use and abuse were statistically significant.

(ii) Among female co-behaviours, only cigarette use predicted 'regular gambler'. Score in the English test at age 15 was a negative predictor (p=.026 in the full model, non-lotto version) but maths score, while signed similarly as for males, was at best only marginally statistically significant across models.

Qualitatively, the results are very similar to those derived from analysis of the larger sample. The only change in the pattern of statistical significance is that we failed to identify statistically significant correlation between regular male gambling at age 20 and use of cigarettes. This may be because of lower sample size rather than because the pattern of behaviour differed between the subset of the mother sample (which was present also in the father sample) and the rest of the mother sample.

3.3 Modelling 'regular gambler': relationship with father's gambling, parents' levels of education and other behaviours in the childhood home

The models for which results are presented here are similar to those reported in Table 9 and 10 above but this time with indicators of fathers' (rather than mothers') behaviour and lifestyle at child age 6. Covariates describing fathers' gambling were the same as those for mothers: breadth of engagement with gambling, as captured by number of activities played weekly; a dummy variable for having bet more than £10 on a single day: and his score on the SOGS screen for problem gambling. For fathers, the set of other covariates added in the following model comprised number of cigarettes smoked per day, his Body Mass Index, a measure of physical fitness and a dummy variable to reflect whether he had been he had ever been *in trouble with the law*. These father variables were collected at child age 12.

We describe, through the equations reported, in Table 17 the relationship between the probability of 'regular gambler' at age 20 and variables relating to father gambling variables at child age 6. Then, in Table 18, we report results which add variables representing parental education and fathers' lifestyle.

Table 17. Logistic regression results: 'regular gambler' as a function of variables representing fathers' gambling at child age 6

	MALES				FEMALES			
	(1)		(2)		(3)		(4)	
	regular gambler		regular gambler (not lotto)		regular gambler		regular gambler (not lotto)	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-1.954***	<.001	-2.024***	<.001	-3.037***	<.001	-3.439***	<.001
number of gambling activities, father	0.350	.106	0.161	.477	0.549**	.013	0.575**	.020
father bet more than £10	0.274	.926	0.143	.639	-0.142	.706	-0.081	.852
father's SOGS score	0.177*	.091	.266**	.012	0.136	.305	-0.166	.246

Table 18. Logistic regression results: 'regular gambler' with education and lifestyle variables

MALES

	(1)		(2)		(3)		(4)	
	regular gambler		regular gambler (not lotto)		regular gambler		regular gambler (not lotto)	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-1.688***	<.001	-1.626***	<.001	-0.522	.711	-1.383	.327
number of gambling activities, father	0.310	.171	0.075	.754	0.345	.140	0.071	.772
father bet more than £10	0.062	.837	0.182	.561	0.075	..807	0.191	.544
father's SOGS score	0.185*	.089	0.273**	.015	0.236**	.038	0.289**	.012
father smoker					-0.370	.471	-0.372	.472
father's BMI					0.048	.295	0.007	.886
father physically fit					0.288	.599	0.041	.939
father in trouble with the law					-0.478	.144	-0.197	.546
mother no qualifications	0.244	.767	0.299	.717	-1.754	.113	0.299	..724
mother A-levels or higher	-.0.299	.320	-0.421	.185	-0.339	.270	-0.448	.166
father no qualifications	-1.747	.110	-1.844*	.097	-1.754	.113	-1.813	.106
father A-levels or higher	-0.387	.727	-0.361*	.251	-0.280	.354	-0.393	.841

