THE
BEHAVIOURAL
INSIGHTS TEAM.

Can behavioural insights be used to reduce risky play in online environments?

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The Behavioural Insights Team in partnership with

GambleAware®

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Executive summary

The rise of online gambling means that placing a bet is only ever a few clicks away. This increased accessibility has been a boon for the majority of gamblers who play safely. However, for those that are negatively affected by gambling, increased accessibility poses a risk of financial, social or health related harm.

GambleAware became interested in behavioural insights as one way of addressing this challenge, following successful application in a broad range of other social issues. As such, GambleAware commissioned the Behavioural Insights Team (BIT) to conduct the third phase of a remote gambling research programme, which aims to support operators in reducing problem gambling. This report describes the activities conducted as part of the first part of this phase, comprising a review of the academic literature, a qualitative study, a mystery shopping exercise, a review of existing operator practices, a data science analysis, and two randomised controlled trials.

As part of this project, we sought to understand which behavioural influences might be most relevant to online gambling. Our first step was to conduct a review of the relevant behavioural literature including:

- Exploring gambling trends in the UK
- Reviewing how problem gambling is best defined, conceptualised, and measured
- Examining key features of remote gambling that influence gambling behaviour
- Considering effectiveness of behavioural interventions

We also conducted qualitative research. We completed semi-structured interviews with 16 current gamblers, and two gambling professionals treating gambling disorders, to better understand online gambling from the perspective of a regular gambler. Gamblers told us that the nature of online sites can encourage them to become engrossed in their play (sometimes described as being in a 'hot state'), and that money spent online doesn't 'feel real'.

These findings were supported by the academic literature but also a third strand of our work; a mystery shopping exercise. Two BIT researchers registered with six operator websites, and engaged in low stakes gambling over a period of two weeks. This included installing relevant gambling applications onto mobile phones, and then participating in a range of gambling activities across operators.

We also wanted to understand operator practice and took three approaches to this. Firstly, we conducted a review of existing operator practices and interviewed several operators

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about current systems and processes. In particular, we explored how players interact with gambling sites, and the key touch points at which operators may intervene to discourage risky play. We created a map of this 'player journey'. Many operators had similar approaches to ensuring safe play, such as online messaging, text messaging, and telephone calls signposting Responsible Gambling tools. If risky play continues, operators may enforce mandatory limits, remove certain privileges, or suspend a player's account.

Secondly, we analysed data from four operators to explore whether problem gamblers could be identified by matching PGSI scores to play data. This exercise helped us to understand which behavioural factors are most predictive of having a high PGSI score. Results were intuitive: the higher and more erratic a players' stakes, the more likely they were to have a high PGSI score.


Average daily stake   Deviation in value of an average stake
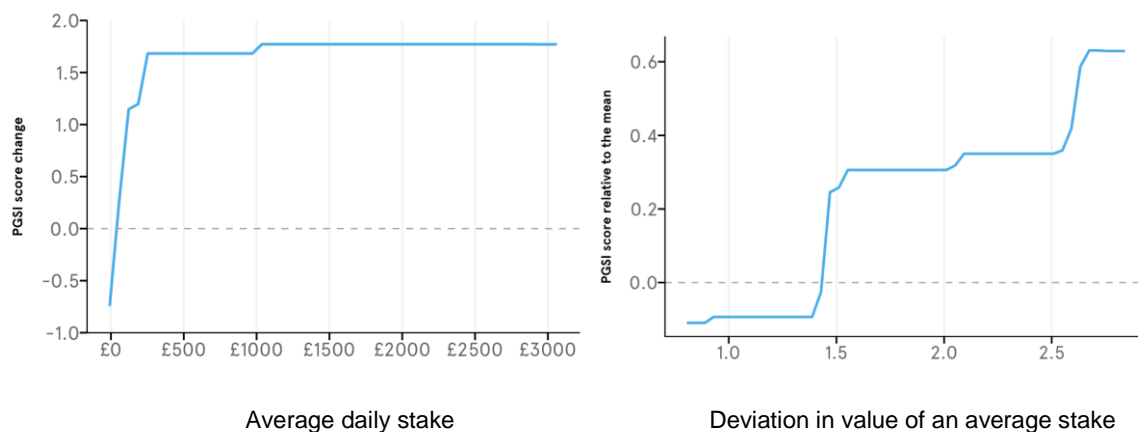
Finally, we also conducted two randomised controlled trials to explore:

> a) the feasibility of implementing and evaluating a behavioural intervention with an online operator
> b) initial efficacy of possible interventions to encourage the uptake of Responsible Gambling tools

For these trials, we worked with Sky Betting and Gaming and bet365 to test behaviourally informed messages to those identified as at risk. We aimed to increase the uptake of Responsible Gambling tools by making them easier to access (i.e. reducing 'friction'), and informing the player that their gambling behaviour is riskier than other people's (i.e. 'social norms'). For players on both websites, we found that reducing friction increased the number of players setting deposit limits and setting a cool-off period, compared with 'business as

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usual' messaging. Our social norms condition, in which feedback about others' behaviour was provided, was not effective.

N = 12711
** p<0.01, * p<0.05, + p<0.1
Primary Analysis
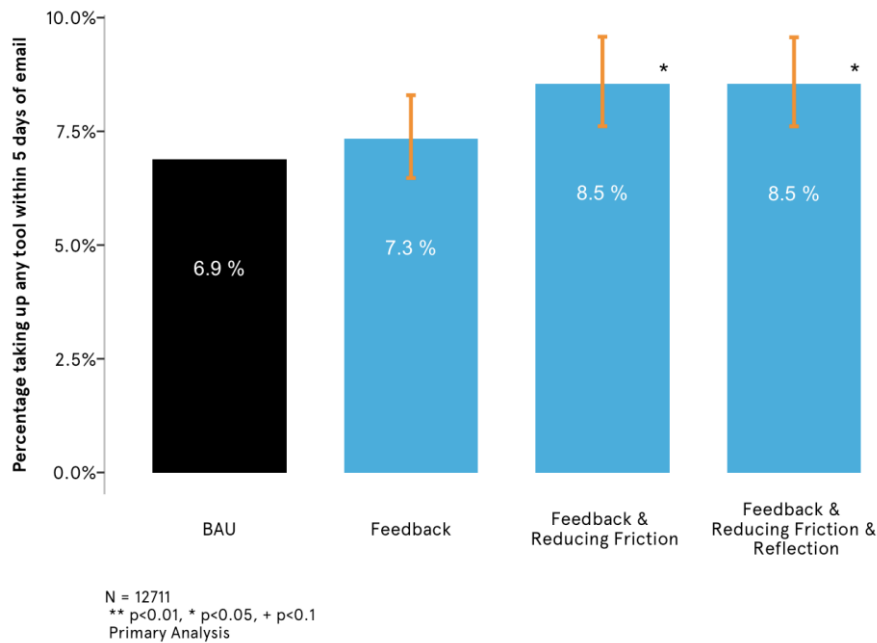
Making Responsible Gambling tools easier to access may therefore be an effective way of encouraging their use. We also propose small adjustments to sites to ensure that play is safe. For example, removing large defaults (such as very large suggested values for a standard bet) is likely to reduce the amount of money with which players are gambling. As a second approach, we suggest taking advantage of periods when players are not yet in the 'hot state'. Before beginning play, players could be required to pre-define a spending or time limit. If this was breached, play could be limited or a high impact message could be delivered (for example, a pre-recorded message from the player themselves). Alternatively people's wider social network could be brought to bear to increase the social pressure to reduce risky play. This could include notification of selected friends and family when play crosses a pre-identified threshold. We are currently discussing testing these interventions with online operators.

This report demonstrates how behavioural insights can be applied to increase the uptake of Responsible Gambling tools. The next step is to build on our earlier trials to target players at risk with behaviourally-informed interventions, and to make adjustments to online sites to reduce risky play.

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The GambleAware commission

The rise of online gambling sites means that placing a bet is only a few keystrokes away. For those that are negatively affected by gambling, increased accessibility poses a risk of financial, social or health-related harm.

As such, the Behavioural Insights Team (BIT) was commissioned by GambleAware to conduct the third phase of its remote gambling research programme, which aims to support operators in reducing reduce problem gambling. This work follows reports produced by PwC (in Phase 1 and Phase 2 of the work), and builds on academic research on key issues in product-based harm minimisation for gambling[1] and operator-based approaches to harm minimisation.[2] For an overview of BIT, please see Appendix I.

The overarching question for Phase 3 is '**Can behavioural insights be used to reduce risky play in online environments?**' The first stage was a research phase, and is covered in this report. The second phase will be an implementation phase.

We split the question into the following component parts for the research phase:

1. How do gambling operators currently identify risky play?
2. Can data science be used to improve identification of risky play?
3. What tools do operators currently use to encourage responsible gambling?
4. What additional behavioural insights can be applied to risky play?
5. What improvements can be made to existing operator tools to encourage responsible gambling?

To answer these questions, we conducted a literature review, a data science analysis, a review of existing operator practices, a mystery shopping exercise, a qualitative study, and two randomised controlled trials. To make this report easier to read, we've signposted when we're moving from one question to another, using **black text boxes**. These boxes also highlight which of the six strands of research contribute to each section. For further details on the methodology across these strands of research, please see Appendix II.

At the end of this report, we have recommended intervention approaches that we hypothesise are likely to encourage responsible gambling, and reduce risky play. Our aim is for GambleAware and the steering group to commission BIT to take these interventions forward in larger trials, which will form Phase 3b (i.e. the implementation stage).

In the next section, we introduce problem gambling and risky play, with a particular focus on the online environment. We also introduce behavioural insights, and how they might apply to risky play.

In this section, we draw upon:

- Our literature review

Problem gambling and risky play

In the UK, around 63% of adults engage in gambling in some form. Those who do gamble can be conceptualised as sitting along a continuum (see Figure 1). "Recreational gamblers" account for the largest proportion of the continuum, approximately 58% of the UK population.[1] As individuals begin to experience harm from gambling, either in their work, personal, or social life, they move toward the right of the continuum. These individuals are considered "at risk". Around 2.5 million people in the UK are considered to fall into this category.[1] "Problem gambling" describes those at the very severe end of the continuum, and affects approximately 500,000 individuals in the UK.[1] These individuals struggle to control their gambling, and experience financial, relationship, and occupational difficulties as a result. They are also likely to suffer from mental health issues, and meet the criteria for behavioural addiction gambling disorder, as conceptualised by the DSM-5.[2]
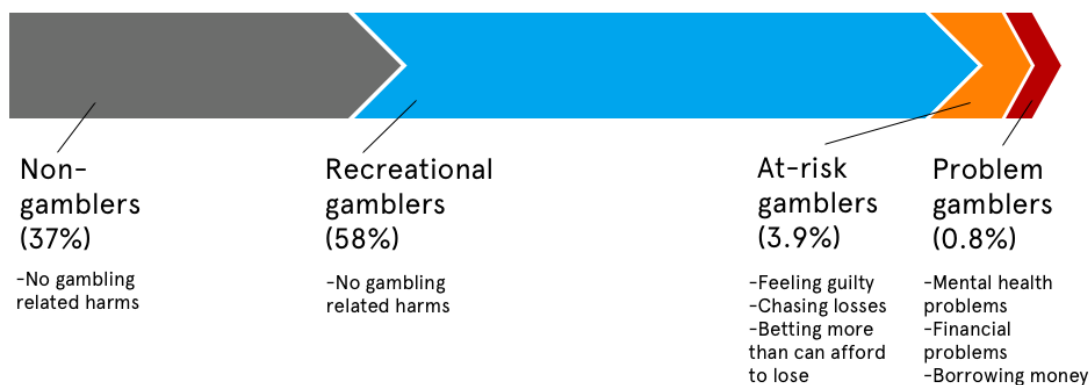

Non-gamblers (37%)
-No gambling related harms

Recreational gamblers (58%)
-No gambling related harms

At-risk gamblers (3.9%)
-Feeling guilty
-Chasing losses
-Betting more than can afford to lose

Problem gamblers (0.8%)
-Mental health problems
-Financial problems
-Borrowing money

Figure 1. Distribution of gambling behaviour within the UK population (2017).

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1 Prevalence estimates from Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.
2 American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Online gambling

The increased use of the internet in all areas of life has resulted in a sharp increase in online gambling. Between 2008 and 2014, the share of the population engaging in online gambling rose from 9.7% to 15.4%.[3] It appears that online play may be replacing land-based gambling; recent survey figures from the Gambling Commission in 2017 also found that 'in person' rates (whether at bookmakers, casino, arcades, or other venue types) are declining.[10] The online gambling sector now accounts for 34% (£4.72bn) of the total gambling sector, where individuals mostly engage in placing bets (accounting for 53% of the online gambling market), followed by casino games, poker and bingo.[1]

A focus on risky play

Problem gambling is a set of addictive behaviours, with associated mental health difficulties. Behavioural insights may help to encourage the uptake of an intervention to reduce problem gambling, but traditional 'nudges' may not be sufficient as an intervention by themselves. For problem gambling, it is likely that intensive intervention (e.g. therapeutic counselling) will be required.

Instead, we hypothesise that 'at risk' gamblers may have more to benefit from the application of behavioural insights. At-risk gamblers represent almost 4% of the UK population (around 2,663,000 people). Those at risk may start to feel guilty about the amount of time or money they are spending on gambling sites, chasing previous losses with further play, and betting more than are able to afford to lose.[4] At risk gamblers are also subject to numerous operator interactions, as we discuss later in this report. These procedures may provide touchpoints at which small adjustments could be applied to steer gamblers towards safer play, and encourage them to make use of Responsible Gambling tools. These small adjustments lend themselves well to the application of behavioural insights.

We therefore centre this report around risky play, and how behavioural insights can be better utilized to reduce its prevalence.

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3 Thorley, C., Stirling, A., & Huynh, E. (2016). Cards on the table: The cost to government associated with people who are problem gamblers in Britain. *IPPR Report.*
4 Holtgraves, T. (2009). Evaluating the problem gambling severity index. Journal of gambling studies, 25(1), 105.

A brief introduction to behavioural insights

As we will demonstrate in this report, behavioural insights have much to tell us about gambling in an online environment, and in particular, risky play. Historically, public policy programmes and interventions have often been designed based on principles from the academic discipline of economics.[3] More specifically, they often make the assumption that people will process all the available information, carefully weigh up the costs and benefits of acting, weight these for risk, and select the option that maximizes the benefits to themselves.[4] This is called the 'rational agent model'. However, findings from the behavioural sciences have started to show that, while this is a good approximation for people's decision making, there are systematic and predictable deviations under certain conditions. For example, behavioural science has shown that we often use mental shortcuts or "rules of thumb" to select an option rather than fully evaluating all possible options.[5] Examples of these shortcuts might be "choose what everyone else has chosen", or "do the same thing I did last time". Behavioural science is about understanding these deviations from the rational agent model and taking them into account in the design of services or products.

In the next section, we explore how operators identify risky play, and discuss some of the challenges of doing so. We also describe our data science work, in which we've built predictive models which identify factors that correlate with the risky play as measured by the Problem Gambling Severity Index. We provide recommendations for how operators can better identify risky play. We then explore these factors from a qualitative perspective, detailing the lived experience of gamblers in the online space.

In this section, we draw upon:
- Our review of operator practices
- Our data science work
- Our qualitative study

Identification of risky play

Operators use factors correlated with self-exclusion as a proxy for risky play

We conducted an extensive review of operator practices, to better understand how operators currently identify risky play. Most have entire teams dedicated to identifying those at risk, using increasingly sophisticated methods to do so. Operators predominantly use play data, and train their predictive models using factors correlated with self-exclusion. For some, this is supplemented by a subjective assessment of harm, conducted by staff. This includes an individual appraisal of key play indicators, such as betting late at night.

On-site algorithms are used to identify behaviours previously shown to be correlated with self-exclusion. This includes, but is not limited to:

- Play activity
    - Measured in real time
    - Includes session lengths, and identifies loss chasing behaviour
- Account management
    - Includes account closures, time-out requests, and deposit limit changes
- 'On arrival' risk score
    - Includes an appraisal of disposable income on arrival
- Payment behaviour
    - Often includes deposit frequency and size, increased stakes, failed deposits, cancelled withdrawals, use of high interest cards, and multiple payment methods

It is worth noting that operators generally do not use net losses as a marker; but those that do so use a relatively large threshold (e.g. an average spend of more than £300 per day).

Later in this section, we describe an extensive data science piece we've conducted to better understand which of the above-listed factors may be most important in identifying risky play.

Some operators report that their 'propensity to self-exclude' systems may overestimate self-exclusion, producing false-positives, but suggest that this is preferable to missing those who may be at risk of problem gambling.

Operators also recognise the great challenge in interpreting the large amount of play and other data available. Given that problem gambling can be exhibited through a range of behaviours, using linear rule-based systems are unlikely to be completely accurate predictors. As such, operators are attempting to move towards systems that are more responsive to nuanced data (e.g. using decision trees, and multiple data points, to build a more complex picture of an individual user) as well as training staff to speak to people identified as risky players through their models.

A deeper exploration of risky play using gradient-boosted decision trees

As part of our project, we conducted research into how gambling behaviour is related to the propensity to be a problem gambler. To do this, we used a data set created by PricewaterhouseCoopers (PwC) as part of Phase 2 of GambleAware's research, which contains both play data and Problem Gambling Severity Index (PGSI) scores for about 10,500 online gamblers. We used this dataset to build a machine-learning model for identifying which of the behavioural factors a gambler might exhibit are associated with a high PGSI score. More information about the dataset is included in Appendix IV. The properties of this model, summarised below, give us an insight into the types of behaviours that are associated with harm as well as those that are more benign and in line with recreational use of online-gambling platforms.

As stated above, the data set includes gamblers' scores on the PGSI, an academically validated scale indicating the severity of harmful gambling behaviour. Although an accurate diagnosis of pathological gambling requires expert assessment, a high PGSI score has been shown to be a reliable marker of problem gambling and we therefore used these scores to categorise the customers in the data set. The PGSI produces scores in the range of 0 to 32, with 0 suggesting no problems and 32 suggesting pervasive problematic behaviour. In line with previous research, we classify a score of eight or higher as a "problem gambler"; however, we also investigate whether the score can be predicted directly.

Previously, PwC built a predictive model using these data, too, achieving high predictive power. Indeed, the AUC (a measure of predictive power – see Appendix IV for details) of their best model was 0.905, which is greater than our best model's AUC of 0.812. However, since their model relied on a range of demographic variables, such as marital status or job family, collected through questionnaires, its practical applications are limited by the fact that operators don't tend to have access to such data. Our model, on the other hand, relies only on operator-held data and thus comes closer to what operators themselves could implement in order to identify likely problem gamblers.

Our approach mirrors some of the conceptual aspects of PwC's work. In contrast to their report, we focus less on descriptive analyses of online gamblers and more on examining the strongest predictors of problem gambling. To achieve this, we draw strongly on the ability of our analytical approach (described below) to rank predictors by their relative predictive power. This allows us to get a simple yet accurate representation of the main aspects that distinguish problem gamblers from non-problem gamblers, and of those factors which are highly correlated with PGSI scores.

Predictive modelling

Key findings

- Behavioural variables related to the amounts of money bet on the platforms are by far the most important predictors of who is a problem gambler; they account for over half of the predictive power of our model. In contrast, bet outcome, deposit and withdrawal behaviour, and time spent betting, together account for less than a third.
- Betting over £250 in an average day of gambling is highly indicative of risky play.
- The more variable one's stakes within a day of gambling, the more likely one is to exhibit risky play.
- The likelihood of risky play gradually decreases with age.
- Making on average two or more deposits per day is associated with risky play, with eight or more being extremely indicative of it.

Our analysis relies on a technique called gradient-boosted decision trees, a state-of-the-art algorithm that can accurately discover complex relationships between data and an outcome (see Appendix IV for details). In order to build (or 'train') such a model, we summarised the data in various ways to build a range of features, each of which captures an aspect of the behaviour of an individual. These included simple quantities, such as the mean deposit value or frequency of betting, as well as more complex ones reflecting some of our hypothesised indicators of problem gambling, such as the value of the bet that directly follows a big monetary win. Of the 321 features we constructed, the algorithm selected those features that best distinguish between gamblers at high risk and low risk of problem gambling and identified the ranges of values associated with high vs. low PGSI scores.

Our final model consists of a refined set of 33 behavioural features and one demographic feature. We quantify which of these features are the most strongly indicative of problem gambling by measuring their *importance*, that is, the proportion of the predictive power that they account for. Table 1 shows the relative importance of six high-level feature groupings: stakes-related, returns-related, deposit- and withdrawal- related, demographic, and time-related features. Table 4 in Appendix IV shows a full list of 34 features and their relative importance.

Group of features	Importance
Stakes	57.7%
Demographics	12.5%
Returns	11.4%
Temporal (time and day)	10.9%
Deposits	5.8%
Withdrawals	1.7%

Table 1. Feature importance aggregated into high-level groupings.

Stakes

The most important features in our model are overwhelmingly features associated with stakes. Of these, the mean monetary amount staked in a day of betting activity and the variation of bet amounts (i.e. whether a user is consistent in the amount that he or she bets, or whether their betting values fluctuate) are most the most important, with variation of stakes within sports betting or within online games being among further important predictors. Together, stakes-related features alone make up more than half of our ability to identify which gamblers are likely to have a gambling problem (see Table 1). This means how much money one spends betting and their pattern of bet amounts are key to evaluating their risk of being a problem gambler.