FEMALES

	(1)		(2)		(3)		(4)	
	regular gambler		regular gambler (not lotto)		regular gambler		regular gambler (not lotto)	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-2.604***	<.001	-3.075***	<.001	-4.107**	.003	-3.209*	.052
number of gambling activities, father	0.326	.185	0.404	.146	0.272	.275	0.034	.221
father bet more than £10	-0.071	.856	-0.052	.908	-0.172	.666	-0.015	.747
father's SOGS score	-0.132	.350	-0.193	..213	-0.132	.358	0.020	.214
father smoker					1.165***	.005	1.259***	.006
father's BMI					-0.007	.886	0.009	.886
father physically fit					0.041	.939	-0.028	.599
father in trouble with the law					-0.197	.546	-0.032	.487
mother no qualifications	1.559**	.042	1.927**	.013	0.299	.724	2.042**	.011
mother A-levels or higher	-0.390	.289	0.177	.686	-0.448	.166	-0.031	.488
father no qualifications	-0.566	.502	-1.256	.293	-1.813	.106	-1.264	.286
father A-levels or higher	-1778***	.001	-1.238**	.021	-0.393	.217	-1.206**	.027

We summarise the results in these two tables as follows.

(i) For males, parental education loses significance in this smaller sample. However, **the pattern that having a mother with the lowest level of education is a risk factor for 'regular gambler'** is still clear enough albeit that the finding is driven by a relatively small number of cases.

(ii) **For both genders, there is correlation in the raw data between the probability of 'regular gambler' and father gambling data. For young men, the father's SOGS score is the key predictor, particularly relevant to predicting regular gambling outside lotto. For young women, the father's number of gambling activities is the key predictor of regular gambling.**

(iii) For males, the relationship between regular gambling at 20 and fathers' SOGS score remains strong even when parental education level and fathers' lifestyle is accounted for. In fact, none of the father's lifestyle behaviours are close to statistical significance. **It appears to be specifically a father's problematic gambling behaviour which correlates with the son's likelihood of gambling regularly in young adulthood.**

(iv) For females, there is no longer a relationship with fathers' gambling once the parental education and fathers' lifestyle variables are added to the models. Particularly in accounting for young women's regular gambling outside lotto, lower levels of parental education and a father who smokes are very strong predictors, both in terms of statistical significance and effect size (for example, the odds ratio for *mother no qualifications* exceeds 7). **For females, although there is correlation with fathers' gambling in the raw data, it appears that it is the general style of the household which drives this relationship rather than father's gambling per se.**

The magnitude of the apparent influence of the father's SOGS score on the probability that the son is a regular gambler at 20 is illustrated by Table 19, which shows probability estimates for different father SOGS scores, assuming the father engaged in three gambling activities and had bet more than £10 in a day (all other covariates set to zero and father's BMI to the mean). Note that SOGS=3 is commonly adopted as the threshold for defining a problem gambler. Here, only a sub-set of SOGS questions was used in the questionnaire, so a score of 3 might be considered a fairly unambiguous signal that the respondent had problems with gambling.

Table 19. Estimated probabilities of 'regular gambler', calculated from male model (3) in Table 18

	probability (regular gambler at age 20)
father SOGS=0	0.403
father SOGS=1	0.460
father SOGS=3	0.577
father SOGS=5	0.686

3.4 Modelling MPPG at 20

In Table 20, we model the relationship between MPPG and fathers' gambling behaviour at child age 6, with no controls included. This reveals patterns in the raw data. There is strong correlation between daughters' MPPG status at age 20 and fathers' SOGS score when the child was 6 but no such correlation in the case of sons. For neither gender is there a statistically significant independent influence from the two measures of fathers' gambling (number of regular activities or betting large stakes).

Table 20. Logistic regression results: MPPG as a function of variables representing mothers' gambling at child age 6

	MALES		FEMALES	
	MPPG		MPPG	
	coeff	p-value	coeff	p-value
intercept	-2.842***	<.001	-5.318	<.001
number of gambling activities, father	-0.279	.360	-0.635	.286
father bet more than £10	0.204	.619	-1.389	.120
father's SOGS score	0.105**	.456	0.518**	.016

When we went on to add variables representing parental education and fathers' lifestyle, modelling was conspicuously unsuccessful in identifying risk and protective factors for MPPG. For example, the tendencies for gambling problems to be associated with low levels of parental education which we noted in the results from the child at 20/ mother sample did not emerge in analysis of the child at 20/ father sample. Evidently the much reduced sample size yields too few MPPGs for it to be possible to isolate particular sources of risk among the factors we study. Indeed, among the 'father variables' only *father physically fit* was ever close to statistical significance; it appeared to be a protective factor (p=.054 in the full male model, p=.009 in the full female model).

Because these models are generally uninformative, we do not present results here. However, we note that, while fathers' gambling variables were always very decidedly non-significant in the follow-up male models, the association between female MPPG at 20 and the father's SOGS score was robust in both statistical significance and estimated effect size when we added, first, parental education and then father lifestyle variables (p-values of .027 and .031). In the full model, this finding was moderated by the father's number of gambling activities such that, holding SOGS score constant, a larger number of activities appeared to moderate risk though the statistical significance of this effect was relatively weak.

From consideration of the results from each sample, we can say that there is strong evidence of transmission of problem gambling from fathers to daughters and from mothers to sons.

This finding is derived from analysing two *separate* samples, one analysis looking primarily at influence from fathers and the other primarily at influences from mothers. But it begs the question of what the outlook is for those brought up by parents who were *both* problematic gamblers.

We investigated this possibility by defining a third sample, smaller again, which comprised the 1,025 ALSPAC children for whom there was information on their own gambling and MPPG at age 20 and on *each* parent's gambling and problem gambling at child age 6. We interrogated the data with logistic regressions to account for each of 'regular gambler at 20' and 'problem gambler at 20'. Covariates were three dummy variables to signify cases where the mother only was a problem gambler, the father only was a problem gambler and both were problem gamblers. Consistent with our other experiments, we found **highly statistically significant evidence of cross-gender transmission from parental problem gambling to children's regular gambling and MPPG.** There was no significant impact on the probabilities according to whether the other parent was a problem gambler (for example, the effect size on daughter's problem gambler status was similar for the father-only variable and the 'both parents' variable). Although these additional exercises supported our earlier findings, we do not put the results in the record here. We judge them to be too reliant on small numbers of cases. The most serious limitation of the data related to the rarity of cases where both parents had been 'problem gamblers'.[32]

In our main results, absence of evidence of transmission from fathers to sons should not necessarily be interpreted as evidence that there is in fact no such linkage. The sample size was sufficiently limited when looking at fathers' gambling that we were unable to confirm other patterns, for example with parental education, which were discernible when we were working with the much larger child at 20/ mother sample. It may therefore just be that MPPG among young men is harder to model unless the sample size is sufficiently large. Further, the association reported earlier between regular gambling at 20 and fathers' SOGS scores suggests that a paternal problem gambling background increases the likelihood that a son will behave in a way that exposes him to elevated problem gambling risk in the future.

But, despite these caveats, we note also that cross-gender transmission of problematic behaviour has also been reported in the case of alcohol.[33] The possibility has been little discussed before in the context of gambling, where modelling of youth problem gambling has typically pooled male and female observations. However, in a cross-section study of 832 18-25 year olds in Australia[34], which depended on respondents identifying parents as having had a gambling problem, the authors found that maternal problem gambling was a larger risk factor for problem gambling by sons than for problem gambling by daughters. This is consistent with our results. On the other hand, the Australian

[32] For these models, we defined a parent as a 'problem gambler' if he or she scored 2 or more on the SOGS screen. This is a relatively low threshold, designed to try to increase the number of cases.
[33] for reference, see footnote 10 above

[34] see chapter 7 in N.A. Dowling, A.C. Jackson, S.A. Thomas & E. Frydenberg, *Children at Risk of Developing Problem Gambling*, Gambling Research Australia, Melbourne, 2010 (https://www.gamblingresearch.org.au/sites/default/files/embridge_cache/emshare/original/public/2016/09/17/ae36c86e6/children%2Bat%2Brisk%2Bfinal.pdf)

study was unable to find any influence running from paternal problem gambling to problem gambling in either gender in early adulthood.[35]

It is beyond the scope of the present study to investigate further the process by which parental problem gambling is transmitted to the following generation, for example whether it is mediated through the psychological stress from having been raised in a household disrupted by gambling harm. Still, that transmission is confirmed by the data suggests that consideration should be given to policy implications. For example, where professionals are called upon to intervene in a case where an individual has presented with gambling disorder, should there be specific intervention with the children in the household to attempt to mitigate the risk that they in their turn will experience harm from their own gambling?