Figures 2 and 3 explore the role of these variables in more detail. The propensity to be a problem gambler rises sharply with the average amount of money spent daily on a platform but stays almost constant (and high) for individuals betting more than roughly £250 per betting day. In contrast, the variation of bet amount (here captured as the standard deviation of the logarithm of the amount) has a two-step relation with predicted PGSI scores, with scores above 1.5 being somewhat indicative and scores above 2.5 strongly indicative of problem gambling. Low scores are associated with placing similarly-valued bets; for instance, betting £5, £20, £10, £5, and £12 within a day would give a variation score of 0.75. Conversely, higher scores are associated with a higher spread; for example, betting £5, £30, £140, and £2 in a day would give a score of 1.89.
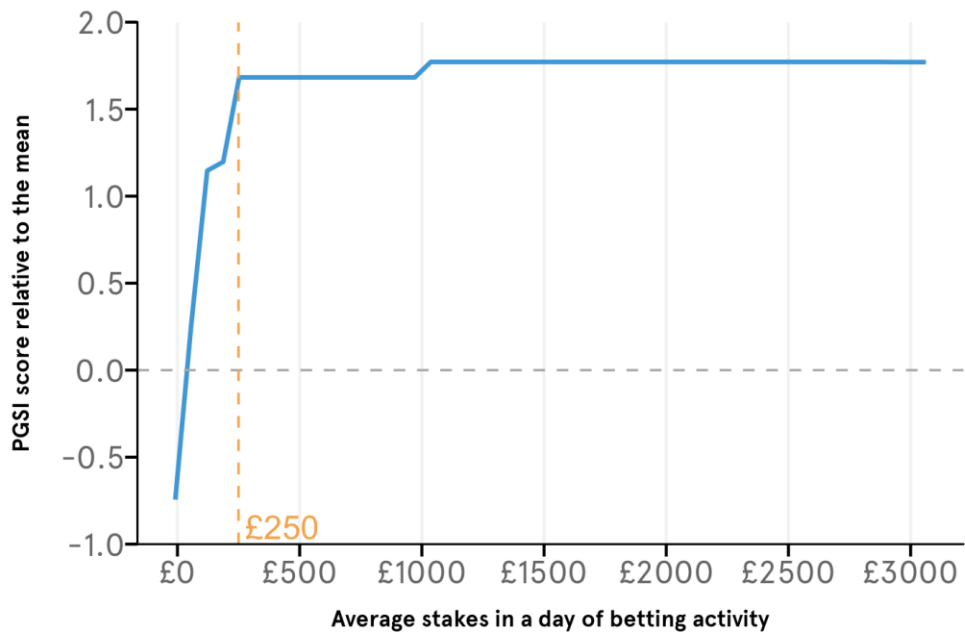
Figure 2. The relationship between PGSI scores and mean daily stakes (the strongest predictor in the model).
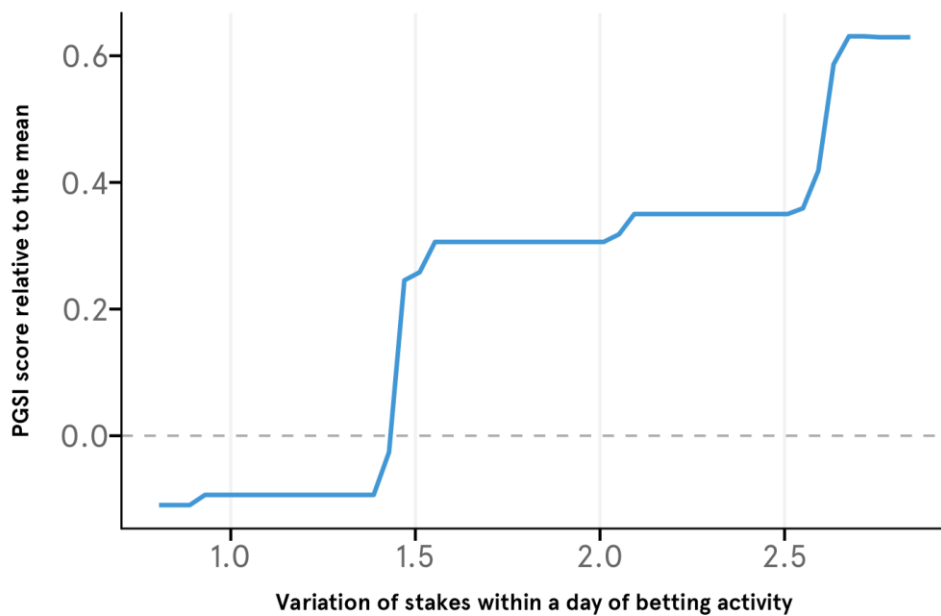

Figure 3. The relationship between PGSI scores and the variation of daily stakes (the third strongest predictor).

Other categories

The other categories of features – aside from demographics, which we discuss later – are jointly responsible for about a third of the predictive power. The strongest of these is the

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within-day variability in the returns to one's bets: highly variable returns are associated with PGSI scores almost a whole point higher than less variable returns (Figure 4). Here, a high score, such as 3.25, can, for instance, corresponds to winning two bets in a day, one returning £2 and the other £200. Such a pattern of returns can either be indicative of placing highly variable bets (since low stakes tend to result in small returns and high stakes in high returns) or placing high-risk bets (which usually result in a loss but can result in wide range of returns).

The average number of deposits one makes per day of betting is the last of the top four behavioural features. Similar to the variation in stakes, it too has a two-step relationship with problem gambling (Figure 5): making more than two deposits per day of betting activity is consistently indicative of higher PGSI scores, but the strength of the association more than doubles for those who deposit more than seven times per day.

Although there is a range of behavioural patterns associated with problem gambling, operators are advised to carefully tune their risky-gambler flagging algorithms to four variables – mean daily stakes, variation of daily stakes, variation of daily returns, and the mean number of deposits per day – since they alone can effectively distinguish between low- and high-risk gamblers.
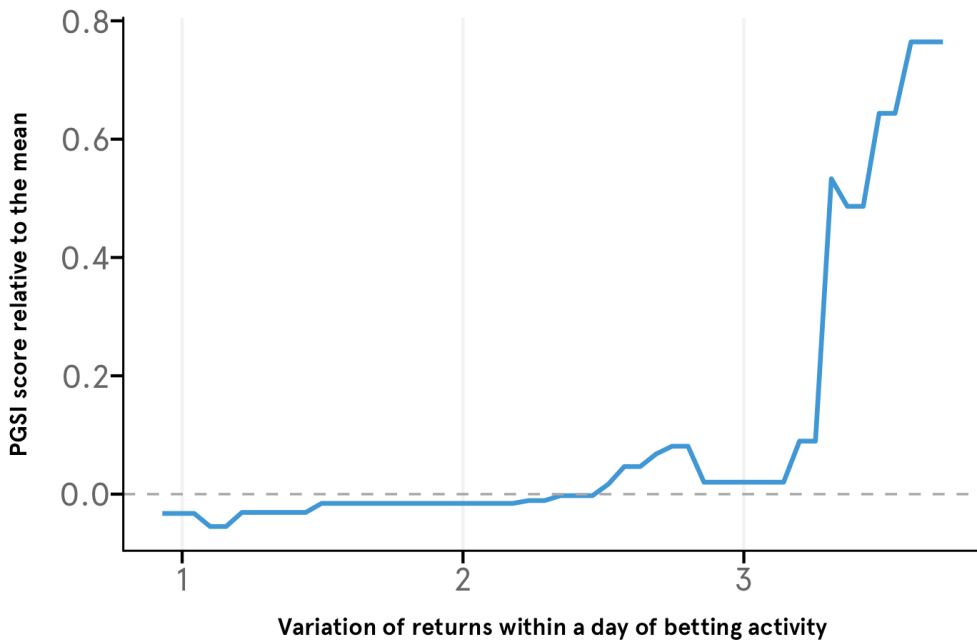
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Figure 4. The relationship between the PGSI score and standard deviation of the value of returns within a day (the fourth strongest predictor in the model).
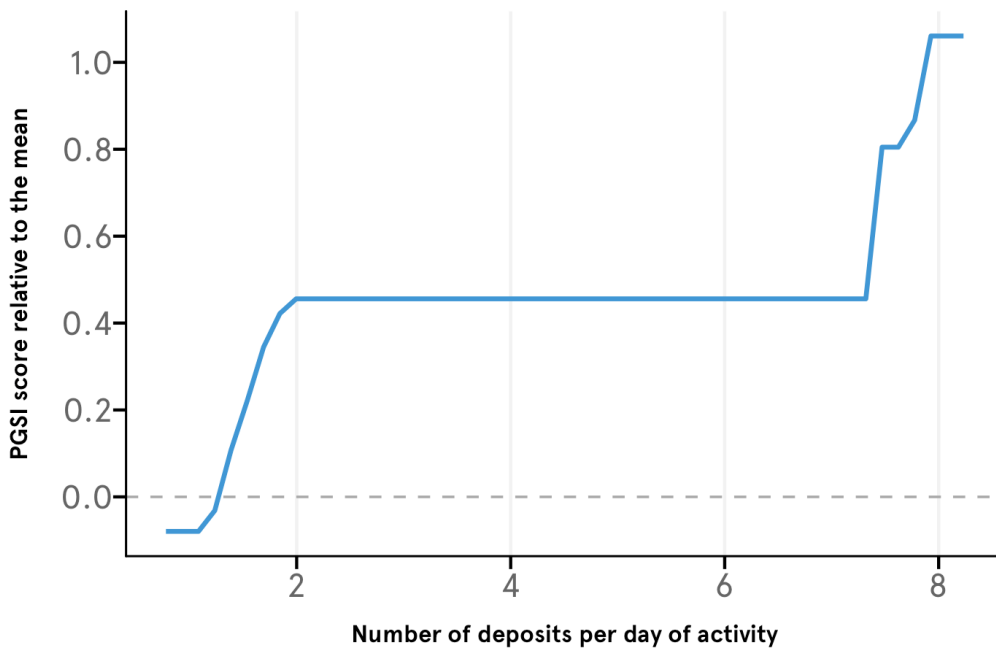

Figure 5. The relationship between the PGSI score and the number of deposits per day of betting activity (the fifth strongest predictor in the model).

Complex relationships and combinations of features

As shown in the figures above, the specific relationships between behavioural features and the outcome (i.e. the PGSI scores) can vary in complexity. For instance, the relationship is sometimes linear but may also be U-shaped or have sharp boundaries. A strength of machine learning – as opposed to human judgment or more traditional analytical approaches – lies in the ability to automatically and accurately discover these relationships.

Another key strength is the ability to discover *combinations* or clusters of features that can identify people at risk of problem gambling. In order to gauge the importance of such combinations, we built a separate gradient-boosting model, one that was not allowed to construct feature combinations (see Appendix IV for details). Interestingly, we found that such a constraint only had a very small effect on the predictive power of the model – it decreases it by less than 1%. This implies that the indicators of problem gambling are similar across different subpopulations of gamblers, and that looking for predictive clusters of features should only be secondary to the identification of behavioural patterns shared across gamblers.

This finding is consistent with the conclusion reached by PwC who, using a different analytical approach, segmented customers into multiple natural clusters and found that doing so only "marginally improves" the performance of their model. From the operators' perspective, this implies that finding the right behavioural threshold for flagging at-risk gamblers should be of greater priority than attempting to come up with a complex set of tailored thresholds.

Self-exclusion and predictive modelling

Many operators have focused on building models that predict gamblers' propensity to self-exclude, as a proxy measure for problem gambling. It is unclear, however, how accurate self-exclusion is as a proxy for problem gambling. Many problem gamblers may conceivably not use responsible gambling tools and, conversely, some responsible non-problem gamblers may self-exclude for reasons other than having a gambling problem. Using the above-described data set, we tried to test how accurate propensity to self-exclude is as an indicator of whether someone is a problem gambler. Unfortunately, we were unable to test this robustly, as we only have self-exclusion data from one operator. In addition, self-exclusion is very rare in the sample: out of 1648 accounts, only 6 used a self-exclusion tool

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over the two-year period covered in the data. As such, we can conclude that there were more problem gamblers than self-excluders, in this sample. If self-exclusion were a perfect predictor of risky play, these numbers would be the same. We therefore recommend that research be conducted to better understand how accurate propensity to self exclude is as a measure of risky play.

Self-assessment is encouraged by some operators, but can be challenging

In addition to approaches that require analysis of data, some operators also encourage gamblers to self-assess, usually via a mandatory online questionnaire. This is unlikely to capture all problem gamblers. Some are likely to know that a high score will mean they will be barred from a site, while others may genuinely not recognise the true issues that their gambling creates.[5] For example, in a recent study, players enrolled in a casino-based loyalty program were asked to estimate their total winnings or losses over a 3-month period, before they were provided with their player-account data. This study showed that subjective recall of gambling spend differs from player-account data, and that after receiving feedback, overall spend was significantly reduced.

Our qualitative work further elucidated the difficulty of self-assessment, as it suggested that thresholds which people viewed as constituting problem gambling were highly dependent on personal circumstances and the subjective views of the individual. 'Gambling too much' was generally categorised in **financial terms** (spending money you cannot afford), or **social terms** (spending time that impacts upon your relationships and everyday life).

Financial harm

A key characteristic of this theme was the relative and subjective nature of what 'too much' represented to each participant. For some, it related to an internal spending limit and was often compared to the cost of other leisure activities (e.g. drinking alcohol). For others, 'too much' was defined in terms of significantly impacting their ability to pay for essentials, such as rent and bills.

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[5] Wohl, M., Davis, C., Hollingshead, S. (2017) How much have you won or lost? Personalized behavioral feedback about gambling expenditures regulates play. Computers in Human Behavior. 70 (437-445)

> "I guess it's just money you can't afford to lose, taking out loans and taking out credit cards, taking out an overdraft, which I am ashamed to say I have done all of the above. It's just going beyond your means and when you have got more money going out than coming in you have got a problem"
>
> "For me, I think I was going on it too much, and in terms of a monthly figure, if I lost £50 within a couple of weeks and felt that I needed to put more in to my account then that would be out of control and I would need to stop for a bit."

Social implications

Several participants in the qualitative work defined 'too much gambling' as that which had a negative effect on their social interactions. Some defined this as prioritising gambling over social activities and others identified warning signs when gambling influenced their mood in social settings. Participant's interpretation of this theme was heavily shaped by their social networks and experiences.

> "Some of my friends would get very into it and spend a long time. One of my friends spent nearly most evenings, week and weekends, playing, which I find depressing because it is taking precedence over other things."
>
> "I think it can be as little as it affects your mood, which I was certainly feeling a couple of times. Where, if you has a couple of losses and especially when you have got your phone and you find out about those losses in a social situation and you can certainly feel a quite downbeat. That's, I think, when it has gone too far."

These findings reflect the subjective assessment of harm that many operators use, and correspond with the existing literature (which we discuss in greater depth in Appendix III).

Typical characteristics of those engaging in risky play

In this section, we discuss what our data science work tells us about the typical characteristics of those engaging in risky play. The academic literature around high-risk groups is relatively limited, but for operators, those aged 18-24 years old are automatically

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flagged. We used predictive modelling techniques to explore the relationship between PGSI score and age, and PSGI score and gender, further.

Age (but not gender) is predictive of PGSI score, used as a proxy for risky play

Age has revealed a strong relationship with problem gambling: the likelihood of being a problem gambler gradually drops with gamblers' age (Figure 6). Age alone accounts for 12.5% of the predictive power of our model.

Somewhat surprisingly, gender was not found to be an important indicator of problem gambling. Although males tend to have somewhat higher PGSI scores than females – 2.27 vs. 2.13 – the difference is likely accounted for by differences in their behavioural patterns, which were captured by other features in our model.
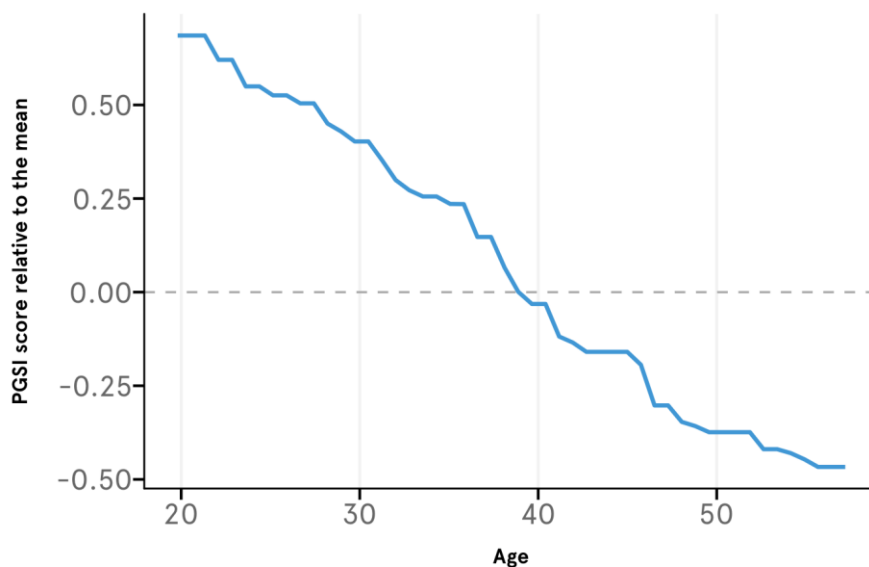
Figure 6. The relationship between the PGSI score and age (the second strongest predictor in the model).

Recommendations for better identification of risky play

Identifying risky play is challenging. As such, operators employ a range of increasingly sophisticated techniques, developing accurate predictive models to identify factors correlated with self-exclusion and employing subjective assessment by highly trained staff.

We have demonstrated in the previous sections that applying machine learning techniques to existing play data can identify risky play. However, there must be a balance between the amount of problem gamblers identified, and the number of times a player is incorrectly
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identified as a problem gambler (i.e. the rate of 'false positives'). If our model was applied in in its current state, it could find 62% of problem gamblers by selecting only 20% of individuals with the highest predicted scores. However, it is important to acknowledge that the model was built on historic information, and would benefit from updated data. Depending on its intended use, it may be that operators would want to set a higher or lower threshold.

In order to improve the predictive power of future models, we recommend that the following steps are taken:

- Conduct another research exercise in which PGSI data is matched to play data. The data we used is old given the rapidly changing nature of online gambling and operator interventions to reduce risky play. Another limitation of our data set was the fact that there were only a few hundred users with PGSI scores greater than 7 (i.e. the 'problem gambling' range), which makes it difficult to find reliable and generalisable predictors. Moreover, problem gambling is not a static attribute: it develops over time and early stages may show different behavioural patterns from later stages. One interesting approach could be to collect PGSI scores from some customers repeatedly over time in order to better understand and be able to predict the establishment of harmful habits. Clearly we are keen not to impose burdens on operators but an approach like this could be light touch and significantly help to understand risky play.

- Commission research into the accuracy of propensity to self-exclude as a measure of problem gambling. As previously described, the size of sample used to analyse factors correlated with propensity to self-exclude was smaller than we would have liked, with relatively few incidents of self-exclusion. Broadening those datasets would be beneficial.

- Ask users for basic demographic information during sign-up. This would, again, enhance predictive models. As our analysis shows, even a single demographic feature (age) can markedly improve a model's performance. Problem gambling is often associated with individuals in specific social situations or stages of life so even limited knowledge of these can serve as strong indicators.

- Combine the data sets with other existing data sources on users' behaviour. Web-analytics data, including click-through rates and time spent on different pages, may be especially useful. As our mystery shopping exercise will demonstrate, some operators require users to go through multiple pages (with repeated requirements to re-login) between first clicking to self-exclude and being able to actually self-exclude.

Since it is conceivable that this process may discourage someone with the appropriate intention to self-exclude or cool off, such clicks indicating interest in self-exclusion tools may provide a better marker of high-risk gambling than actual use of the tools.

- **Train staff to identify risky play through telephone conversations and chat room interactions.** Our review of operator practices revealed that some staff subjectively assess gamblers' behaviour and that this may be an effective way to identify risky play; we suggest this is considered by all operators.

In the next section, we explore existing tools that are designed to reduce risky play. We map the user journey, identifying the key touchpoints at which operators intervene. We review the evidence around effectiveness, and describe tools which work across operators.

In this section, we draw upon:
- Our review of operator practices
- Our literature review
- Our qualitative research
- Our mystery shopping exercise

Existing tools to reduce risky play

Responsible Gambling intervention throughout the user journey

Through our review of operator practices, qualitative research, and mystery shopping exercise, we have identified that a variety of Responsible Gambling interventions exist. These include 'light touch' tools designed to prevent risky play, such as self-imposed stake or deposit limits. These may be communicated using email and on-screen pop-ups. Telephone conversations are also common, in which problem gamblers are signposted towards available Responsible Gambling material and relevant support agencies. For those continuing to exhibit risky play, Player Protection Measures may be enforced, such as removal of VIP status or mandatory limits on stake increases.