[35] It should be noted that the results we quote are from the authors' study of a survey from the same age group as ours. In separate chapters they report on analysis of surveys of (i) the general population and (ii) secondary school pupils. The pattern of paternal versus maternal transmission is not consistent across the three studies.

4 The child at 17/ child at 20 sample

4.1 Gambling at age 17

The number of ALSPAC children who answered all the gambling questions when they were surveyed at (to use the median age) 17 years and nine months was 2,246. Of these 157 (7.0%) were 'regular [weekly or more often] gamblers' and 32 (1.4%) were MPPGs.[36]

Comparing these figures with those for the 20-year-olds who had answered the gambling questions at both time points, it is clear that **the proportions of regular gamblers and MPPGs increased greatly in the three years between the surveys. The prevalence rate of 'regular gambling' went up from 7% to more than 11% and the prevalence rate of MPPG more than tripled to 4.9%**. Probably this was to be expected given that the first survey was administered when most of the respondents had not quite reached the age at which the full range of commercial gambling products would be legally accessible to them.

We do not propose to provide detailed analysis of the child at 17 sample because this has been done before, by Emond, Doerner & Griffiths in a Report for the Responsible Gambling Trust.[37] However, we probed a little further into one of the principal findings of their Report. Emond, Doerner & Griffiths found that there was 'weak' evidence[38] of an association between problem gambling of the child at age 20 and mother problem gambling at child age 6; but there was no evidence of a relationship with father problem gambling at child age 6.[39]

We were curious as to whether their findings on intergenerational transmission applied equally to males and females. Emond, Doerner & Griffiths pooled the data for young men and young women, allowing in their models for the effects of gender on problem gambling risk only through a shift dummy variable: this will have lowered the estimated probability of problem gambling for young women compared with young men but it restricted estimates of the influence of other covariates to be the same for each gender.

First, we sought to confirm that pooling the data leads to the finding that MPPG at age 17 is associated with maternal problem gambling at child age 6 but not with paternal problem gambling at child age 6 (where we defined parental problem gambling by a score of 2 or more on the short version

[36] Nearly all the MPPGs fell into the 'moderate level of problems' range of the PGSI. Fewer than five (we cannot be more precise because conditions for using ALSPAC data do not permit references to cells with fewer than five observations) met the strict definition of 'problem gambler' (PGSI≥8).

[37] See reference at Footnote 7 above.

[38] By 'weak', they meant that the level of statistical significance was just outside the 5% threshold.

[39] They note that, like us, they were hampered by the much smaller numbers of fathers who had completed their child age 6 questionnaires.

of the SOGS screen). Then, we estimated separate logistic regression models for young men and young women.

The results are in Table 21. Like Emond, Doerner & Griffiths, we find, from analysis of 'pooled data', that there is a 'weak' association of MPPG at 17 with maternal problem gambler status at child age 6 but that there is no evidence at all of a link with paternal problem gambler status at child age 6. When we estimate the model for males only, the result holds.[40] But, when we estimate it using only the female sample, it is paternal problem gambling that proves to matter (odds ratio 2.69) and there is no evidence of a link with mothers' problem gambling.