In the next sections, we describe operator practices to encourage responsible gambling during recreational play and once a player has been identified as being at risk. We also

describe the possible outcomes of each contact, and options open to operators should users continue to exhibit risky play. We have generated a hypothetical map of possible interactions between a user and a gambling operator (see Figure 7):

- During recreational play
- When a player is identified as at risk
- After Responsible Gambling conversations
- When a player continues to exhibit risky play

This map provides a diagrammatic representation of the various touchpoints at which operators encourage responsible gambling, and intervene when play is identified as problematic. These interactions are described in detail below.
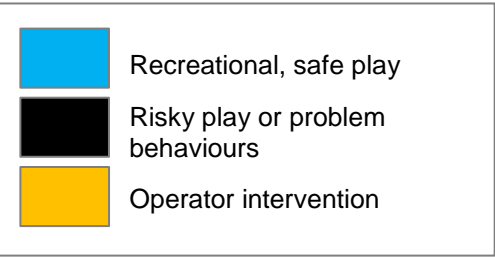
Figure 7. Hypothetical map of possible interactions between a user and a gambling operator

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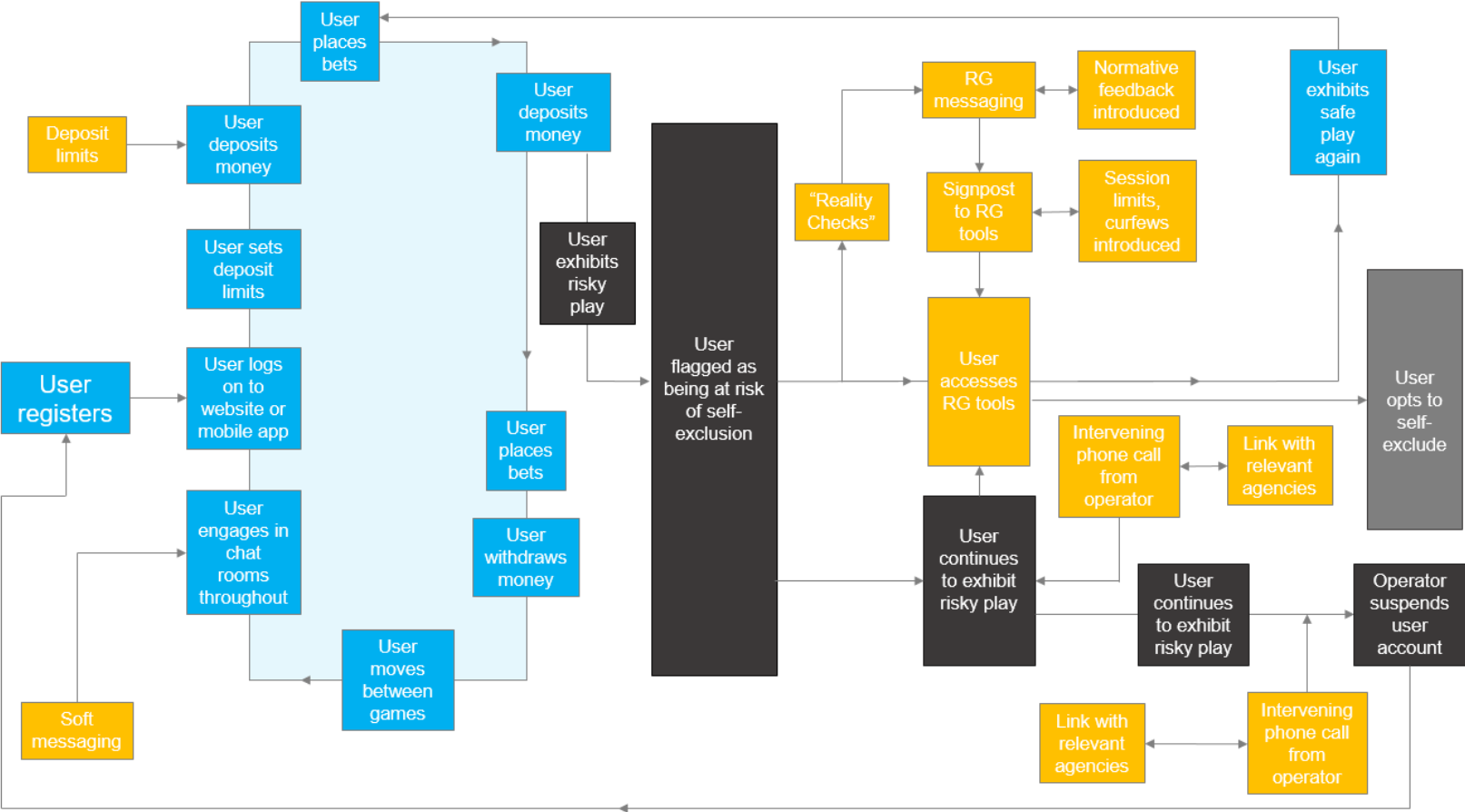
Recreational play

As we demonstrated earlier in this report, gamblers engaging in 'recreational play' represent around 58% of the UK population.[10] These are users for whom gambling is a leisure activity; something to be enjoyed that does not impact negatively on their financial, mental, or social health. These users will have access to 'light touch' Responsible Gambling tools designed by operators to prevent risky play (see Figure 8). This includes single pop-ups or prompts which, although acknowledged to be ineffective in reducing severe problem gambling, may help to prevent risky play before it develops.
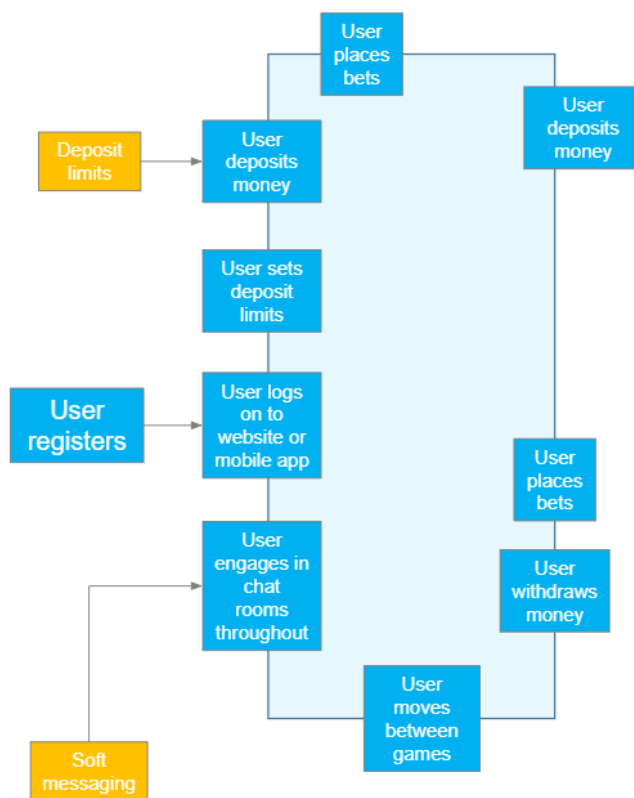
Figure 8. Hypothetical diagram representing recreational gambling.

Stake and deposit limits are increasingly common for those engaging in recreational play, particularly across 'slots' sites. For example, one large operator limits customers to £1 per play for arcade games, and £2 per stake (with a deposit cap of £500 per week) for bingo games. This operator also incentivise customers for applying Responsible Gambling tools, providing a £1 bonus for setting a limit (reporting that this increased the proportion of players who did so from around 30% to 50%.

Player identified as at risk

When a user is identified is playing in a risky way, they tend to be contacted using an automated system, and a telephone conversation with a Responsible Gambling specialist is initiated (see Figure 9). During these conversations, Responsible Gambling tools (e.g. deposit limits) are signposted, and relevant support agencies are identified (e.g. GambleAware).
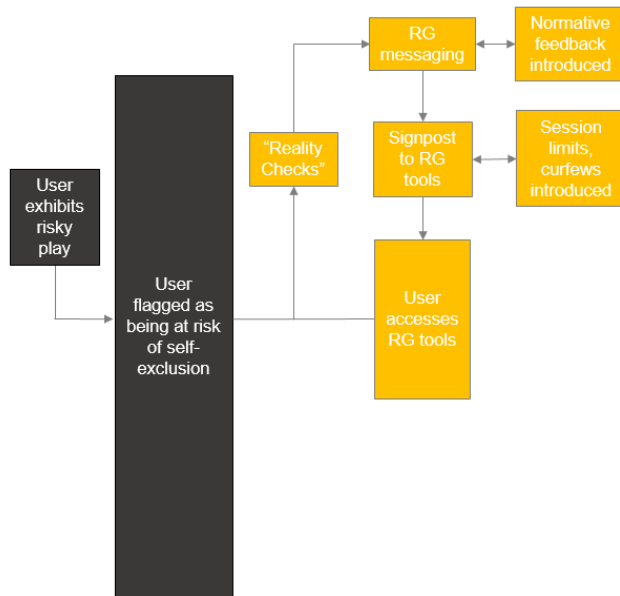

Figure 9. Hypothetical diagram representing the first phases of communication once a user is identified as being at risk of self-exclusion.

After a Responsible Gambling conversation

After a Responsible Gambling conversation, the user may access Responsible Gambling tools signposted by the operator (see Figure 10). The hope is that they then return to recreational play, and are no longer at risk of self-exclusion (the common proxy for risky play). Alternatively, the user may opt to self-exclude, for any length of time. In cases where Responsible Gambling conversations have not been effective, the user will continue to exhibit risky play.
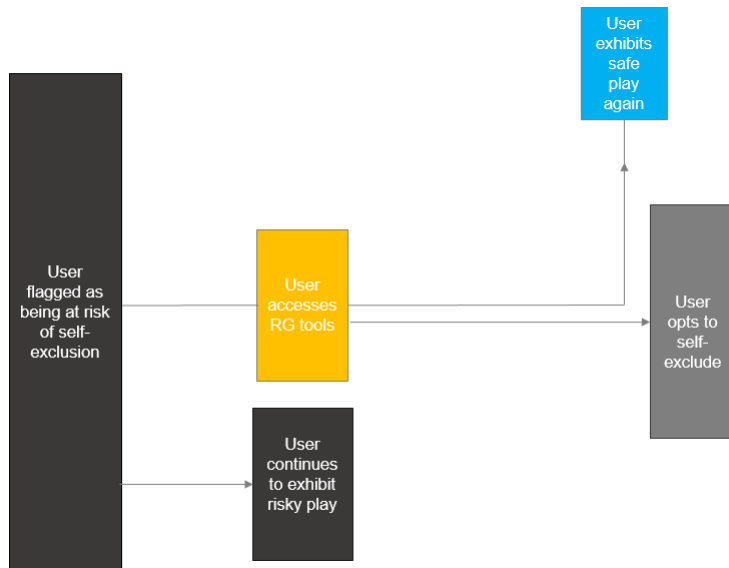
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User continues to exhibit risky play

If risky play persists, the language of messaging escalates (see Figure 11). For some operators, communications are personalised to the individual's behaviour, and questions such as "Do you feel like you are in control of your gambling?" and "Are you aware of how much you spent yesterday?" may also feature. For some operators, offering self-exclusion or enforcing Playing Protection Measures (e.g. mandatory deposit limits, removal of VIP status, ability to cancel withdrawals and self-exclude from marketing and/or loyalty schemes, limits on stake increases and bets over an identified stake, and reduced risk thresholds) follows.
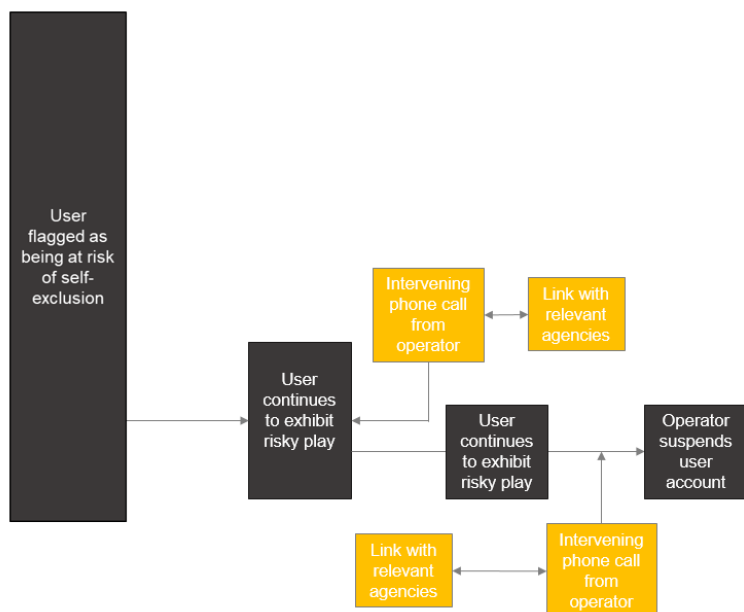
Beyond Responsible Gambling conversations, existing operator practices can be broadly split into account suspension and exclusion, self-exclusion and curfews, and stake and deposit limits. Most large operators use account suspension, a mandatory shutdown of the user's account, which remains until the user contacts the operator. For some, this is automatically triggered by a negative response to the pop-up question, "Do you feel in control of your gambling?". Some websites include a 'Stop button' which links directly to all Responsible Gambling tools. Curfews and session limits are also frequently offered to users as Responsible Gambling tools. There is an emerging use of global information systems for land-based users, which may have useful applications in the online space. For example, one operator offers a mobile phone application which alerts staff to the presence of a self-excluded users in their premises. This application has the capacity to set further limits, restricting users to certain times and/or days of the week. Account exclusion is a 'last resort' for gambling operators, and for some operators, is permanent.

Products working across gambling operators

There are numerous self-exclusion products that are external to, and work across, individual gambling operators. For example, GamStop functions as a database which requires operators to check for voluntary self-exclusion before an operator can allow play. Many operators report signposting to GamStop as part of their Responsible Gambling

conversations. Equivalent tools exist in Spain (www. jugarbien.es) and Denmark (ROFUS); ROFUS also excludes users from land-based gambling. Gamban is a commercial gambling blocking software which is specific to an individual user's computer.

Evidence on the uptake of Responsible Gambling interventions

In appraising the academic literature (see Appendix I), we reviewed the evidence on the use of behaviourally informed interventions to reduce problem gambling and risky play. In summary, there is little robust evidence around Responsible Gambling interventions. The field is relatively new, and given that play data isn't publicly available, operators are at the forefront of research activities (rather than academics or external bodies). Whilst there is some sharing of best practice, there does not yet exist systematic testing of hypotheses, nor regular publication of trial results.

However, we were able to elucidate some information about how frequently users are accessing Responsible Gambling tools (rather than whether they are effective if taken up). For example, uptake of temporary or permanent self-exclusion is relatively rare: one large operator suggested that less than 0.1% of users opt to self-exclude, whilst another reported that 6% of gamblers self-exclude. This may be somewhat attributable to the low agency of those exhibiting risky play; these players may not feel in control of their own behaviour, and therefore not feel able to take up helpful tools. Exclusionary tools such as GamStop are likely to be effective, but operators should consider ways to encourage those at risk to access them.

Emails and text messages are used across operators to signpost Responsible Gambling tools, but with mixed efficacy. For example, one operator suggests that ~80% of messages are opened, whilst another reports minimal engagement with emails sent from mobile gaming apps. Qualitative and survey data suggests that between 50-80% of land-based gamblers voluntarily set monetary limits whilst few set time limits. This is in contrast with real-world data from online gamblers which found that just 1.2% of online gamblers make use of limit-setting responsible gambling tools. Lack of awareness of self-exclusion as a Responsible Gambling option was also identified in recent research by the Gambling Commission, which found that 59% of gamblers were not aware of self-exclusion.

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In the next section, we describe how insights from behavioural science, particularly psychology and economics, can be applied to risky play. This includes consideration of the online environment and how this may encourage play in a more dissociative state.

In this section, we draw upon:
- Our literature review
- Our qualitative research
- Our mystery shopping exercise

Application of behavioural insights to risky play

The field of behavioural science recognises that individuals do not have perfect self-control and are profoundly influenced by context of a decision. This can be explained by 'dual process theory', which was popularised by Daniel Kahneman, and states that we use two types of thinking in our everyday lives – which he names System 1 and System 2. System 1 is the 'fast' system that is automatic and intuitive, with no sense of effort or voluntary control. It is the system that is used when someone asks "What's 1 + 1?". System 2 is the slower and more deliberative system that requires active attention. The deliberative thinking capacity of System 2 enables individuals to consider and evaluate relevant information, weighing pros and cons, to make the best choice for themselves. In reality, due to limited attentional resources, we cannot make every decision in this way, and more often than we might expect, end up relying on System 1. Most of the time this fast system, which relies on rules of thumb and heuristics, serves us fine. However, it can also lead to systematic biases in the way we think and behave.

Companies and governments often offer choices in a way that assumes that we are using the kind of deliberative thinking associated with System 2. For example, a service might provide people with a lot of information to inform their decision making, whether about good schools or mortgage plans. However, in practice, due to constraints such as limited time or mental capacity we do not use all the information we may have access to. People often choose to satisfice; to get a good enough outcome rather than the economically optimal one. There are a wide range of tools (e.g what we think others are doing, our own previous decisions) that people may use to make a decision quickly. For the purpose of this report we refer to these heuristics but also wider behavioural factors (such as emotional state) as

'behavioural influences', which lead to behaviour choices that may appear suboptimal in the economic sense.

There are many behavioural factors relevant to decision making in an online gambling environment. To best describe these, we will draw on our qualitative research and mystery shopping exercise, and our comprehensive literature review (see Appendix III for the full paper).

In this section, we will cover:

- The immersive nature of online environments and the dissociative state they encourage in users
- Decision making in an online environment
- Online environments facilitating detachment from 'real' money
- How operators facilitate easy access to games, but not Responsible Gambling tools
- Anchoring in online environments encourages risky play
- The use of defaults in online environments
- How targeted marketing messages attempt to move users between games
- Other subtle features of the online environment which may increase risky play

The immersive nature of online environments and the dissociative state they encourage in users

Gambling is associated with changes to a person's state of consciousness - either due to inducing higher states of arousal or inducing dissociative states. When considering dissociative states, there are a number of different terms that can be used to describe the subjective experience of high engagement in a particular activity and the consequent feeling of disengagement with one's surroundings. Immersion, flow, and psychological absorption all describe forms of altered consciousness. These states occur when we are deeply focused on a particular activity or thought. In comparison, dissociation is a clinical term that has come to describe more severe forms of detachment from reality. In the gambling literature, the term dissociation can used to describe anything from losing track of time, to 'blacking out' and having no later recollection.

Dissociation has regularly been implicated in problem gambling, both because of the negative effects of losing track of time and money (meaning that more time and money is spent on gambling than intended), but also because of the positive effect of the feelings of dissociation themselves. Studies have found that that dissociative experiences are

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reinforcing in that they appear to offer escape from psychological distress. One laboratory study found that higher levels of dissociation were linked to greater cravings to continue play, an effect which was mediated by higher levels of negative arousal/mood. In this way, gambling represents a form of mood regulation, or an escape from emotional distress. That is, escaping from problems and chronic feelings existing prior to the onset of gambling (such as a pre-existing mental health problem) as well as escaping from problems and negative feelings derived from gambling's consequences.

Whilst the propensity to experience dissociation from deep engagement in an activity such as gambling may be determined in part by individual differences - characteristics of the gambling environment also play a powerful role. For instance, the interactive nature of online behaviour in and of itself (in comparison to a more passive behaviour such as watching television) has been found to support feelings of escape. Additionally, although not a well-researched area, some forms of gambling, such as those supported by video lottery terminals (e.g. electronic games of poker, black-jack, and keno) are particularly associated with dissociative states. From the video gaming literature, the level of immersion felt by gamers has been found to positively correlate with the extent of stimuli and attentional resources needed whilst playing, indicating that the presence of visual, auditory, and sometimes tactile stimuli (e.g. use of buttons or using a joystick) may enhance immersion.

This disassociate state is further compounded by the purely intangible forms of payment used in remote gambling. In land based settings, a key disruption to play is needing to insert more funds into whatever machine is being used. The introduction of bill acceptors in gambling machines (which prevented the need to handle large amounts of change and reduced the number of interruptions to feed money in) led to a significant increase in revenues from the machines. When Norway banned bill acceptors this was followed by a 16% reduction in the number of calls to the problem gambling helpline as well as a 24% drop in the number of people seeking help with problem gambling. In the remote gambling environment, there is no requirement for the insertion of money, but rather deposits are placed electronically at the start of a session, with no interruption to play.

The characteristics of games and environments that might lead to higher levels of immersion or dissociation is an area that warrants further research. The rise of virtual reality technology and virtual reality gambling (such as virtual poker rooms to virtual sports events) means that the environments in which individuals gamble are becoming even more immersive. For those vulnerable to experiencing dissociation during gambling sessions, it might be that these highly immersive environments might lead to more prolonged and problematic play.

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Decision making in an online environment

In order to understand how to encourage individuals to make safer choices when engaging with online gambling operators it is necessary to investigate when and how decisions are made and the various influences present. Through analysis of our qualitative interviews it emerged that decision making could broadly be divided into two domains; pre-platform influencers - 'factors that influenced decisions to *sign up* to or *enter* gambling platforms' and within-platform influencers - 'factors that influenced decisions made *within* the gambling platform'. These factors were examined from two angles; firstly how participants perceived that operators influenced their decisions and secondly how the participant's personal characteristics and contexts influenced their choices.

Operator driven factors that influenced decisions to sign up to or enter gambling platforms

- Operator offers sometimes encouraged longer or riskier play
- Money as a prime motivation to gamble was mostly cited by problematic gamblers, whilst recreational gamblers cited enjoyment, sociality and engagement in sports more motivating

Three main factors that influenced decisions to sign up to enter online gambling platforms emerged; odds, convenience and offers. Odds and convenience of using online gambling services were largely perceived by gamblers as unproblematic aspects of how operators influenced decisions. Offers were a key influence on decision making and predominantly consisted of financial incentives such as free bets. A significant subset of these bets required 'play through', that prompted participants to play longer and with higher stakes than they would normally do.

Odds

For some participants odds were essential and they tended to bet with the operator who had the best odds for any given event.

- "They are easy to use and they give good odds. Sometimes I will check odds and I'll how much [Gambling Operator 1] are giving for a certain result and I'll check [Gambling operator 2]. I generally find that their odds are pretty good so that's pretty much why."
- "I think I prefer [Gambling Operator] because they do seem to have better odds than the others, but I do shop around sometimes for particular odds if I am looking for it."

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Convenience

Several participants highlighted the convenience offered by online gambling operators as it reduced the time required by place bets by not having to travel to a bookmaker.

- "Convenience, often you make a gamble at the spur of the moment, so you go to a game with some friends and you have a chat before the game and go: who is going to be the first goal scorer and rather than write it down you think sod it, we'll put in on [Gambling Operator]. So it's convenient, it's there, you're on the train and there exactly when you need it."

Offers

Most participants identified offers as a key factor that influenced their decision making. The offers were generally described as free bets and were mainly designed to incentivise sign-up with an operator, to encourage continued betting when they had not gambled for a while or if a big event was happening in the near future.

- "There's lots of times when you join up they give you free bets to sign up. They will give you a ten pound free bet when you spend your first ten pounds. so, you would put the ten pounds into your account, get two ten pound bets; one is free one is yours. But I guess once you have done that once you then have the account with them and you have your credit account set up, and you then have the ease of being able to bet whenever you want."
- "They will give you free bets if they haven't heard from you for a while, and it's a five pound free bet so you can bet again."

Several participants noted that some free bets involved certain 'play through' requirements. A 'playthrough' requirement meant that the bet had to generate winnings of e.g. five times the amount of the original free bet before any profit could be withdrawn from the online account. It appeared that these stipulations were not always clear to the participants and that these offers prompted participants to play for longer time periods or encouraged them to increase their stakes in order to reach the amount required for withdrawal.

- "There was a lot of marketing like that where you have a certain playthrough requirement on anything you won. That was a bit deceitful I think because you were hidden terms and conditions and it was never obvious that was going to be the case."

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- "Me and my friend did the [Gambling Operator] signup where you get two hundred pounds if you match two hundred, and basically you have to roll it. You have to roll it up to one thousand two hundred so that you can withdraw."

Personal factors that influenced decisions to sign up to or enter gambling platforms

The participants' personal motivations for signing up to or entering gambling platforms were centred on four main areas: a) to increase and enhance engagement with sports events, b) to seek enjoyment, c) to participate in a social activity, and d) to win money - this driver was characteristic of problem gambling.

To increase and enhance engagement with sports events

Most participants expressed that betting on sporting events increased their engagement with and enjoyment of the event through feeling like they had a stake in the outcome.

- "Sometimes there's games that aren't that interesting but you think you have a good idea and put a few quid on it to make it a bit more interesting."
- "It gives me some sort of stake in the game I guess, otherwise I am just watching two teams play football, whereas this is like I'm actively cheering for a team [...] It makes it a bit more fun having that stake in something".

To seek enjoyment

Many participants also found gambling to be an inherently enjoyable activity and therefore decided to enter gambling platform and place bets. There were however differences between participants concerning the degree of enjoyment they experienced through gambling.

- "I think some guys have to climb mountains and some have to swim the channel, and I get the same buzz from putting money on a bet."
- "I just do it for a bit of enjoyment."

To participate in a social activity

Half of the participants referred the social aspect of gambling as a motivation for deciding to place bets, this related in particular to sports betting.

- "Definitely on a Saturday. I really enjoy it with the boys watching on Saturday from three until five and just having a few bets on."
- "...it is normally driven by a situation where someone else is doing it, therefore you feel it would be fun to have a go yourself."

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- "I guess if you are sitting in an office and all of you have got bets on then you want to be involved because you are all going to watch it together anyway"

To win money - this driver was characteristic of problem gambling

Around half the participants mentioned that the chance to win money was one of several motivating factors for gambling. However, monetary gain as the main motivation for gambling was more prevalent among participants with a history of problem gambling and this desire for money was often experienced as problematic. For some of these participants, gambling to make a profit also stood in sharp contrast to the enjoyable aspects of gambling such as the previously outlined social element.

- "You know, that social element kicked in and I have just got a much more level head on my shoulders now. There is no desperation for me to win money now there is no desperation for me too spend money to win it."
- "Actually, I was gambling - and it sounds quite stupid, to provide a better life for my family [...]. You are risking your family's future. You know, you are betting with your child's inheritance. You have lost so much and you just want so badly to win big and then you will leave that all behind you."

Platform driven factors influencing decision making within the gambling platforms

When makings decisions about gambling within the platforms, operator led influences went largely unnoticed by the participants; only a very small number commented on nudges designed to increase gambling within the platforms. In contrast, several participants had some knowledge of responsible gambling tools designed at reducing harmful or risky play, but most participants found these tools to be inefficient.

Nudges went largely unnoticed by recreational and problem gamblers

A theme that was particularly noticeable by its absence, was participants lacking ability identify operator led influences on their decisions within gambling platforms. Most participants were unable to pinpoint any influences by the operator. This was despite the known use of nudges by gambling operators to influence betting behaviour. Only three participants had noticed tools such as anchoring and defaults - two well known and effective nudges known to influence decision making.

One way the operators used anchoring was through offering to match bets of a certain size with a free bet, thereby anchoring the participant to a bet that is potentially larger than what

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they would normally spend and, in addition, offering an incentive to stake the suggested amount.

- "There are sites that do free bet offers where if you bet a certain amount they will match it with a free bet. Very often the amount they suggest is what you end up betting. [...] I guess that places an image in you mind that betting fifty pounds on an event is standards. Then that ends up being what you end up betting."

Applying defaults was another method for influencing gambling behaviour that was noticed by only two participants. These defaults were characterised by either automatically suggesting stakes, eliminating the step where the person gambling enters what they would like to stake, or by imposing a minimum amount for depositing funds into the online gambling account.

- "Some of the websites have a feature whereby they would automatically populate your stake with your last stake. For example, if I had a bet on yesterday and if I was really confident and really liked it, and if I thought it was worth chucking fifty pounds instead of ten. Then say I put fifty two pounds on it, and when I came to load up a bet today it would automatically be populated to say fifty two. [...] it reduces that typing in a number, and it leads to perhaps putting a bigger bet on which you wouldn't normally."
- "Theres is a minimum and you sort of go okay I'll do the minimum, and then you just spend half, but end up spending it all anyway"

Responsible gambling tools were found to be difficult to access and to have limited effect
A small number (3) of participants referenced benefiting from the support tools available within gambling platforms at some point. The Responsible Gambling tools mentioned were: taking a break, self excluding, or setting spending limits. Nevertheless, the majority of participants who had any knowledge of Responsible Gambling tools expressed they had either not used them, or had found them to be insufficient in helping them manage their own risky play. Further research should consider the overlap between those exhibiting risky play, and those expressing dislike of Responsible Gambling tools. Understanding this nuance will be imperative in developing tools that reach those most in need.

Setting limits were generally perceived as ineffective as they could easily be reset within a relatively short time period. Additionally, some participants expressed the view that setting

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spending limits would impact their freedom to spend their money as they wished and therefore did not use them.

- "I think I did it once and within 24 hours I unset it and never bothered to set any limits or timeouts again in my whole time gambling"
- " I just wanted the power that if I wanted to do my whole bank balance then I want to be able to do it. Because on the last very thousand I might win fifty grand"

For participants who had experienced gambling addiction self excluding from individual operators had a limited effect on their behaviour as they would soon after sign up to other operators and continue gambling. Some participants also found it difficult to self-exclude.

- "You tend to create an account, self-exclude from the account, sign up for a new account, self exclude from that account, so I wouldn't be surprised if it was twenty or thirty providers I've used over the six or seven years".
- "I tried to self-exclude but it was so difficult to self-exclude. Once you are in the online gambling, and once you have got an account and even if you try to shut it down, and you haven't been on it for a while they still send you emails, junk mail, trying to entice you to get back online and gamble."

In sum, external influences on decisions such as nudges went largely unnoticed by participants and responsible gambling tools external to the participants were largely perceived to be insufficient.

Personal factors influenced decision making within the gambling platforms

Several key differences in the way participants personally managed their online gambling emerged through the analysis of the interviews. Participants who gambled recreationally and primarily for entertainment purposes generally expressed having an internal limit for the money or time they were willing to spend and several also had a form of withdrawal strategy that ensured they did not leave large sums of money in their online gambling account. In contrast, participants who had experienced problem gambling described behaviours such as spending excessive time and money on gambling.

Recreational gamblers had better internal limits to time and money spent on online gambling

The internal limits that emerged as key aspect of responsible gambling were characterised by: Accepting losses as a part of the experience of gambling and therefore only depositing
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what you are willing to lose; setting a daily or weekly limit on money or time spent that made sense to the participant's personal context, or comparing money spent on gambling to other entertainment activities and spend thereafter.

- "Twenty pounds is my limit because that is how much I spend on dinner or a quick drink after work and valuing it in comparison to entertainment"
- So, I would never play more than twice a week, I would only ever do it if I wasn't doing anything."

Recreational gamblers could better articulate a personal withdrawal strategy

A pattern emerged across several of the participants who engaged in gambling responsibly: they often had a form of strategy for withdrawing funds from their online betting account, whether explicit or implicit, which manifested in the way they managed their online gambling. The strategies were generally characterised by withdrawing a percentage of the funds in their online account immediately after a big win (the definition of a big win varied considerably among participants ranging from less than fifty pounds to several thousand pounds), leaving some money for continued play.

- "for example if I won one hundred and twenty pounds, I'll take out the one hundred pounds and probably keep twenty in to play with."
- "Nowadays, like the big win I had last week, nowadays, I tend to make sure that if I win anything I withdraw at least a minimum of the stakes that I put into the account over the course of the week or that day or two weeks. So if I win five hundred pounds and I know I spent one hundred yesterday, I would actually draw four hundred of it and leave one hundred in."

Excessive time and money spent on gambling characterised problematic behaviours

In contrast to the aforementioned responsible gambling behaviours, experiences with problem gambling were often expressed in terms of increased betting frequency, excessive time spent on gambling and increasing stakes.

- "Like, I don't want to wait until the weekend, and now you don't want to wait until three PM. You know, when you wake up on a Sunday you don't wait until the three PM games you start at eleven o'clock games. They are in Vietnam, Turkey and things like that, and before you know it you have already lost you ten pounds that you

would have bet on that day. So then you go, okay, I'll just put another ten pounds on."

Online environments facilitating detachment from 'real' money

The requirement to use intangible forms of currency (e.g. credit and debit cards) rather than coins, chips or cash can also reduce financial self-monitoring. For instance, there is evidence that less tangible forms of money increase spending and reduce decision making time, and an experimental study found that participants gambling with intangible currency were significantly worse at keeping track of their balance.

This was further elucidated by our qualitative findings. The perception that funds in a gambling account were disconnected from real money was a theme that emerged across all the interviews. Both low stakes recreational gamblers, and those previously addicted to gambling, experienced detachment from the money in their online gambling account or felt that the money in the online gambling account was not real.

- "It's just a digital number and you have not exchanged cash via hand to spend it. So all of a sudden it's just a balance on your screen that says you have got £350 and it doesn't mean anything to you."

This detachment also led some individuals to spend much more than they would like:

- "You are just clicking away and you just see this number increase or decrease. Then when it gets to zero, then you check your real-life bank account at a cash machine or on Internet banking and it says zero. That's when it's like oh shit, what have I done, I've got no money for food."

Additionally, most participants felt more willing to take risks with their winnings than with money in their bank account:

- "It's feels that if it's money that has been won [...] you treat it with less respect than you would with your own money that you have earnt, and you are a lot more risky with it."
- "It was like then money you could spend on gambling that didn't have to come out of an account, so it almost felt free. Even although you had the opportunity to withdraw it and have the cash in your hand if you wanted to it doesn't necessarily feel that way because there is no transaction that has occured."

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This perception of detachment from the funds in their online gambling account influenced several gamblers to be less careful with their spending regardless of whether the money came from winnings or was transferred directly from their bank accounts.

- "I think you are more flippant with the money that is in the online account. I think you see it as a fun account and therefore if you lose it's almost like it's not real money. Whereas if you saw it come in and out of your bank account I think you would see it a lot differently."
- "I guess it desensitises you a little bit, it makes you lose touch because you are just clicking buttons. Whereas, if you have to go to a cashpoint and withdraw say one, two, three hundred, I think you are more likely to stop and think what you are doing."

The way gambling operators handled financial transactions appeared to exacerbate this disconnection from money. This occurred through a combination of:

1. Facilitating one-click deposits which removed friction in the transaction process,
2. Adding friction to the process for withdrawing funds, and
3. Making it difficult to track deposits, losses, wins and withdrawals within the platform.

These themes were commonly raised by all participants, however those with a history of problem gambling were particularly stressed by the frictions operators put in place to withdraw funds. This friction sometimes led them to not withdraw funds altogether or reverse the withdrawal process due to an inability to wait for the funds to reach their bank account. This stark finding demonstrates the potent effect that negative frictions can have upon online gamblers, and suggests more positive nudging may be able to support gamblers.

Operators facilitate easy access to games, but note there is often some friction in taking up Responsible Gambling tools

Our mystery shopping exercise, combined with qualitative research, showed clearly that operators reduce friction in setting up bets, and continuing play. However, it appears that equal resource or incentive may not have been assigned to Responsible Gambling tools. This is likely due to the relative newness of Responsible Gambling as an initiative for operators.

Ease of depositing money

All categories of participants expressed that depositing money was easy and that the operators had removed the usual transaction frictions that many people are used to when dealing with money such as confirmation pop-ups or handling cash.

- "You don't need to go to the shop and you don't need to look after a bet slip, and it just happens automatically. You can deposit money into it just from your phone and there is no need to get cash out and take it into the bookies. It's a reduction in the transaction steps I suppose."
- "They have my card details, and all I have to do is put in my security code, which I know by heart. Also it has got little squares at the top like £5, £10, £20 and it goes up to £100 or something, you just click on how much you want to deposit and it's pretty much instantaneous. [...] you don't get a separate pop-up click saying OK this has been done. It's quite subtle that they confirm the money has been deposited. If you are not paying attention you could feasibly keep depositing money and not realise it has gone through."

Some participants experienced the ease of depositing money as a positive convenience of online gambling whereas others thought it was possibly "too easy" or even "dangerous" that it was possible to easily deposit large sums of money with only a credit card at hand.

- "It's comfort, and if you can't go there and if you don't want to trek halfway across the country, have problems parking and then walk around and rush to put your bet on each time, for some people that's fun and for others it's easier and more fun to sit at home and do it."
- "It's too easy to sit in front of a computer and just keep depositing money into the account and keep spending it; it's too easy"

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Ease of placing bets, and setting up complex bets

Our mystery shopping exercise showed that some operators placed very low levels of friction between interruptive app notifications to suggest a bet, and the bet being placed (see Figure 12). The following series of screenshots illustrates the low levels of friction:
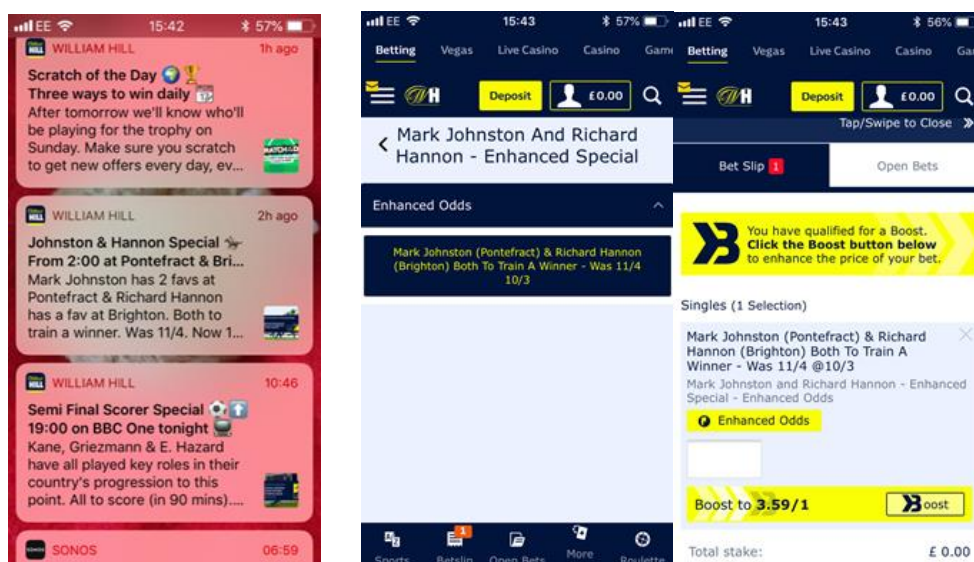

Figure 12. Screenshots related to reducing friction for those placing bets

In the first screen on the left, the phone app notification contains a suggested bet. Clicking on the notification opens the operator app with the bet added to the slip (screen 2). After clicking on the betslip (at the bottom of the app), the gambler just needs to enter the stake in the final screen on the right hand side above. This represents just four clicks from being interrupted on the phone, to having placed a bet.

The interruptive nature of the app notifications that both serve as a reminder of the presence of online gambling platforms while also suggesting a bet - combined with the low friction to placing that bet - means that potentially people who were not even thinking about gambling are prompted and just several clicks later can have placed a bet.

For some operators there are low levels of friction in adding complex bets (accumulators, or 'ACCAs'), and the platform user experience (UX) gives a sense of being heavily optimised to create such compound bets where the gambler is unlikely to be successful.[16]

This example (see Figure 13) shows a website feature that allows easy addition of further football bets. Very complex compound bets can be created, with the potential winnings (in

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this case £332.50) being made more salient than the combined probability of all four bets.
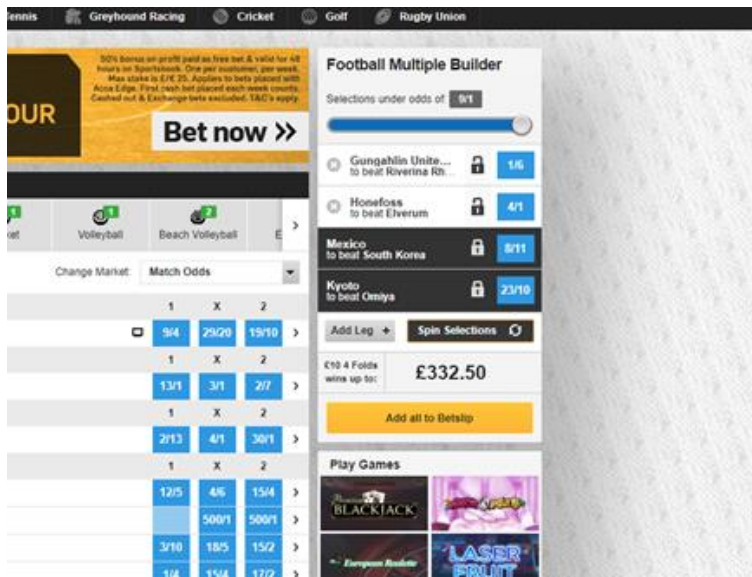
Figure 13. Screenshots related to reducing friction for those setting up complex bets (1)
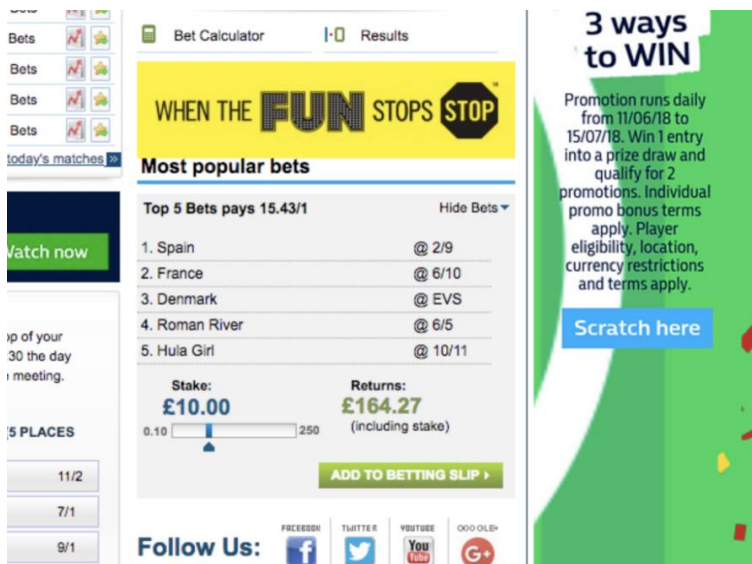
This example (see Figure 14) shows an innovative slider feature that demonstrates how a single stake across 5 popular bets would pay out a large sum. The return is accentuated, and dragging the 'thumb' of the stake slider exponentially increases the returns based on the stake. A single click will add all those popular bets to the betting slip.

Figure 14. Screenshots related to reducing friction for those setting up complex bets (2)

Difficulty withdrawing funds

Our qualitative research highlighted that although operators made placing a bet very easy, there was some friction for users wishing to withdraw funds. One participant who usually placed bets recreationally on a weekly basis illustrated the contrast between the ease of depositing money with the friction of withdrawing funds by explaining the process to the researcher:

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- "I've got it. I'm on the phone interface and at the top right is my profile and if i click on that it says I've got £5 in my account, and then there is a green button that says deposit and a call to action to put money in. To withdraw I have to go on a submenu which is called history. Within history there is buy-in options and - no, that's not even it. Here it is, in members - no, I can't even find it. Here it is on my profile you have to go on bank and there are seven options there and the last option is to withdraw. Then you have to put the expiry date of you card in, amount to withdraw and password."

Most participants noted the friction of withdrawing money, such as having to enter a separate menu to withdraw money or a delay of 3-5 days before the funds were deposited into their bank account. However, for participants with a history of problem gambling this friction was experienced as particularly challenging and sometimes led them to not withdraw funds altogether or reverse the withdrawal process due to an inability to wait for funds to clear into their bank account during a pending period.

These findings suggest that options for cancelling a withdrawal during a pending process or experiencing long delays before funds are deposited in the user's bank account is potentially more harmful for vulnerable users and may encourage them to gamble more.

- "You can literally just press one button to cancel the withdrawal and it's instantly back in your account again. The amount of times I've done that I couldn't tell you. It's almost every time I've had 12 hours without gambling [...] then suddenly you have lost all the money."
- During that period of six months when things got quite bad, I was just leaving it in [the online account] almost all the time."

This finding was also borne out by our mystery shopping exercise. We found that the process of withdrawing funds from the gambling account to an online wallet was relatively easy and friction free - a small number of clicks were required to do this (notwithstanding a slight complication around hypothecated wallets, see later in this report for details).