Table 21. Logistic regression results: MPPG at age 17 as a function parental problem gambling

	POOLED		MALES		FEMALES	
	MPPG		MPPG		MPPG	
	coeff	p-value	coeff	p-value	coeff	p-value
intercept	-2.842***	<.001	-2.237***	<.001	-3.456***	<.001
mother (only) problem gambler	1.168*	.069	1.456*	.087	1.058	.323
father (only) problem gambler	0.367	.347	-0.113	.856	0.988*	.058
both parents problem gamblers	-12.724	.986	-13.194	.985		

note: there were no cases in the female sample where both parents had been problem gamblers at child age 6

Thus, at age 17, we find the same pattern as we did for the age 20 samples: there is evidence of *cross-gender* transmission of problem gambling from one generation to the following generation.

Were this pattern to be confirmed by examination or re-examination of other data sets, it would have the implication that professionals working with families where there was a parental gambling problem should be aware of the elevated risk for the children; at the level of the individual, daughters' risk of developing gambling problems appears to be particularly strongly increased if the father in the household is a problem gambler.

On the other hand, the emphasis on high odds ratios found in most literature in gambling studies can lead to an unbalanced view of what is significant at the aggregate level in understanding the sources of problem gambling. If intergenerational transmission were only cross-gender, this would in fact serve to limit the extent to which parental problem gambling fed into the pool of problem gamblers in the next generation. For example, our best estimate suggests that maternal problem gambling is a quantitatively large risk factor for young men. But the risk factor is present for only a low proportion of young men because female prevalence is low: few young men have mothers with gambling problems. This route into the pool of youth problem gamblers is therefore not capable of contributing heavily to the pool. Similarly, having a father with a gambling problem appears to more than double the odds that a daughter will have gambling issues; but the baseline to which this more-than-doubling

[40] Statistical significance of the mother variable weakens (only) slightly- as was to be expected given the reduction in sample size- but effect size increases, with an odds ratio of 4.29.

is applied is itself low (for females). The general lesson is that the social significance of a risk factor should be evaluated not by the estimated odds ratio but by the expected number of additional problem gamblers generated in the population.

4.2 Transition between ages 17 and 20

4.2.1 Introductory remarks

Our principal focus in this chapter is on changes observed in individuals' gambling behaviour between ages 17 and 20. The number of young people who had fully completed the ALSPAC gambling survey in each of the two waves was 1,349. This is a much smaller number than those who had completed at age 17. The drop-out rate was 39.9%.

It is of interest to note that the drop-out rate was significantly *lower* among those who had reported either regular gambling or MPPG at age 17. Only 27/157 (18.7%) 'regular' gamblers' were lost to the sample and only 6/32 MPPGs (17.2%) dropped out. The gambling questions were asked in a distinct module of the ALSPAC process, so a plausible explanation is that those who have been or are very engaged with gambling are disproportionately likely to choose to take part in a survey specifically labelled as being about gambling. If generally true, this would imply that gambling prevalence surveys which are free standing, rather than embedded within, say, a more general health survey, will tend to yield somewhat upwardly biased estimates of the popularity of gambling and the extent of problem gambling in a population.[41]

Despite the attrition rate between the age 17 and age 20 waves, the final sample size of 1,349 is still impressively high compared with the few previous longitudinal surveys which have attempted to track individuals' gambling trajectories as they progress from youth to adulthood. For example, Delfabbro, King and Griffiths[42] recruited 614 individuals aged 16-19 from probabilistic community sampling in South Australia and followed them to three subsequent time points; but the retention rate to the first of these, two years from initial interview, was only 56% (similar to ALSPAC), thus giving only 386 cases for study of behavioural change over two years. Slutske, Jackson & Sher[43] achieved much higher retention rates in an 11-year, 4-wave study of gambling behaviour from age 18-19. But the initial sample was only 468 and, moreover, a highly specialised one (first year students at a university in Missouri). Edgerton, Melnyk & Roberts[44] worked with four waves of the Manitoba Longitudinal Study of Young Adults. They had 679 18-20-year-olds in the first cycle (and a relatively high retention rate subsequently).

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[41] We noted in Footnote 16 above that gambling participation in the ALSPAC child at 20 sample was rather higher than might have been expected from figures in the approximately contemporaneous *Health Surveys for England* and *Scotland*. This is an additional possible partial explanation.