However, a number of operators offered a 'reverse' feature that allows the gambler to reverse the withdrawal for a period of time before it is completed (see Figure 15). This can be done with a single click. On one occasion when withdrawing funds, the operator informed

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us that we had up to six hours to reverse the transaction. For problem gamblers attempting to withdraw money this might represent a period of temptation, and our qualitative research suggests that many gamblers cannot resist the temptation to withdraw.
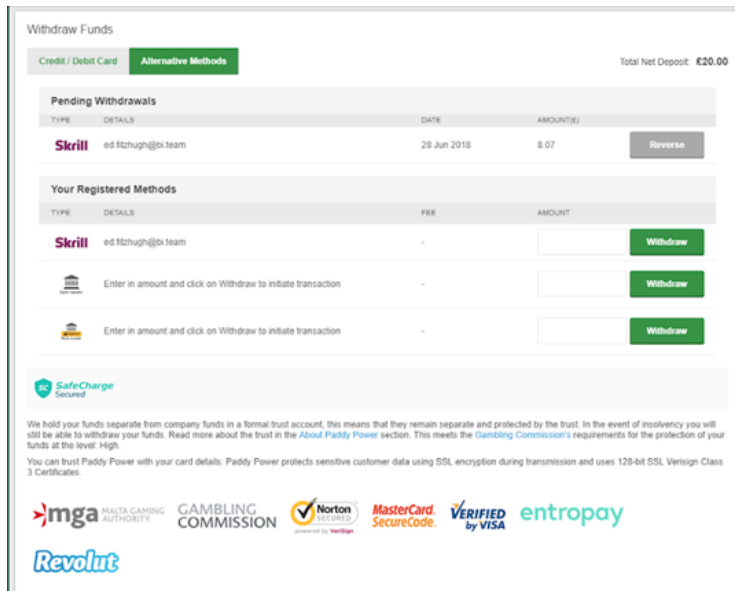
Although some operators offered the ability to disable the 'reverse withdrawal' feature, this feature was enabled by default. One operator had a withdrawal 'floor' of £15, and would not permit withdrawals of less than this amount.

Difficulty tracking and recording transactions in online gambling

In our qualitative study, participants found it difficult to track the deposits, wins, losses, and withdrawals in their online account. They expressed this as a negative aspect of online gambling and several participants perceived it as a risk factor for spending more money than they intended.

- "They make it very difficult on the website which I think is very bad. They make it very hard the way they organise [operator name] website to keep track of how much you deposit and how much you win. I can't remember the exact details but it is very difficult to work out from there so I would do that myself [...] by a spreadsheet."
- "In play for me was just too exciting, too dangerous, too fast [...]. You can't keep track of it so even if you win thirty five and take thirty pounds out you are going to bet that

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five and put another tenner in . So you can't track your winnings how much you have done."

While some operators have removed friction associated with placing a bet, they had not gone as far in removing friction around Responsible Gambling tools. In some cases, it was necessary to first locate the part of the website, and then set up the Responsible Gambling tools. For example, some operators featured prominent links to Responsible Gambling in their site top navigation. Often these linked to pages that contained information about Responsible Gambling tools, without actually directly linking the user to the tools. Additionally, the Responsible Gambling pages sometimes contained a description of how to navigate to or find the Responsible Gambling tools, without actually linking to them.

Anchoring in online environments can encourage higher levels of play

Anchoring effects in deposit processes

Anchoring and adjustment describes a tendency for choices to be influenced by a suggested reference point. In the context of a decision, merely being exposed to an arbitrary high or low number (which becomes an anchor, or reference point) can influence subsequent numerical estimates or choices in the direction of the anchor point.[17,18] This phenomena has been widely researched in the context of charity donations, where the presence of a higher or lower anchor has been shown to influence subsequent donations amounts in a similar direction.[19]

Our mystery shopping suggested a number of ways that the deposit and withdrawal processes might present relatively high numbers that work as implicit suggestions or anchors, and potentially increase the amounts that gamblers deposit compared to how much they may have intended.
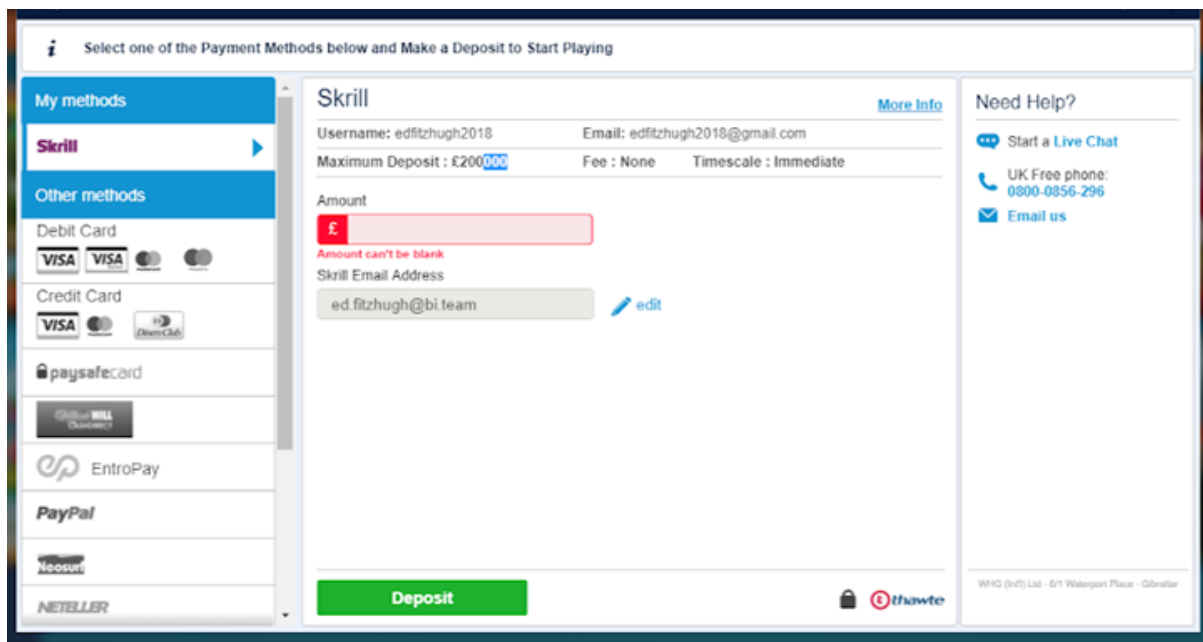
Figure 16. Screenshots related to anchoring effects in deposit processes

For example, when making an account deposit, a maximum deposit of £200,000 is specified (see Figure 16). While this is much, much higher than the typical deposit for many gamblers, this figure is likely to act as an anchor and therefore increase the average amount deposited.

Anchoring effects in deposit limits

Similar anchoring effects may have some influence on the context of setting account deposit limits (a limit on a maximum they can deposit over a given time period) (see Figure 17). When presented with options, the mere presence of a very high daily limit option (up to £100,000) might influence gamblers to set a higher daily limit than they would otherwise have done.
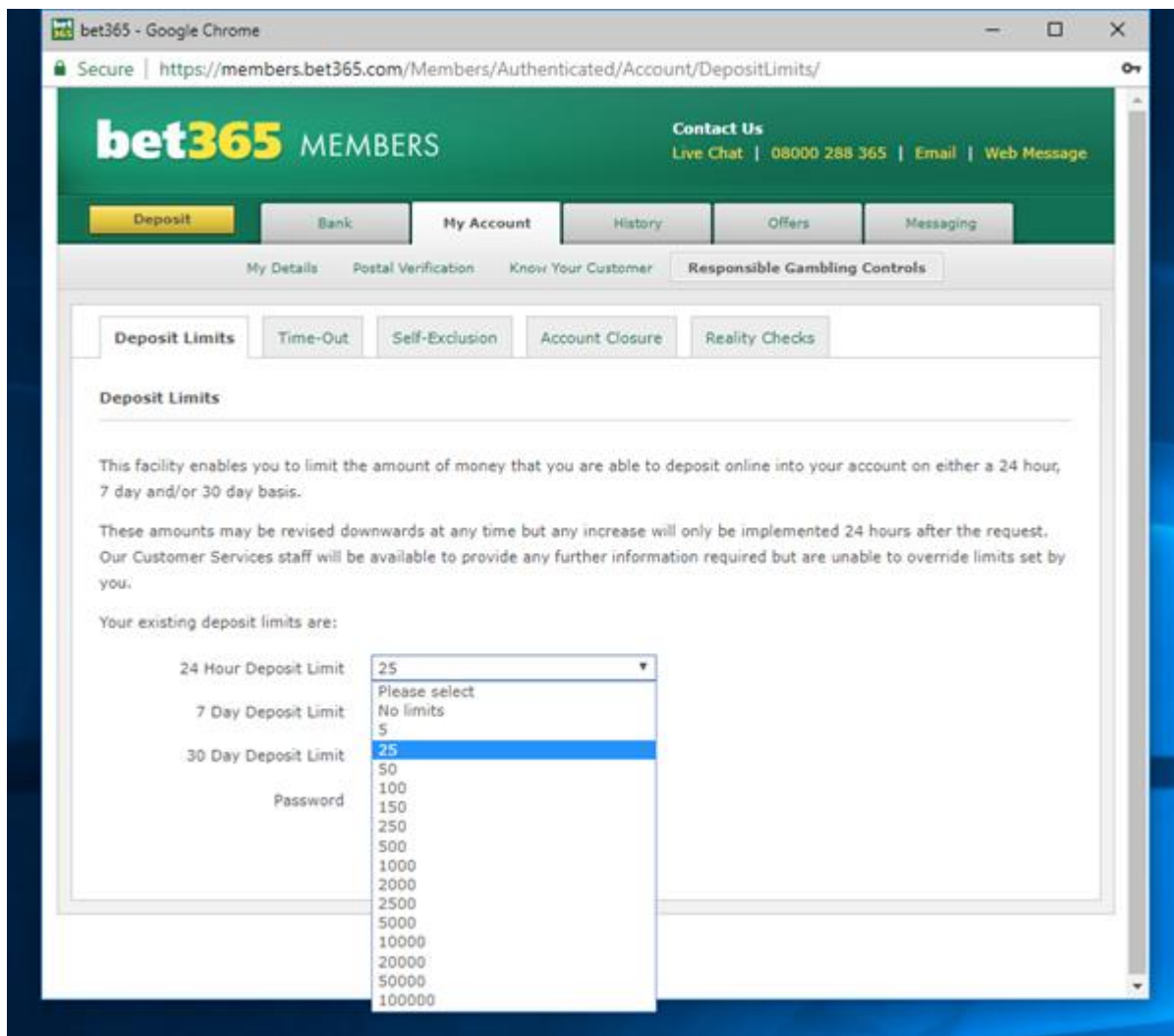
Figure 17. Screenshots related to anchoring effects in deposit limits

The use of defaults in online environments

Previously staked bets as the default option

We know that people have a broad tendency to 'go with the flow' of pre-set options such as defaults. For example, the roll-out of automatic pension savings (with the option of opting out) as opposed to opt-in schemes saw large increases in the number of savers. In this way, how operators choose what pre-set options are displayed when consumers are making decisions about the size of their deposit, their deposit limits or bet-size, will have an important impact on behaviour.
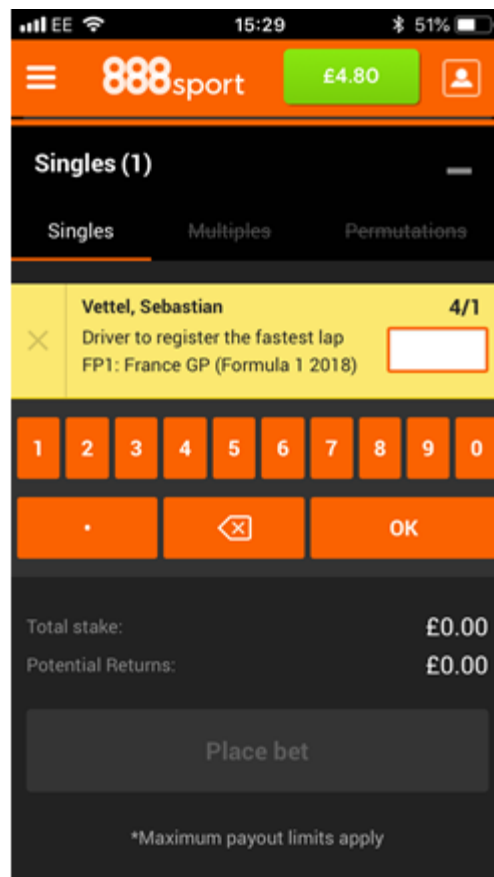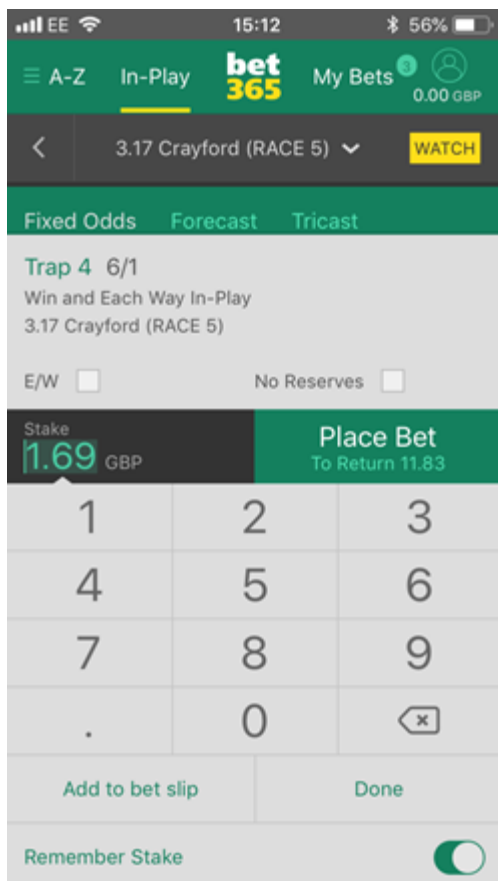
Figure 18. Screenshots related to previously staked bets as a default option

The app interface on the left (see Figure 18) has a 'Remember Stake' feature such that the previously placed bet becomes the default suggested amount for the next bet that is placed. The 'Remember Stake' feature can be disabled with the toggle box, but is activated by default. In contrast, not all operators deploy such a feature - the app to the right hand side above requires the gambler to enter the stake each time.

Our qualitative research shows that operators will often provide a set of pre-set options or defaults for deposit amounts (e.g. "£50" "£100") next to a free text box for the customer to enter their desired amount. Since individuals tend to be heavily influenced by the presence of previously presented information (also known as 'anchoring'), even if a gambler chooses to reduce the deposited amount to one that is lower than the pre-set option, the default is still likely to influence how much is chosen to be deposited.

How targeted marketing messages attempt to move users between games

Over the course of the two-week mystery shopping exercise, each researcher received approximately 470 promotional messages. Both researchers observed a strong tendency for these promotional communications (particularly emails) to push users towards casino and slot type games. While our early betting sessions focused only on sports betting, we observed heavy on-site advertising and emails promoting play on casino and slots; games with predictable and profitable payouts by operators (see Figure 19).
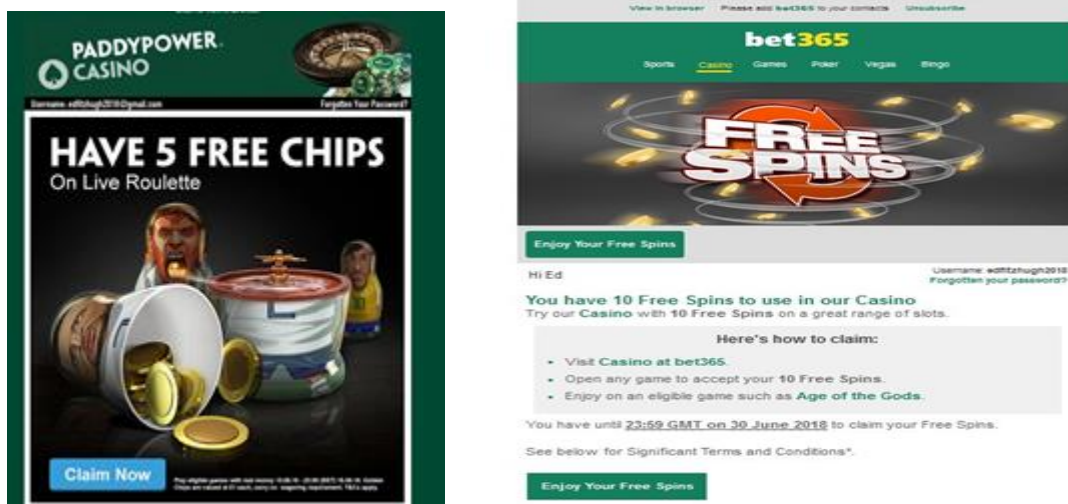
Figure 19. Screenshots related to messaging encouraging varied game play

Qualitative research suggests advertising encourages gambling,[20,21] and promotions sent to problem gamblers may both increase the urge to gamble while providing an inducement and easy route to the gambling sites.[22,23] When signing up for new accounts, operator offers often involve onerous and complicated terms and conditions.

Other subtle features of the online environment which may increase risky play

Live betting and 'cash out'

Some operators have a strong push towards encouraging live sports betting, and cashing in and out of bets while matches are still in play.
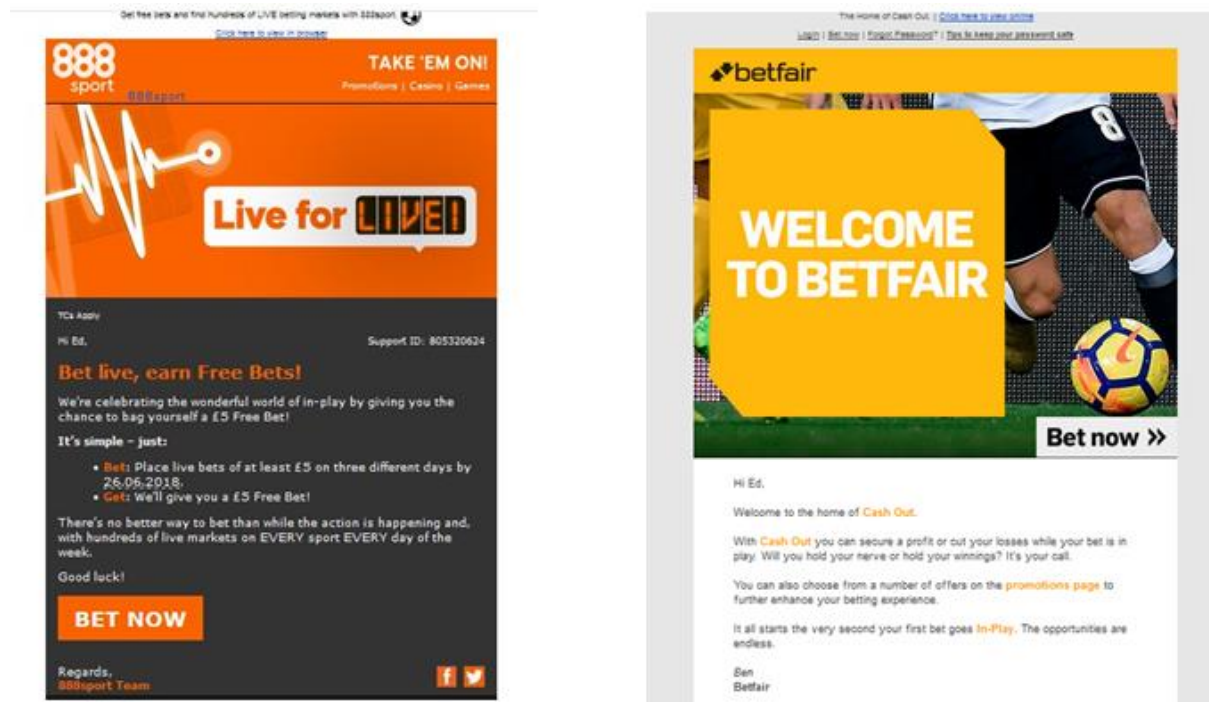
Figure 20. Screenshots related to live betting and 'cashing out'

One operator also sent high volumes of notifications as updates on a match that bets had been placed on (see Figure 20). These live updates, combined with encouragement to cash in and out of bets could encourage the high volumes of betting that were found to be associated with problematic gambling and high PGSI scores.

Hypothecated wallets

Early research in the emerging field of behavioural economics suggested that rather than money being fundamentally fungible, spending can be influenced by explicit and implicit budgets.[24] Assigning money to different accounts, and labelling these accounts in particular ways can influence behaviours in both positive and negative ways. For example,

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hypothecating salary income into 'buckets' such as rent money, utilities, food budget etc can help people to stick to person budgets and manage their income, by creating a 'mental account', or psychological allocation, for how that particular pot of money ought to be spent. However, the same principle might also be deployed in ways that lead to less optimal outcomes. Allocating money into different pots according to different gambling types, and presenting these allocations to gamblers in a way that suggests the money is hypothecated, the operator might encourage the gambler to spend the money on that type of gambling, as opposed to (for example) withdrawing the funds. We found that some operators divided the account balance into hypothecated sub-wallets, based on game types.
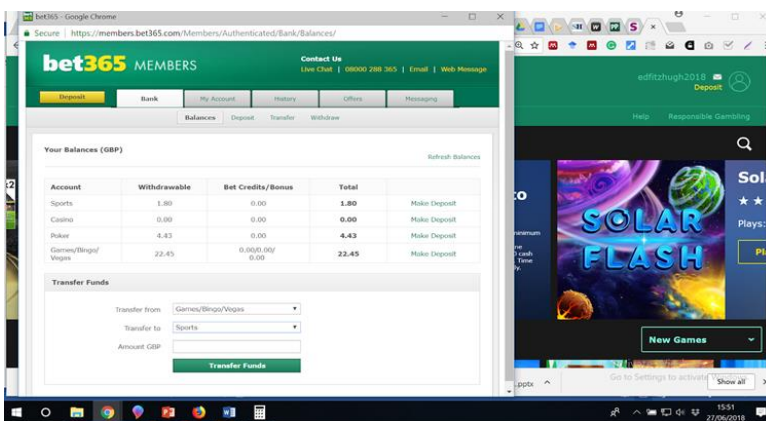
One operator divides available balance into four wallets: sports; casino; poker; games/bingo/vegas (see Figure 20).

Figure 21. Screenshot related to hypothecated wallets

Another operator hypothecates between the main balance, and poker balance (see Figure 22).

Figure 22. Screenshot related to hypothecated wallets

Dividing an overall balance into smaller sub-balances might also have the effect of making the sum seem smaller, and potentially less worthwhile to withdraw. Additionally, the mere existence of small amount of friction in moving money between different wallet types might discourage movement and withdrawals, and encourage spending on that type of gambling.

On some operator platforms, there may be logistical or practical reasons for hypothecating the balance between wallets (for example different games sit on different software platforms), and the gambler may even have chosen which of the wallets to place funds into - but we should also recognise the subtle influence a mental account may have in encouraging people to spend money on particular game types rather than, for example, going ahead with a withdrawal.

So far, this report has covered how operators currently identify risky play, and how we can use data science to better understand risky play in online environments. We then described how behavioural science applies to risky play, drawing on our qualitative study, mystery shopping exercise, and literature review.

In this section, we will summarise our main hypotheses, and detail how we've tested some of these with two large online operators.

Recommendations for those seeking to reduce risky play, and encourage responsible gambling

Our hypotheses broadly cover consideration of context and messaging, reducing user's detachment from 'real money', changing defaults and reducing or increasing friction where appropriate, and reflection on dissociative states.

Considering the context of the individual

- Any limits on time or money spent on online gambling would need to consider the wider context the the individual faces, such as their general financial situation and social circumstances, in order to be meaningful but not restrictive.

Improving messaging

- Messages that encourage internal management of gambling limits should be explored. These could include, for example, prompts to set a withdrawal strategy.

Reducing detachment from 'real money'

- Targeting interventions at the various factors that contribute to detachment from funds in the online gambling accounts could be explored to reduce risky play.
- In particular, messages that increase how 'real' the funds feel to the user should be included in any attempt to reduce risky play. These could consist of, for example, users agreeing a default amount of winnings to be automatically transferred to their bank account, to better connect the user.

Changing defaults

- Behavioural nudges that increase risky play, such as defaulting stakes and minimum deposits, should be removed. It may be beneficial for users to be required to

manually type in the amount they wish to deposit, rather than being presented with a high default which they then must adjust.

Reducing or adding friction

- Adding friction to the action of depositing funds into online gambling wallets should also be considered, as this would allow for engagement of System 2 and may discourage users from making repeated and large deposits. It may also be helpful to increase the friction to those bets placed with a few clicks, directly from an advert.
- Reducing the friction of withdrawing money from online gambling accounts (e.g. by making the process more visible) may reduce continuous risky play. In particular, we advise removing pending periods where withdrawals can be cancelled, and reducing the time lag between withdrawing funds and the money being deposited into the user's bank account.
- Further, Responsible Gambling tools should be very easy to access.

Considering dissociative states

- Given that it is harder to monitor and control behaviours when in a state of high arousal or in a dissociative ('hot') state, having gamblers limit their future time or money whilst in a 'cold state' may be effective.
- To further support responsible gambling, these self-imposed limits on play should be difficult to change.

As an additional recommendation, we advise encouraging more transparency in transactions within the gambling platform may also be effective. For example, operators could implement easier tracking of deposits, wins, losses, and withdrawals, to help users better understand their own gambling behaviour.

Exploratory trials conducted by BIT

With the above hypotheses in mind, BIT conducted two randomised controlled trials. Below we provide a summary of both of these trials as evidence for BIT's ability to work with operators, and to deliver the work outlined in our bid for Phase 3b of the programme.

Introduction and summary

BIT ran one trial in partnership with Sky Betting and Gaming (SBG) and another with bet365: the overall objective was twofold. The first aim was to test whether behavioural interventions

can increase uptake of Responsible Gambling tools such as deposit limits[1], reality checks[2], cool-offs[3] or self-exclusions[4]. The second aim was to test whether BIT could work with operators to design and deliver robust trials in a live business environment. Rather than testing more comprehensive changes to the online gambling environment, BIT worked within operators' existing processes and made changes to the messages currently targeted at those identified as risky players by the operators' risk models.

Our main results across both trials suggests that making it easier for users to access Responsible Gambling tools is an effective way of increasing uptake. We do not observe any effects of providing users with feedback on their gambling behaviour or with prompts to reflect on their gambling. This picture is complicated slightly by our exploratory analysis in the SBG trial where we observe a moderate significant effect of the prompt to reflect on the uptake of cool-offs. This suggests that people considering using Responsible Gambling tools may be susceptible to different behavioural interventions, but further research is required to draw any firm conclusions.

While our objective was not to influence gambling behaviour itself, we did measure it and found that there was no effect of taking up Responsible Gambling tools on subsequent gambling behaviour. However, these are indicative results as they are based secondary analysis with small samples. The rest of this report is structured as follows. First, we describe the behavioural interventions we tested and the evidence behind them. We then give an overview of both of our trials, including the existing processes for intervening with risky players, our interventions, the trial design and the results. We conclude with a discussion of the findings from both trials.

Research

The selection of behavioural interventions for our pilot trials was informed by our wider exploratory work aimed at understanding the drivers of risky play and interventions aimed at reducing or preventing it, described earlier in this report. We initially identified a long-list of

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[1] Deposit limits can be applied by users to limit the amount of money that they can deposit into their account. They can be set for different time periods and cannot only be decreased but not increased during that period.

[2] Reality checks are a pop-up alert that appears as a reminder once a user has been logged into their account for a specified period of time. The user then has the option to click 'logout' or close the pop-up.

[3] Cool-offs can be applied by users to take a break from gambling by locking themselves out of their account for a short period of time (typically 1-30 days). They cannot be removed.

[4] Self-exclusions can be applied by users to lock themselves out of their account for longer periods of time (typically 1-5 years). They cannot be removed and once in place operators typically try to stop users from opening new accounts with them.

approaches that we then narrowed down in an internal think group. We selected concepts based on their expected impact and fit with the operators' communication channels.

Behavioural Concept	Explanation	Operator	Reason for selection
Social norm feedback	Perceived social norms have a powerful effect on people's behaviour, yet people often under- or overestimate how common particular behaviours are. Research shows that pointing out that most people perform a desired behaviour (i.e. highlighting a social norm) can be an effective way of encouraging people to adjust their behaviour in line with the norm.[5]	SBG & bet365	We hypothesise that risky players may disregard Responsible Gambling messages for a range of reasons. First, they may believe that it is common to gamble as much as they do, even when it is not. Social norm feedback, e.g. highlighting that an individual's gambling behaviour is rare, has already showed promise in gambling intervention research.[6] [7] Moreover, Responsible Gambling messaging is generally fairly pervasive and risky gamblers may believe that all or most users receive such pop-up messages or emails. Therefore, social norm feedback could be an effective intervention strategy.
Reducing friction	The effort required to perform an action often puts people off. Reducing the effort required, for example by reducing the number of steps in a process can increase behaviours such as uptake of services.[8]	SBG & bet365	Our research showed that there were clear opportunities for reducing friction in operators' existing processes, for example by guiding interested users straight to Responsible Gambling tools.
Self assessment	Gambling is associated with lack of self-awareness, due to a narrowing of attention and dissociation.[9] [10] Creating opportunities for self-reflection, through questions,	SBG	Pop-up messaging to encourage self-appraisal has been shown to impact gambling related thoughts and behaviour.[11] We therefore considered self-assessment to be an interesting option, particularly if used in

[5] Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. Journal of Consumer Research, 35, 472-82.
[6] Testing normative and self-appraisal feedback in an online slot-machine pop-up in a real-world setting. *Frontiers in psychology*, *6*, 339.
[7] Marchica, L., & Derevensky, J. L. (2016). Examining personalized feedback interventions for gambling disorders: A systematic review. *Journal of behavioral addictions*, *5*(1), 1-10.
[8] The Behavioural Insights Team. 2014. EAST: Four simple ways to apply behavioural insights.
[9] Powell, G. J., Hardoon, K., Derevensky, J., & Gupta, R. (1999). Gambling and risk taking behaviour of university students. *Substance Use and Misuse*, 34 (8), 1167– 1184.
[10] Diskin, K. & Hodgins, D.C. (1999). Narrowing of attention and dissociation in pathological video lottery gamblers. Journal of Gambling Studies, 15, 17-28.
[11] Monaghan, S. M., and Blaszczynski, A. (2010). Impact of mode of display and message content of responsible gaming signs for electronic gaming machines on regular gamblers. *J. Gambl. Stud.* 26, 67–88. doi: 10.1007/s10899-009-9150-z

			conjunction with social norm feedback to provide additional meaning. However, when used alone we expected it to be less impactful than social norm feedback or reducing friction. We therefore only tested it in the final arm of the SBG trial.In our bet365 trial, where we can link users straight to Responsible Gambling tools, we only test Social Norm Feedback and Reducing Friction as well as a combination of the two.

Table 2. Overview of behavioural concepts selected for operator trials.

SBG Trial

Existing process

In order to identify risky players SBG uses a 'self-exclusion propensity' model. This predicts how likely someone is to self-exclude as a proxy for risky play. The inputs into the model are behaviours such as bet value, betting frequency and time spent playing. Users who are flagged by the model receive three emails on Day 1, Day 14 and Day 30 after being flagged. The first email introduces the concept of responsible gambling to users. It suggests that betting should be an enjoyable activity and offers three simple tools (deposit limits, cool-offs and self-exclusions) to those who feel like this is no longer the case. The second and third introduce the different RG tools to the user in greater detail. There are links in these emails, but they direct users to a landing page describing the respective tools rather than to the actual tools themselves on the platform.

Intervention

We tested three different behaviourally-informed messages to SBG's Day 1 email, and compared them to the existing email. This means that people that were flagged received one of four messages (referred to as 'arms' of the trial): images of our messages can be found in Appendix V.

- **Arm 1 - Existing Day 1 email**

- **Arm 2 - Feedback**: We highlighted to recipients that their behaviour differs significantly from that of most users ("You have spent much more time or money than most SkyBet users. Only 1% of customers are receiving this message."). We also

provide an infographic depicting this. Because different markers feed into the risk model, we cannot give more specific feedback.

- **Arm 3 - Feedback & Reducing Friction**: In addition to providing feedback, we aimed to make it easier for users to access the RG tools. Unfortunately, it was not technically possible to provide a link that directly guides users to the tools. As a second best option, users were sent to the SBG platform where the main toolbar containing icons linking to the three different tools was popped out on the right hand side. In our message, we also provided a screen grab of the toolbar and highlighted the tools to help users locate them once redirected. However, users still had to perform an additional click to get to the tool.

- **Arm 4 - Feedback & Reducing Friction & Reflection**: In addition to feedback and reducing friction we asked users to take a moment to reflect on their gambling ("Take a moment to consider how you feel about your gambling. Are you still in control? Has the fun stopped?").

We had concerns about using one single email subject line across all arms as a low opening rate could undermine the entire trial. We therefore tested a different subject line in each arm:

- **Arm 1:** Responsible Gambling by SkyBet

- **Arm 2:** Just 1% of users are getting this email

- **Arm 3:** You have gambled much more than most SkyBet customers

- **Arm 4:** Has the fun stopped?

Trial design

The trial ran for the month of July, and included 12,711 unique customers. Users were randomly allocated to one of our messages or the control on Day 1 and we measured uptake of Responsible Gambling tools 5 days after. We did not include Day 14 and Day 30 messages in the trial for simplicity.

We had two primary, and four secondary outcome measures:

- Primary:
  - Uptake of an Responsible Gambling tool within 5 days of receiving email
  - Email open rates

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- Secondary:
  - Amount of money deposited following email
  - Number of logins following email
  - Amount of time spent on platform following email
 - Net winnings following email

Results

We saw a moderate and statistically significant increase in take up of RG tools in Arm 3 (Feedback & Reducing Friction) and Arm 4 (Feedback & Reducing Friction & Reflection) of 1.6 percentage points (a 23.2% relative increase). This suggests that reducing friction was the only effective way of increasing uptake.
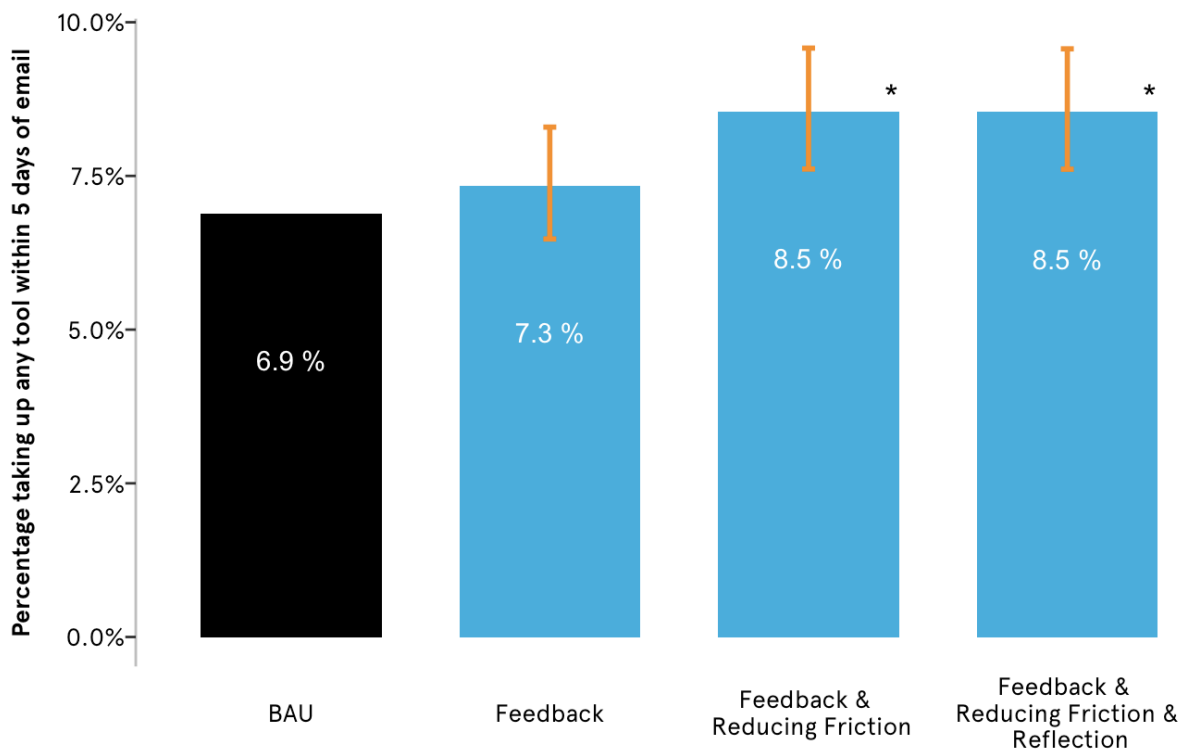
N = 12711
** p<0.01, * p<0.05, + p<0.1
Primary Analysis

We also saw a large and statistically significant effect on open rates in Arm 3 (Feedback & Reducing Friction) of the trial with the subject line "You have gambled much more than most SkyBet customers". Given the significantly higher open rates in Arm 3, more users were
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directly exposed to this intervention than in other arms, which could have had an impact on uptake in that arm. However, BIT has run a large number of email trials and in our experience there is often a weak correlation between open rates and actual behaviours such as click through or uptake of services.
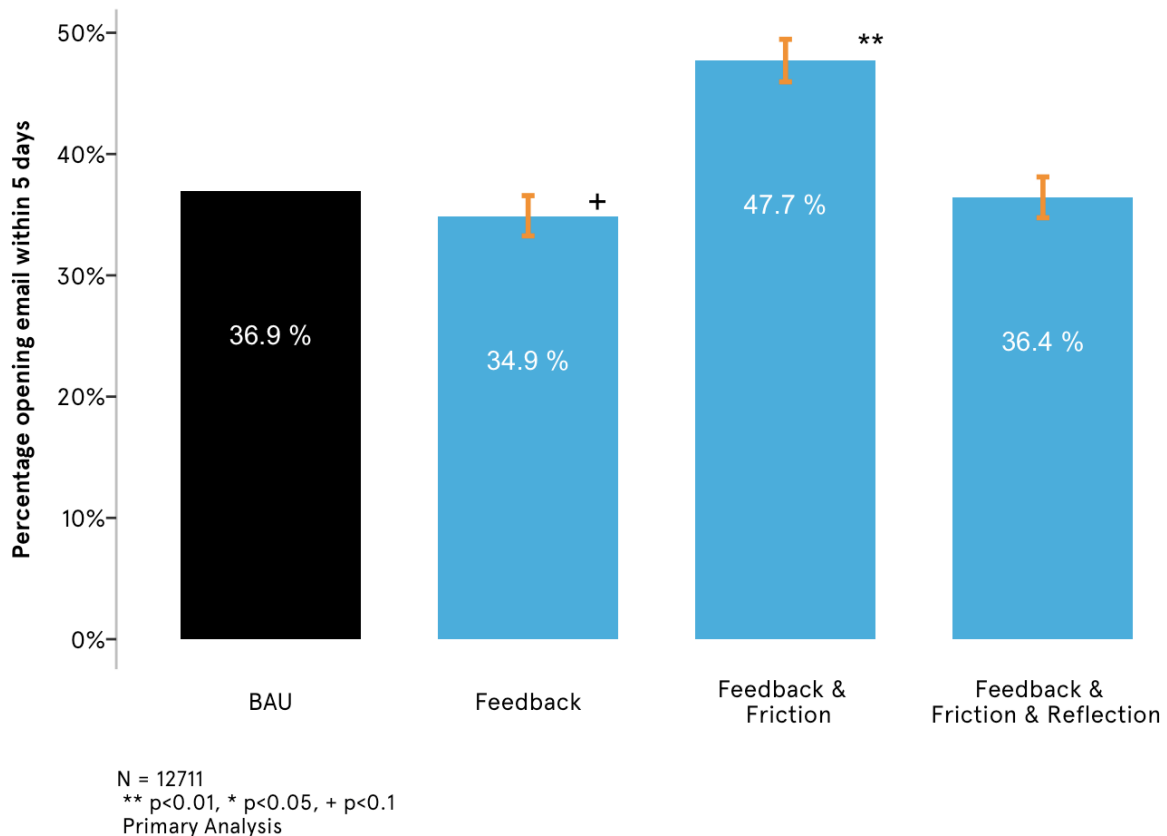
N = 12711
** p<0.01, * p<0.05, + p<0.1
Primary Analysis

We observed no effect in any of our trial arms on users' gambling behaviour (amount deposited, wins/losses, number of logins and time spent playing). However, testing the effectiveness of RG tools in changing gambling behaviour was not a primary objective of this trial and drawing firm conclusions on these measures would likely have required a larger sample size.

We also conducted exploratory analysis to take a more detailed look at the association between the different trial arms and the uptake of each of the individual RG tools. We did not observe a significant increase in the uptake of self-exclusions in any of our trial arms, but observed a small statistically significant increase of 1.1 percentage points (a 33% relative increase) in Arm 3 (Feedback & Reducing Friction) on the uptake of deposit limits.

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Y-axis: Percentage setting a self exclusion within 5 days of email

Bars:
- BAU: 0.9 %
- Feeback: 1.1 %
- Feedback & Friction: 1.2 %
- Feedback & Friction & Reflection: 1 %
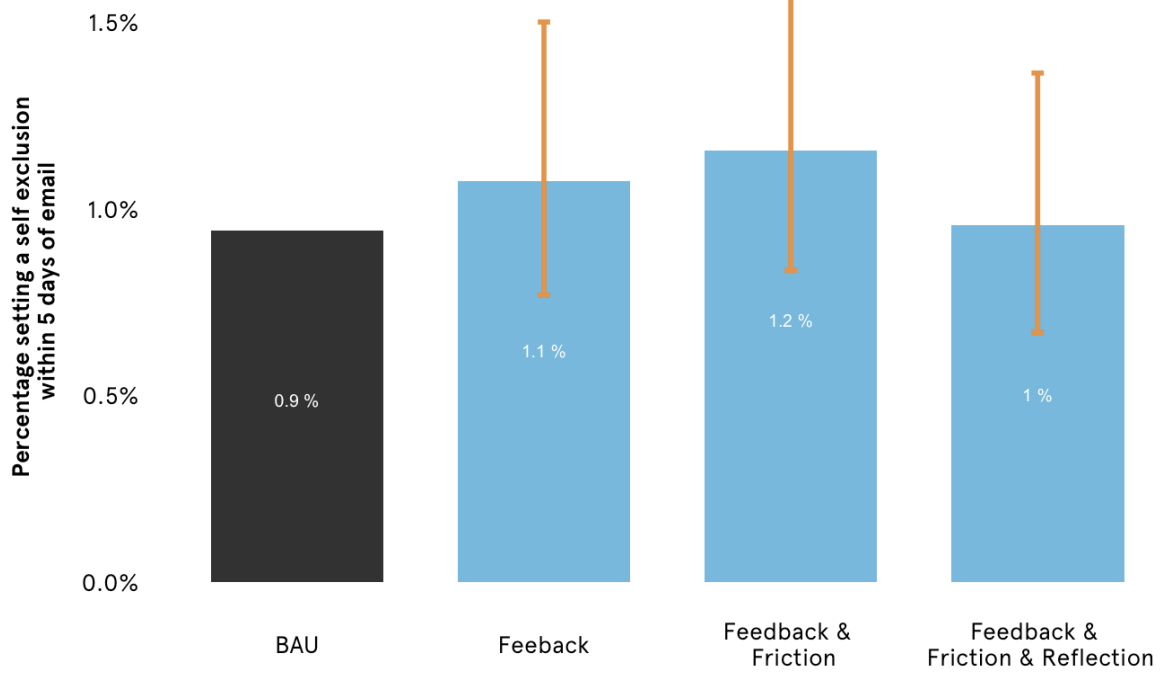
N = 12711
** p<0.01, * p<0.05, + p<0.1
Exploratory Analysis

We observed a small statistically significant increase of 1.1 percentage points (a 33% relative increase) in Arm 3 (Feedback & Reducing Friction) on the uptake of deposit limits.