[42] P. Delfabbro, D. King & M.D. Griffiths, 'From adolescent to adult gambling: An analysis of longitudinal gambling patterns in South Australia', *Journal of Gambling Studies*, 2014, 30:547-563.

[43] W.S. Slutske, K.M. Jackson & K.J. Sher, 'The natural history of problem gambling from age 18 to age 29', *Journal of Abnormal Psychology*, 2003, 112(7): 263-274.

[44] J.D. Edgerton, T.S. Melnyk & L.W. Roberts, 'Problem gambling and the youth-to-adulthood transition: Assessing problem gambling severity trajectories in a sample of young adults', *Journal of Gambling Studies*, 2015, 31: 1463-1485.

The few earlier studies, despite limited sample sizes (which necessarily have the particular limitation of including only small numbers of problem gamblers), do display a certain consistency in findings, pointing to considerable fluidity in gambling and problem gambling behaviour in youth and early adulthood. Delfabbro, King & Griffiths found that "young people showed little stability in their gambling [participation]" (p. 547) and "it was not the case that those who reported difficulties in gambling in any 1 year necessarily reported problems in subsequent years" (p. 558). In the Missouri study, problem gambling was "transitory and episodic" and the evidence suggested that "natural recovery may be the rule rather than the exception" (p. 263)". In Manitoba, there was a "lessening of problem gambling risk severity across time" (p. 1463).

In her review for the Responsible Gambling Trust, Prof. Valentine[45] identified a research gap: "further longitudinal research is needed to test the evidence of recent findings which show that young people may grow out of gambling problems as they get older" (p. 5). Given its much larger sample size compared with previous studies, the ALSPAC data set provides an opportunity to test and build on the earlier evidence.

We investigated changes in gambling behaviour and problem gambling scores between ages 17 and 20 for all those who had completed the gambling module at both ages. Table 22 is a transition matrix which shows, in abbreviated form[46], the patterns observed. The table delineates members of the sample according to whether or not they were 'regular gamblers' (weekly or more often, as before) and according to their level of problem gambling as indicated by the PGSI screen. For example, the cell in the top right of the table records that 13 of those who had reported as not being regular gamblers and with PGSI=0 at age 17 became MPPG (but still not regular gamblers) at age 20.

4.2.2 Transition: initial problem gamblers

Consider first all those represented in Table 22 who endorsed any items on the PGSI at age 17.

At age 17 we observe 26 cases of MPPG (of which the large majority fell within the 'moderate level of problems' category). Of these, 10 were still classified as MPPG at age 20, but 16 had improved their classification and 6 indeed had a PGSI score of 0.

Thus, of those classified as in one of the top two levels of harm at age 17, about two-thirds showed an improvement and about one-quarter appeared not to be experiencing any problems at all at age 20.

[45] Reference at Footnote 11 above.

[46] Conditions for using ALSPAC data include that exact numbers in cells referring to fewer than five observations may not be reported. This necessitated the merging of the 'moderate level of problems' and 'problem gambler' categories.

Table 22. Transition matrix

			Gambling Status, age 20					
			Not a regular gambler			Regular gambler		
			Not a Problem Gambler	Low Level of Problems	MPPG	Not a Problem Gambler	Low Level of Problems	MPPG
Gambling Status, age 17	Not a regular gambler	Not a Problem Gambler	816	160	22	66	37	13
		Low Level of Problems	46	25	5	6	5	6
		MPPG	<5	5	<5	<5	<5	<5
	Regular gambler	Not a Problem Gambler	42	10	0	15	17	6
		Low Level of Problems	<5	7	<5	<5	7	<5
		MPPG	<5	<5	<5	<5	<5	<5

Note: conditions for using ALSPAC data include that exact numbers in cells referring to fewer than five observations may not be reported.