Y-axis: **Percentage setting a deposit limit within 5 days of email**

Bars:
- BAU: 3.3 %
- Feeback: 3.4 %
- Feedback & Friction: 4.4 % *
- Feedback & Friction & Reflection: 3.6 %

N = 12711
** p<0.01, * p<0.05, + p<0.1
Exploratory Analysis
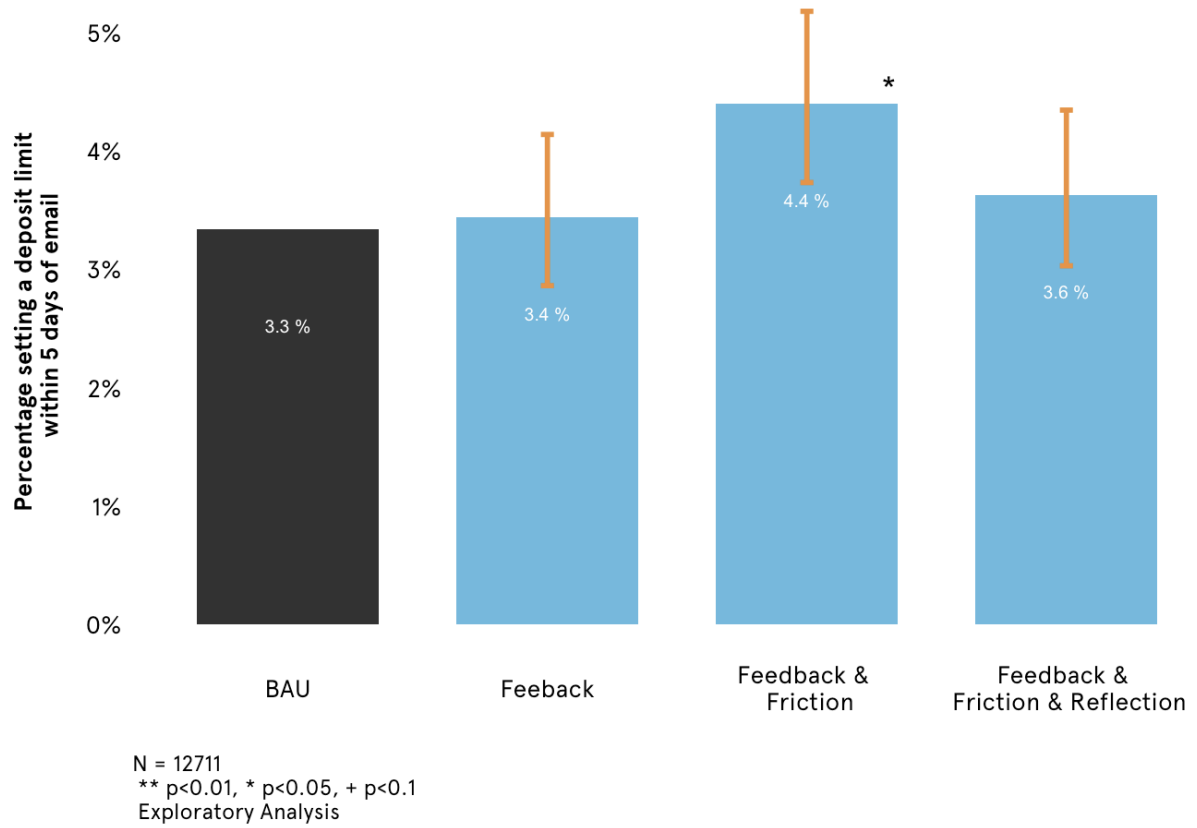
We also tested take up of cool-offs. In Arm 4 (Feedback, Reducing Friction & Reflection) we observed a statistically significant 1.8 percentage point increase (a relative increase of 64%) on the uptake of cool-offs.

Percentage setting a cool off within 5 days of email

Category	Value
BAU	2.8 %
Feeback	3 %
Feedback & Friction	3.3 %
Feedback & Friction & Reflection	4.6 % **

N = 12711
** p<0.01, * p<0.05, + p<0.1
Exploratory Analysis
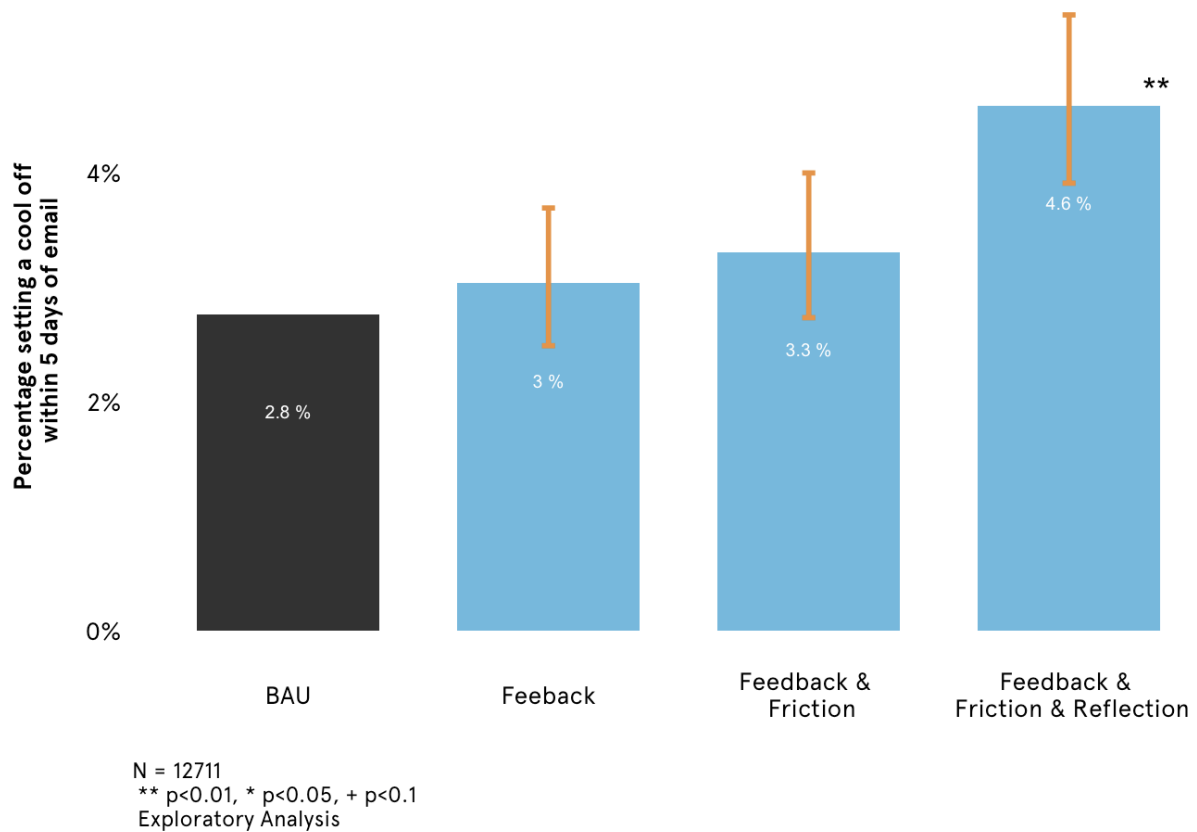
bet365 Trial

Existing process

bet365 uses a range of behavioural flags to identify risky players. If a user is flagged by the system they receive a pop-up message when they log in again. These messages currently guide users to a longer in-platform message, which provides responsible gambling information and links to relevant Responsible Gambling tools. However, this message is long and the links to Responsible Gambling tools are not immediately visible resulting in some friction for users considering taking up a Responsible Gambling tool.

Intervention

As part of this trial we used two flags to identify players for intervention: use of multiple payment methods and time spent playing.[12] We tested three different behaviourally-informed changes to bet365's existing pop-up message, using that message as a control. Our

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[12] Each behaviour is tracked over different time periods and different thresholds apply for each period.

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messages varied depending on which behaviour caused the user to be flagged to the system. Images of our messages can be found in Appendix V.

- **Arm 1 - Control**

- **Arm 2 - Reducing friction:** We provided recipients with a direct link to the relevant Responsible Gambling tool.

- **Arm 3 - Social norm feedback:** We highlighted to recipients that their behaviour differed significantly from that of most users (e.g. "You have spent more than X hours playing over the last Y days. Most customers played for no more than Z hours in that time."). The message is tailored to the behaviour in question (time spent playing or use of payment methods) and we compare their behaviour to that of the median customer.

- **Arm 4 - Reducing friction + feedback:** Both of these approaches combined.

The Responsible Gambling tools that we highlight to users is based on which behavioural flag they have activated. We use deposit limits for multiple payment methods and reality checks for time spent playing.

Trial design

This trial ran from early July to mid-August, and included 7,564 unique customers. The trial had the following outcome measures:

- Primary:
    - Uptake of any RG tool within 5 days of receiving message
    - Uptake of specific RG tool within 5 days of receiving message
- Secondary:
    - Amount of money deposited following message
    - Number of logins following message
    - Amount of time spent on platform following message
    - Amount of staked following message
    - Net winnings following message

We observed a large and statistically significant increase in take up rates of Responsible Gambling tools in Arms 2 (Reducing Friction) and Arms 4 (Reducing Friction & Feedback) at 5.3 percentage points (a 79.1% relative increase) and 5.1 percentage points (a 76.1% relative increase), respectively. This suggests that reducing friction is driving these results.

N = 7564
** p<0.01, * p<0.05, + p<0.1
Primary Analysis
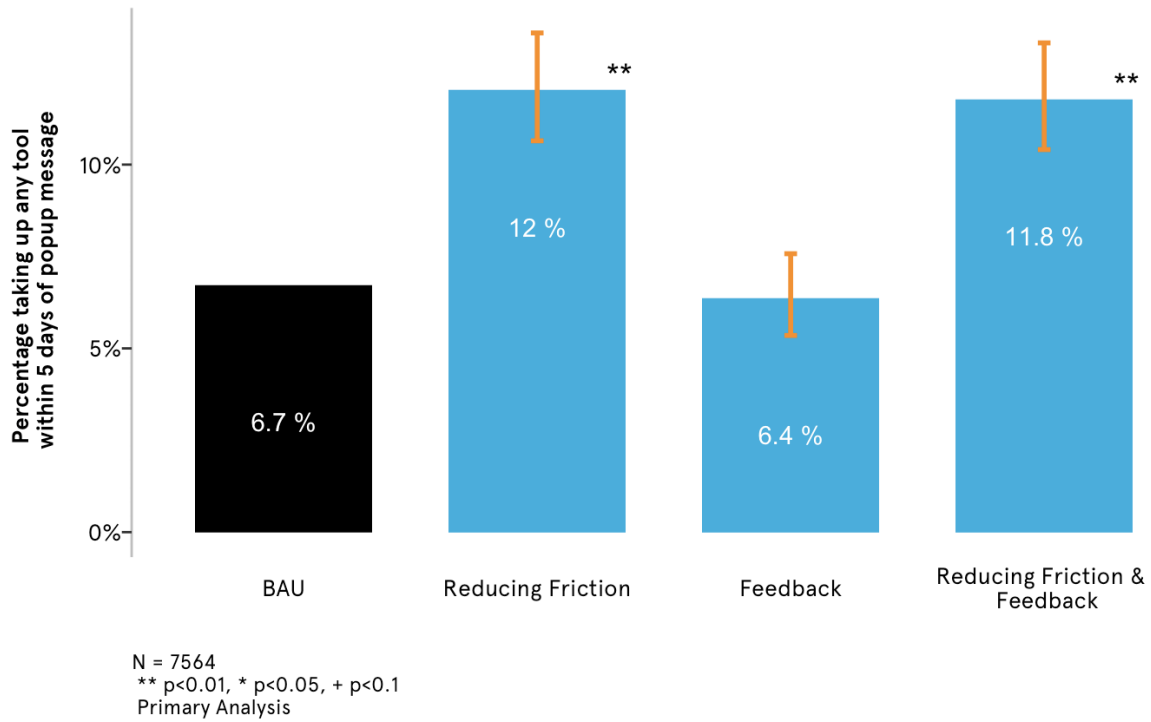
Although far more users took up or reduced a deposit limit than reality checks, the direction and size of the effect in Arms 2 and 4 was similar for both behaviours.

Top chart:

Y-axis: Percentage setting or decreasing Deposit Limits within 5 days of multiple payment methods popup message

- BAU: 14.5 %
- Reducing Friction: 20.3 % *
- Feedback: 14.2 %
- Reducing Friction & Feedback: 19 % +

N = 2097
** p<0.01, * p<0.05, + p<0.1
Primary Analysis

Bottom chart:

Y-axis: Percentage taking up Reality Checks within 5 days of time spent playing popup message

- BAU
- Reducing Friction: 5.7 % **
- Feedback
- Reducing Friction & Feedback: 5.7 % **
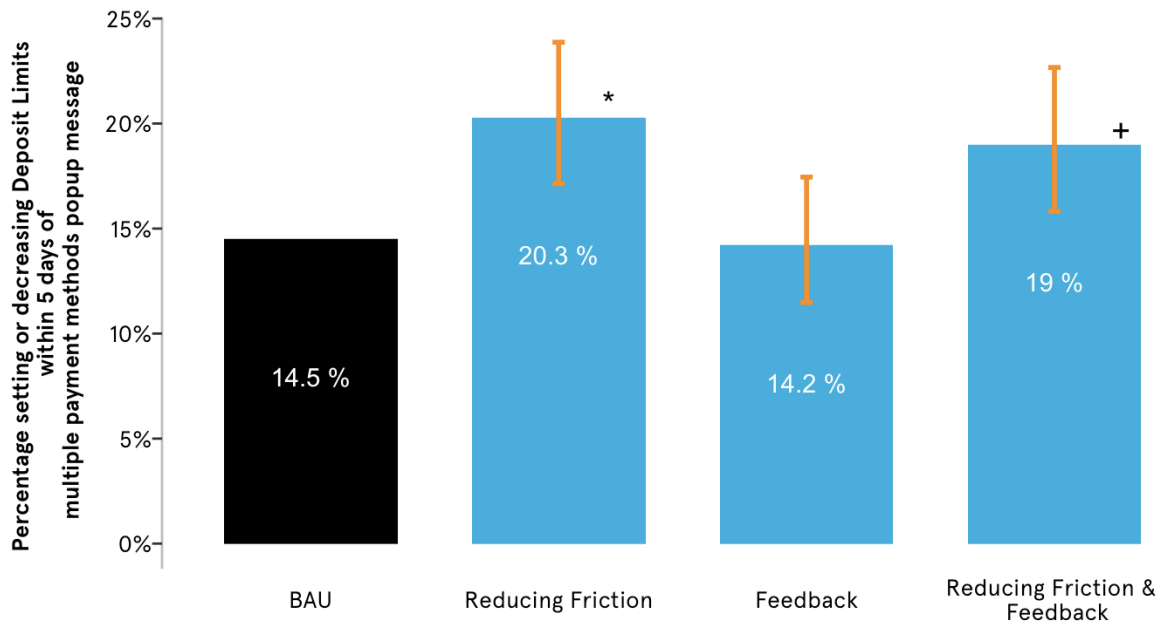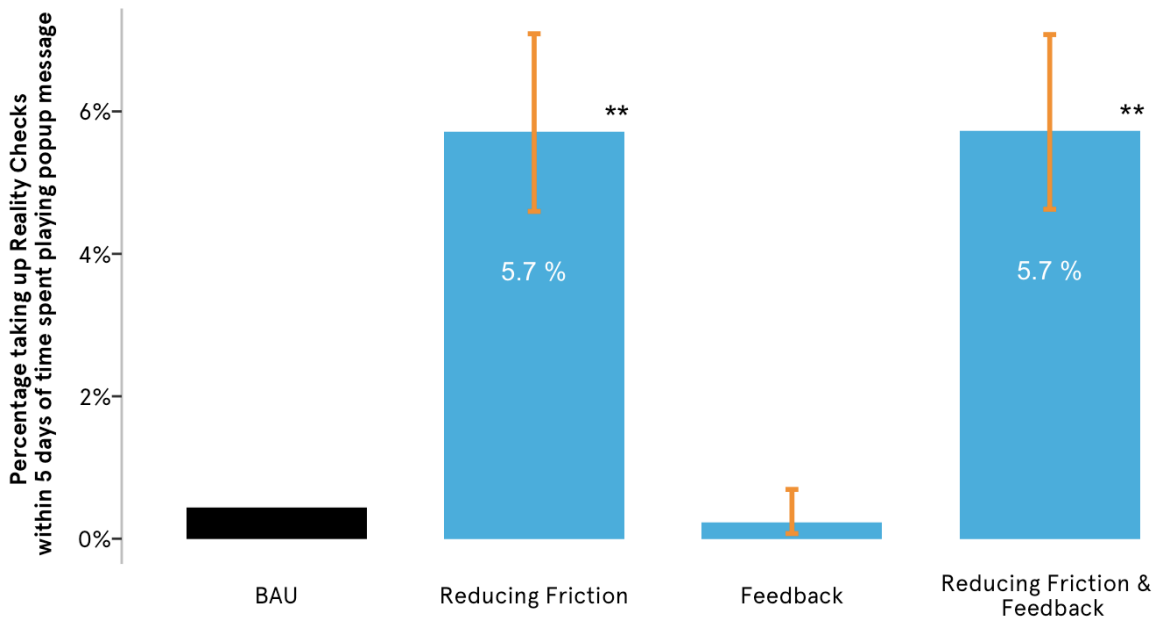
N = 5467
** p<0.01, * p<0.05, + p<0.1
Primary Analysis

We observed no effect in any of our trial arms on users' gambling behaviour (amount deposited, wins/losses, number of logins and time spent playing).

Discussion

Our main analysis across both trials suggests that making changes to how Responsible Gambling messaging is presented to customers can increase uptake of RG tools.

Although social norm feedback is a well-evidenced intervention for changing behaviour in many other contexts and there is indicative evidence that it can reduce risky play, we do not observe an effect in either of our trials. We also do not see an effect of prompting users to reflect on their behaviour in the main analysis of the SBG trial.

However, the trials suggest that reducing friction is an effective way of increasing uptake of RG tools and that the effect is proportionate to the degree of friction removed from the customer journey. In the SBG trial it was not possible to embed links in emails that would directly guide users to the RG tools. Instead, we sent users to the platform and provided instructions for where to find the tools in the toolbar that was visible on the right hand side. However, users still had to perform an additional click to get to the tool. We only marginally reduced friction and observed a small but significant effect. In the bet365 trial, on the other hand, where users were already logged into the platform when receiving the pop-up message and where we could guide them straight to the tool, we observed a much larger effect.

Nevertheless, this picture is complicated slightly by our exploratory analysis. In the SBG trial we observed a moderate significant effect of the prompt to reflect on the uptake of cool-offs. At the same time, we did not observe any differential effect of our interventions on the uptake of deposit limits compared to reality checks in the bet365 trial. This suggests that people considering using Responsible Gambling tools may be susceptible to different behavioural interventions, but further research is required to draw any firm conclusions.

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In this final section, we will provide a high-level overview of suggested approaches to the next phase of work.

In this section, we draw upon:
- Our review of operator practices
- Our qualitative research
- Our literature review
- Our mystery shopping exercise
- Our two randomised controlled trials

High-level overview of approaches to be tested in Phase 3b

We will now propose approaches to reducing risky play and encouraging Responsible Gambling in online environments, for consideration in Phase 3b. This is a very high-level summary, to be further developed after discussion with the GambleAware steering group.

A focus on only high risk users

We propose a focus on only those users at high risk of problem gambling. As described earlier in this report, around 92% of those who gamble experience no harm. These users fall into the 'safe play' category, shown in Figure 23.
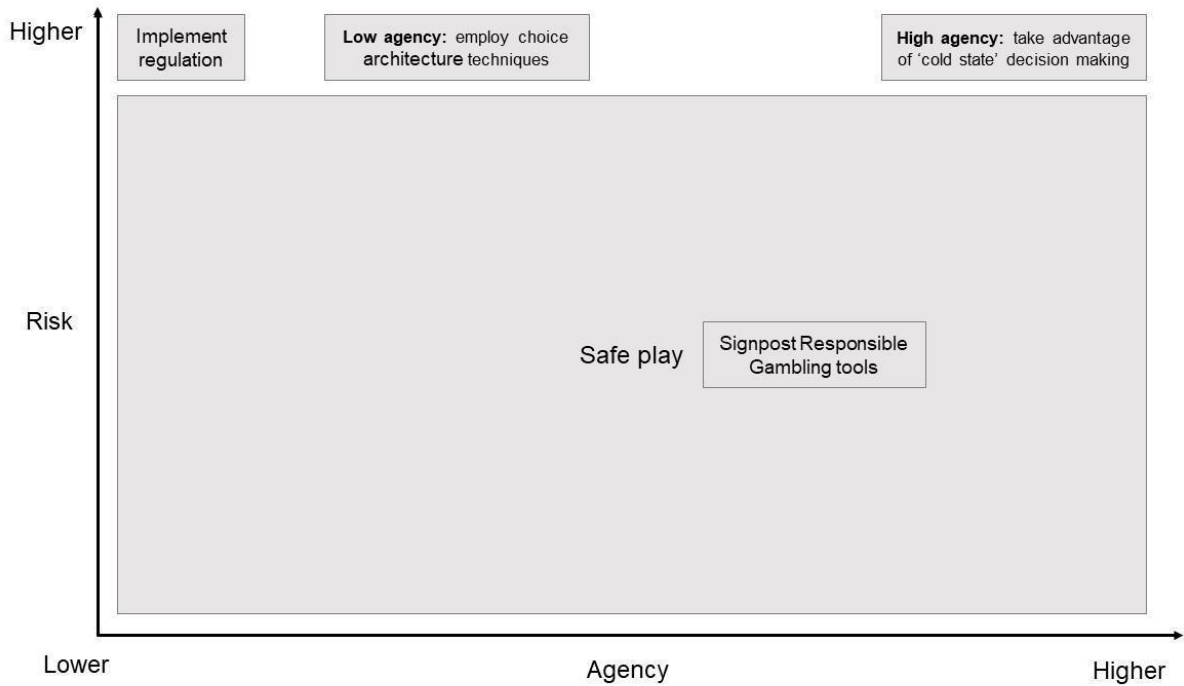
Figure 23. Complex relationship between risk of problem gambling and user agency, and the intervention approaches suggested

For those exhibiting recreational gambling, or safe play, we would suggest that operators continue with usual practice, signposting to Responsible Gambling tools and using existing algorithms to monitor play. We have instead focused our attention on intervention approaches to reduce risky play in those categorised as 'high risk' in Figure 23.