There were 119 cases of *low level of problems* observed at age 17. Of these, 17 had progressed to MPPG status by age 20 (nearly all of whom were classified as 'moderate level of problems').[47] Therefore, only for a minority were limited signs of problem gambling at age 17 followed by worse, as captured three years later. The remainder either stayed in the same category (44) or ceased to record problems (60).

Thus, among those with low-level problems at age 17, more 'improved' than progressed to a higher level of problems.[48]

This pattern over time is fully consistent with the consensus, both in the general gambling studies literature[49] and in that dealing specifically with young people, that **problem gambling is often a transient state and self-correcting such that the average trajectory amongst those with any level of problem gambling is downwards towards a lower level of problems**. Of course, this does not

[47] Conditions for using ALSPAC data do not permit reference to exact numbers in cells with fewer than five observations. This prevents our reporting the exact number of those progressing to the highest problem gambling status.

[48] A caveat to this finding, and similar findings, from other authors, is that problem gambling level will be subject to measurement error of unknown but potentially severe magnitude. 'Getting better' is an example of reversion to the mean. A proportion of those in a given classification on the day of the first survey may have strayed into a higher classification just because of some random choice when completing the form, for example they had happened to lose a bet with a friend the night before or they were feeling unusually self-critical that day. For them, there might be no change at age 20 but the data represent them as having got better.

[49] For a useful review of findings from early longitudinal studies which produced this consensus, see M.W. Abbott & D. Clarke,*' Prospective problem gambling research: Contribution and potential', International Gambling Studies*, 2007:7: 123-144.

imply that much harm will not have been done. Indeed, the problems may be so disruptive to life that it is they which trigger a shift towards more moderate behaviour.

4.2.3 Transition: new cases of problem gambling by age 20

If most young people with moderate or top-level problem gambling at age 17 resolve their issues by age 20 but the prevalence rate of MPPG nearly triples between these years, it follows that there is a high incidence of new cases between these ages. There were 66 MPPGs (PGSI≥3) observed at age 20, of whom 56 were newly classified, an incidence rate relative to the whole sample (of those participating in the gambling module on both occasions) of 4.9%, measured over a span of three years.[50]

It is striking that more than half of the 66 observed at age 20 had shown no signs at age 17 that would give cause for concern. They had not been regular gamblers and their PGSI score had been 0.[51]

What are the implications of this finding?

Clearly there is evidence here that early adulthood is a very risky period for entering into gambling harm. Those who become MPPGs may well subsequently self-correct their behaviour (just as those who had problems at age 17 tended to do). But the harm generated in the meantime may be lasting because early adulthood is the critical stage at which education and training defines career paths for the future and often it is also the time for forming long-term relationships. There would therefore be value in a research programme focusing further on risk and resilience factors which affect the incidence of problem gambling in these early years of exposure to the full range of commercial gambling opportunities.

For policy makers, regulators and operators, there is scope for consideration of specific measures that would afford greater protection to the youngest adults. At the societal level, the adaptation hypothesis proposes that, when a population is first exposed to new gambling opportunities, prevalence rates will increase because of high incidence among new users; but eventually problem gambling prevalence will level off or fall back again as individuals gain experience of the new products. Prof. Abbott maintains[52] that this is equally applicable at the micro level, for example recent migrants may have

[50] It is possible that some of the 'new' cases are relapses: an individual may drift in and out of problem gambling and have experienced problems that were resolved by the age of 17, only for them subsequently to reappear.

[51] From the fact that most 'problem gamblers' at 20 had not been 'regular gamblers' at 17, it does not follow that regular gambling at 17 is not a risk factor. There are relatively few regular gamblers at 17 and therefore they do not contribute as many cases at 20 *even though they are more likely to become problem gamblers*. 8/130 (6.1%) 17-year-old regular gamblers were 'problem gamblers' (PGSI≥3) at 20, 48/1,219 (3.9%) 17 year-olds who were not regular gamblers at 17 were 'problem gamblers' at 20. The difference is highly statistically significant.

[52] for example in: M. Abbott, 'Gambling and gambling harm in New Zealand: A 28-year case study', *International Journal of Mental Health and Addiction*, 2017, 15(6): 1221-1241.

high prevalence rates because accessible gambling is new to them and they will initially be at high risk from lack of experience. They will have above-average frequency of problems because they have not had time to adapt. Those reaching the legal age for gambling appear to be in the same position and, from the high incidence we observe, the same consequences and harm appear to follow. The youngest (legal) gamblers therefore need a special watch. **Because so many problem cases appear in a short time from age 18, there is a case for operators, when monitoring players, to adopt lower thresholds to trigger intervention where the customer is under 21. Regulators might introduce additional provisions to Codes of Practice to require operators to be particularly rigorous in their duty of care to young customers. Legislators and regulators might even consider differential access to products for the young, analogous to recent measures to address the high fatality rate among new drivers.**

5 Concluding remarks

The ALSPAC data set presented a unique opportunity, unprecedented in the area of gambling studies, to delve deep into the past of a large group of young adults for whom there is current and recent information on their gambling participation and problem gambler status. In our Report, we pursue a number of disparate themes. To conclude, we now draw attention again to what we regard as the principal findings and implications, whether directly relevant to public policy or as fresh knowledge to be followed-up by future researchers.

1. Gambling behaviour of study members was observed when they were young adults, at ages 17 and 20. A number were identified as 'moderate harm' or 'problem gamblers' at age 17. This group tended towards self-recovery by age 20. This tendency towards self-recovery of young gamblers is consistent with findings from cohort studies in other countries; but the confidence that could be put in those studies was limited by much smaller sample sizes than in our case.

2. The number of 'moderate harm' or 'problem gamblers' was much higher in the survey conducted at age 20 than at age 17. Given that most of those who had problems at 17 had recovered by 20, this implies that significant numbers of new cases develop at ages 18, 19, 20, the period when young people first have legal access to most forms of commercial gambling. This suggests that operators should have particular care when dealing with their youngest customers and that there should be debate on appropriate regulatory action specifically to protect members of this age group.

3. While school performance as a predictor of gambling and problem gambling has been considered before, we were able to differentiate between maths and English test results. Our finding is that aptitude in maths, as captured in national examinations at age 15, was a strong positive predictor of participation in gambling at age 20 and aptitude in English a strong negative predictor. Each test score also had predictive power in respect of the probability of moderate harm or problem gambling though the evidence here was less strong statistically. These results are relevant to the policy issue of whether teaching adolescents maths related to gambling might be a protective factor against gambling harm. They suggest proceeding with caution. Indeed a higher understanding of maths may even encourage young people to play.

4. From observation of parents' scores on a problem gambling screen when the child was aged 6, we were able to test for inter-generational transmission of problem gambling. We found evidence for such transmission but only cross-gender: mothers' problem gambling fed into greater risk for sons and fathers' problem gambling was a risk factor for their daughters.

5. There was strong evidence that parental lifestyles were factors influencing the risk that their children would experience gambling problems in early adulthood. In particular, risk was higher for young women where parents had a history of smoking, being overweight and eating fried food frequently. It might be that young people from households tolerant of risky and stigmatised activities are at greater risk of problematic gambling independent of whether gambling had been present in their background. To some extent, parental gambling in some previous literature might serve principally as

a proxy for a more generally ‘lax’ lifestyle, with the potential for misleading conclusions then being drawn.

6. We had many results where there were important differences between those for young men and young women. Many previous studies react to having only a small number of female problem gamblers available for study by pooling male and female samples. Because males will normally far outnumber females in the set of problematic gamblers, there is a risk that general conclusions will be drawn even though the results from a pooled sample are driven by and apply only to men. We contend that, if the number of females for study is too small for statistical inference to be possible, the researcher should publish only results for males. To assume that they would apply more generally may, from the examples of gender-specific findings in our study, be grossly misleading.