Identifying high risk users

To identify those exhibiting risky play, we propose a three-stage approach:

1. First, utilising collaborating operator's own algorithms to highlight those at risk. As we describe earlier in the report, operators use a number of factors which correlate with self-exclusion, and we would first seek to explore the utility of these models to flag those upon which to intervene.

2. Second, we'd hope to broaden the above-mentioned algorithms to include those previously on the threshold of 'at risk'. This would allow for a more preventative approach (particularly relevant for those with low levels of agency), intervening on those players likely to be problem gamblers before the problem behaviour begins.

3. Third, we'd explore a bootstrapped model, developed by BIT's data science team. This would be personalised for a specific operator, and would ideally include user-provided sociodemographic data (e.g. job role, salary band) in addition to spend data.

We suggest that intervention approaches targeting only these users be implemented, as per the following sections.

Working across all players

This approach could be described as classic behavioural economics, employing 'nudge' techniques to reduce risky play. As previously discussed, we suggest implementing a slightly lower risk threshold for these interventions. Based on our earlier mapping exercise (see Figure 7), we propose adjusting the choice architecture of an operator's website at key touchpoints along the user journey.

Touchpoint	Adjustment
User deposits money	• Adjust anchoring (i.e. remove or lower suggested deposit) • Remove hypothecated wallets
User places bet	• Lower default bet • Make odds of winning more salient than potential earning
User is pushed to move between games	• Reduce advertisements that sit alongside games • Remove targeted offers that appear in push notifications and emails
User accesses Responsible Gambling tools	• Reduce friction (i.e. reduce the number of clicks required, ensure user is directed straight to Responsible Gambling tool)
User withdraws money	• Ensure money is immediately withdrawn from site • Remove option to reverse withdrawal
Player self-excludes	• Cease all marketing once a user has self-excluded

Table 3. Overview of suggested adjustment to touchpoints along the user journey

Targeting those with high agency

This approach builds on our earlier discussion of dissociative states of play. Interrupting users during periods of engrossed play is increasingly challenging, particularly given the nature of an online environment, which can allow for continuous, mindless play. These periods of play can be tracked in real time using existing operator systems. We propose taking advantage of the periods of time when users are not in this 'hot state', but instead are in a 'cold state' and may be amenable to making Responsible Gambling decisions. This could be done by both strengthening existing mechanisms, and setting up hot state 'social triggers', whilst the user is in a cold state.

Strengthening existing mechanisms
This could include, for example:

- Encouraging users to set deposit limits and maximum bets relative to own salary
- Enforcing short breaks in play
- Offering alternatives to play (e.g. free access to mobile games, such as 'Candy Crush')

Setting up 'social triggers'

When in a cold state, users could be asked to:

- Pre-record message to oneself to be played back when in a hot state

- Provide a photograph of something meaningful, to be presented to them whilst they're in a hot state (e.g. photograph of a friend or family member)

- Provide contact details of a friend or a family member, whom they would like notified when their gambling behaviour becomes problematic

We recognise that key to this approach is determining the optimal time at which users should be contacted. For this, we could mirror marketing times, or consider implementing these interventions during existing Responsible Gambling conversation or in the period following a loss.

Outcome measures

To ascertain whether the proposed intervention approaches have been effective, we suggest the following outcome measures:

Primary outcome

Our primary interest would be a reduction in risky play. This would be demonstrated via a reduction in current spend relative to prior spend, and a reduction in the variance on spend relative to prior variance (i.e. how sporadic a user's spend behaviour is).

Secondary outcomes

Secondary outcomes of interest would include time spent on site, type of games played, and uptake of Responsible Gambling tools. In addition, we would look to explore process evaluation measures (which would be dependent on the intervention implemented). Measuring the harm caused by risky play is beyond the scope of Phase 3b; but has been addressed in BIT's bid for the Patterns of Play work.

Based on the six strands of research conducted, we hypothesise that the above-described intervention approaches will reduce risky play and encourage use of existing Responsible Gambling tools. We propose testing this in further randomised controlled trials as part of Phase 3b, commissioned by GambleAware.

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Appendix I. An introduction to the Behavioural Insights Team

BIT started life inside No. 10 Downing Street as the world's first government institution dedicated to the application of behavioural sciences. We are now a social purpose organisation, still partly owned by the UK Government, whose mission is to help organisations and governments to design policies or interventions that can encourage, support and enable people to make better choices for themselves and society.

The following factors make BIT uniquely placed to support GambleAware apply behavioural insights to risky play in online gambling:

- **Applying behavioural science to policy.** We have been recognised globally as the leading institution integrating behavioural theory into public policy. Although BIT has not yet worked on reducing gambling-related harm, we have undertaken a range of relevant projects (including running trials in online environments, and the provision of timely messages). For example, our work with Public Health England and DrinkAware demonstrated that appearance-based messaging increased the use of an alcohol self-monitoring tool.
- **Academic rigour.** BIT is staffed by a combination of experienced psychologists, economists, and policy makers. We also have an academic panel, which includes Prof. Richard Thaler, author of *Nudge,* and Prof. Theresa Marteau, Director of the Behaviour and Health Research Unit. BIT has published its work in leading journals, such as *The Lancet, The Journal of Public Economics,* and *PLoS One.*
- **Implementation skills.** As well as academic rigour, BIT has a track record of working with partners at the local and national level to implement ideas in practice. A core part of BIT's methodology is to integrate its interventions into existing infrastructure and processes, thus minimising the impact on partner organisations. In addition, we have experience in scaling successful interventions, such as our JobCentre Plus approach, which is now used throughout England.
- **Measurable results.** BIT has been at the forefront of the movement to increase the use of randomised controlled trials in governments across the world. We have run more RCTs in a few years than all the rest of the UK government, combined, in its history (around 500). As a consequence, BIT can point to high-quality evidence of the results it has produced through its interventions.

Appendix II. An overview of BIT methodology

In this report, we bring together the findings of six research strands designed to explore how behavioural insights might be used to reduce risky play (see Figure 24). These comprised: a literature review, a data science analysis, a review of existing operator practices, a mystery shopping exercise, a qualitative study, and two randomised controlled trials. We explain each of these in more detail below.
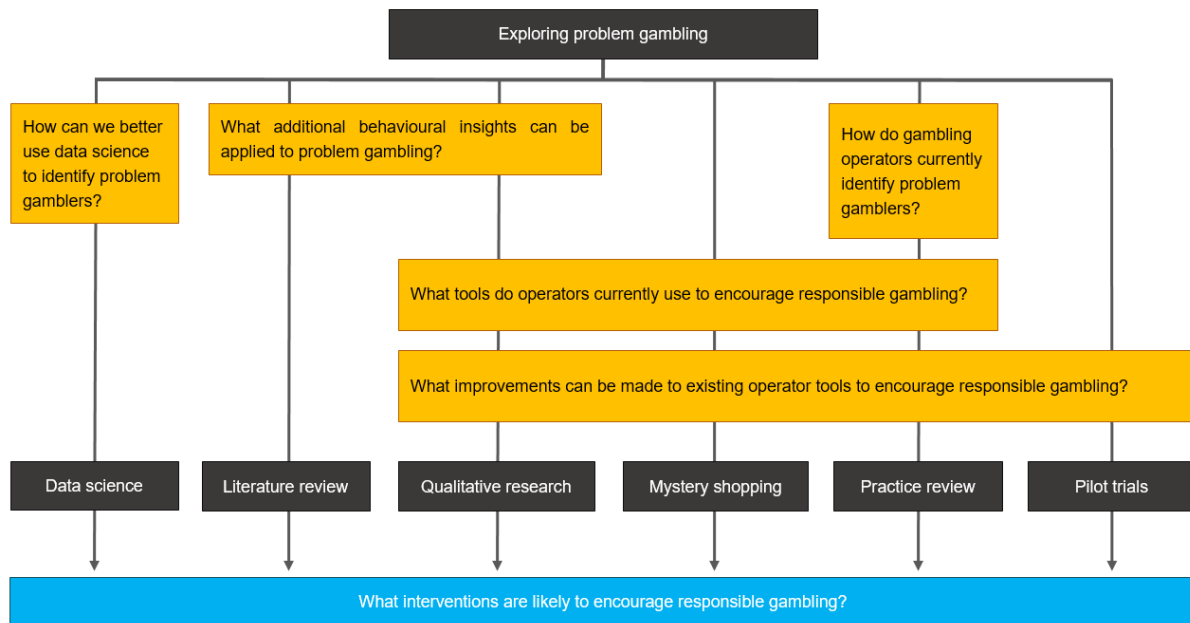

Figure 24. Overview of methodological approaches used.

A **comprehensive literature review** was conducted, which aimed to identify the key behavioural factors that influence gambling behaviour, to inform behavioural interventions to reduce risky play. In this strand, we explored gambling trends in the UK, before reviewing how problem gambling is best defined, conceptualised and measured. We examined the key features of remote gambling that influence gambling behaviour, and consider the effectiveness of behavioural interventions to reduce risky play and encourage responsible gambling. This review is available as Appendix III.

We also completed an extensive **data science** analysis of four operators' data. We used gradient-boosted decision trees, a state-of-the-art algorithm that can discover complex relationships between data and an outcome to understand whether problem gamblers could be identified from their play data. This work furthered our understanding of the behaviours that are most related to risky play, and the correlation between these behaviours and a user's Problem Gambling Severity Index score.

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We conducted a **review of existing operator practices** designed to encourage responsible gambling and reduce problem gambling. This work serves to enhance BIT's understanding of extant approaches, and inform intervention development.

We also completed a **mystery shopping exercise**, conducting pseudo-ethnographic research to better understand the user experience. This comprised two members of BIT staff registering with six operator websites, and gambling over a period of two weeks. Gambling was at low financial levels and the aim was to understand user experience rather than responsible gambling activities by operators. Researchers installed relevant gambling applications on their mobile phones, and engaged in slots, sports betting, and casino games across operators. Each researcher received typical marketing from operators, including pop-up and push notifications on their phones, text messages, and email communications. The mystery shopping exercise built upon our review of existing literature, and our review of operator practices, and provided valuable examples of common themes noted across other research streams.

We also conducted **qualitative research** as part of the project. We completed semi-structured interviews to better understand online gambling from the perspective of a regular gambler. We interviewed 16 current gamblers and two professionals treating gambling disorders. We used an inductive, data-driven approach, that allowed patterns of developing themes to emerge organically from the data. In doing so, we were able to uncover new insights into the experiences of online gambling from a variety of user perspectives.

Finally, two **randomised controlled trials** (RCTs) were conducted, to explore a) the feasibility of implementing and evaluating an intervention with an online operator, and b) initial efficacy of possible interventions operators to encourage the take up of responsible gambling tools. These trials drew on core behavioural science principles of feedback, friction, and self-reflection.

Appendix III. The role of behavioural influences in remote gambling and problem gambling

Executive summary

Technological advances mean that gambling is increasingly occurring in remote (online) settings. There are concerns that for an important minority of gamblers, this increased accessibility will increase risky and problematic gambling behaviour.

BIT was commissioned by GambleAware to conduct a literature review to explore the role of remote settings on the development of risky and problematic gambling. We also explore the possible opportunities afforded by these settings to reduce problematic play.

Risky and problem gambling

Problem gambling emerges due to a complex interaction of biological, psychological, and environmental factors. Whilst some gamblers gamble for the increased levels of arousal, others may be more motivated by the induced feelings of dissociation.[13] As gambling severity increases, distorted cognitions around attribution, personal skill and control over outcome, start to appear.[14]

There is a continuum of gambling involvement and gambling related harm, from those who do not gamble and do not experience harm, to those who struggle to control their gambling and experience significant difficulties as a result. Lower ends of gambling severity are characterised by feeling guilty, chasing losses and betting more than one could afford to lose.[15] More moderate forms are characterised by gambling to escape problems, whilst jeopardising relationships and health is more characteristic of high levels of severity.[16]

Psychometric measures of gambling problems tend lack the sensitivity to reliably identify low to moderate-risk gamblers, However, data-scientific methods, which have enabled the identification of problem gamblers using remote gambling data, show promise in being able to identify people (and therefore intervene) before significant harm occurs.

The remote gambling environment

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[13] Griffiths, M. D., Wood, R. T. A., Parke, J., & Parke, A. (2006). Dissociative states in problem gambling. *Current issues related to dissociation*, 27-37.

[14] Fortune, E. E., & Goodie, A. S. (2012). Cognitive distortions as a component and treatment focus of pathological gambling: a review. *Psychology of Addictive Behaviors*, *26*(2), 298.

[15] Holtgraves, T. (2009). Evaluating the problem gambling severity index. *Journal of gambling studies*, *25*(1), 105.

[16] ibid

Gambling behaviour is profoundly influenced by context. Many features of the remote gambling environment will influence gambling behaviour. This includes features that make it easier to gamble such as being easily accessible and low levels of friction on websites when engaging in gambling activities. There are also features that make responsible gambling harder, such as relatively high levels of friction when engaging in activities such as using of responsible gambling tools or closing an account. Furthermore, remote settings have features that make self-monitoring harder such as highly immersive interfaces and lack of tangible currency. Finally, online operators hold large amounts of data on their customers and are able to target communications that aim to encourage increased gambling.

Responsible gambling interventions

Interventions to promote responsible gambling include those providing consumers with information about the product or about the risks of gambling, those that involve using responsible gambling tools as well as pop up messages to help self-control. Information-only interventions tend not to be effective unless information is highly salient, comprehensible and meaningful. Furthermore, voluntary use of pre-commitment tools is low. Barriers to uptake include lack of insight into gambling problems, lack of awareness of the existence of such tools and inconvenience of using them. There is need for more experimental research in real world gambling environments to test the effectiveness of responsible gambling intervention.

Introduction

Half of the UK population have gambled at some point in the last four weeks, and while this is an enjoyable pastime for most there are a minority of people who experience harm as a result of not being about to control their gambling. As gambling increasingly takes place online, GambleAware are interested in how gambling can be made as safe as possible. They have commissioned BIT to carry out the third phase of their extensive programme of work on online gambling. This is a review of the literature to support that work. It aims to identify the key behavioural factors that influence gambling behaviour to help inform behavioural interventions to reduce risky and problem gambling.

Section 1 of this review addresses gambling trends in the UK before reviewing the literature on how problem gambling is best defined, conceptualised and measured in Section 2. Section 3 reviews the key features of remote gambling settings that influence gambling behaviour and Section 4 considers the effectiveness of behavioural interventions to reduce problem gambling and increase responsible gambling. Section 5 concludes this review.

1. Trends in gambling activity in the UK

Summary

- Technological advances mean that gambling is increasingly occurring in remote and online settings
- Whilst for many this greatly increased accessibility will not lead to problems, for some this can increase likelihood of risky and problematic gambling behaviour. This is of concern to governments, gambling charities and wider organisations who work with problem gamblers to many stakeholders

Latest figures show that close to half of the UK population have gambled at some point in the last four weeks,[17] contributing to a healthy and growing gambling industry. Between 2016 and 2017 the industry saw a total gross annual yield (total income minus pay-outs) of £13.8 billion - which is 0.7% higher than the previous year.[18] The most popular forms of gambling, aside from lottery draws (including the National Lottery) and scratchcards, are sports betting,

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[17] Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.
[18] Gambling Commission (2018). Industry Statistics.

horse races and fruit and slot machines.[19] Most people report gambling for the chance of winning, but it is also common, particularly with games, for gambling to be for fun and enjoyment.[20]

With the continued advance of the internet, people are increasingly gambling online. Between 2008 and 2014, the share of the population engaging in online gambling rose from 9.7% to 15.4%.[21] Recent survey figures from the Gambling Commission in 2017 also found that 'in person' rates (whether at bookmakers, casino, arcades, or other venue types) are declining whilst remote gambling is increasing across almost all types of gambling.[22] The online gambling sector now accounts for 34% (£4.72bn) of the total gambling sector,[23] where individuals mostly engage in placing bets (accounting for 53% of the online gambling market), followed by casino games, poker and bingo.[24]

Remote gambling tends to take place in the home on personal laptops, mobile phones or tablets.[25] In this way, remote gambling has opened up the possibility of immediate, 24-hour access to the full range of gambling activities. Governments and industry regulators across the globe have expressed concern that this vastly increased accessibility will lead to an increase in the prevalence of problem gambling.[26] Since there is already evidence that there is a higher proportion of problem gambling in online environments,[27] regulating bodies and the industry are recognising the need for effective identification of, and intervention with, online problem gambling to minimise harm or prevent harm to those at risk.

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[19] Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.
[20] ibid
[21] Thorley, C., Stirling, A., & Huynh, E. (2016). Cards on the table: The cost to government associated with people who are problem gamblers in Britain. *IPPR Report*.
[22] Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.
[23] Gambling Commission (2018). Industry Statistics.
[24]PricewaterhouseCoopers (2011) Global gaming outlook. Available from https://www.pwc.com/gr/en/publications/assets/global-gaming-outlook-2011-2015.pdf
[25] Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.
[26] Gainsbury, S., & Wood, R. (2011). Internet gambling policy in critical comparative perspective: The effectiveness of existing regulatory frameworks. *International Gambling Studies*, *11*(3), 309-323.
[27] Gainsbury, S. M. (2015). Online gambling addiction: The relationship between internet gambling and disordered gambling. *Current addiction reports*, *2*(2), 185-193.

2. Risky play and problem gambling

Summary

- Problem gambling emerges due to a complex interaction of biological, psychological, and environmental factors. Whilst some gamblers gamble for the increased levels of arousal, others may be more motivated by the induced feelings of dissociation. As gambling severity increases, distorted cognitions around attribution, personal skill and control over outcome, start to appear.

- People fall along a continuum from those who do not gamble and do not experience gambling related harm, to those who struggle to control their gambling and experience significant difficulties as a result

- Analysis of item endorsement on questionnaires suggests that lower levels of problem gambling severity is characterised by feeling guilty, chasing losses and betting more than one can afford to lose. More moderate forms of problem gambling can be characterised by gambling to escape problems, whilst jeopardising relationships and health is more characteristic of high levels of severity

- Psychometric measures of problem gambling tend to incorporate a behavioural dimension as well as a harm dimension. Measures tend to have items that identify the end-stages of problematic gambling and there is a need for increased measurement sensitivity to identify low to moderate-risk gamblers

- Data-scientific methods have enabled the identification of problem gamblers using remote gambling data, which potentially enables the identification of people before significant harm occurs

2.1 Defining problem gambling

A wide range of terms exist in the literature to refer to problematic gambling, including 'pathological', 'excessive', or 'disordered' gambling.[28] For the purpose of this review we differentiate between 'gambling disorder', which is recognised as a mental health condition and problem gambling which is a more general term that incorporates subclinical conditions,

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[28] Neal, P. N., Delfabbro, P. H., & O'Neil, M. G. (2005). Problem gambling and harm: Towards a national definition.

where an individual experiences significant negative consequences as a result of gambling.[29]

2.1.1 Problem gambling as a psychiatric disorder

The Diagnostic and Statistical Manual of Mental Disorders (DSM), which is designed for clinicians to assess whether someone meets criteria for a psychiatric disorder, conceptualises gambling disorder as a behavioural addiction.[30] Like other addictions, whether behavioural (such as compulsive skin picking or kleptomania) or substance related, gambling disorder is characterised by a failure to resist an impulse or urge to perform a behaviour that is harmful. The persistent and recurrent engagement with the behaviour then ultimately interferes with functioning in other areas of life, leading to clinically significant impairment or distress. As with other addictions, gambling disorder is characterised by feelings of tension or arousal before performing the behaviour, pleasure or relief at the time of carrying out that behaviour and a tendency over time for the behaviour to be less motivated by positive reinforcement and more by negative reinforcement (relief from a negative or aversive state).[31]

To be diagnosed with gambling disorder according to the fifth edition of the DSM (DSM-5), an individual must display at least four of nine clinical symptoms, which capture the typical features of addiction (see bulleted list below). Those who score only two or three symptoms are considered to be subclinical and may be described as 'at-risk' or 'moderate' problem gamblers. The list of criteria includes:

- having a preoccupation with gambling;
- a diminished control over gambling behaviour;
- repeated unsuccessful attempts to cut back or quit;
- persistent and maladaptive engagement in gambling despite harm to oneself or others;
- tolerance (such as requiring an increased bet size to generate comparable effects);
- withdrawal symptoms (such as irritability when cutting down) and;
- an interference in major areas of life functioning (such as financial debts and jeopardising personal and occupational relationships).

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[29] ibid

[30] American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

[31] Grant, J. E., Potenza, M. N., Weinstein, A., & Gorelick, D. A. (2010). Introduction to behavioural addictions. *The American journal of drug and alcohol abuse*, *36*(5), 233-241.

This mental health approach to problem gambling is useful for clinical diagnosis, and for identifying those individuals most in need of support. However, this approach will not serve the needs of those at risk of developing gambling related problems. For this reason, a broader, more continuous approach to problem gambling is often preferred.[32]

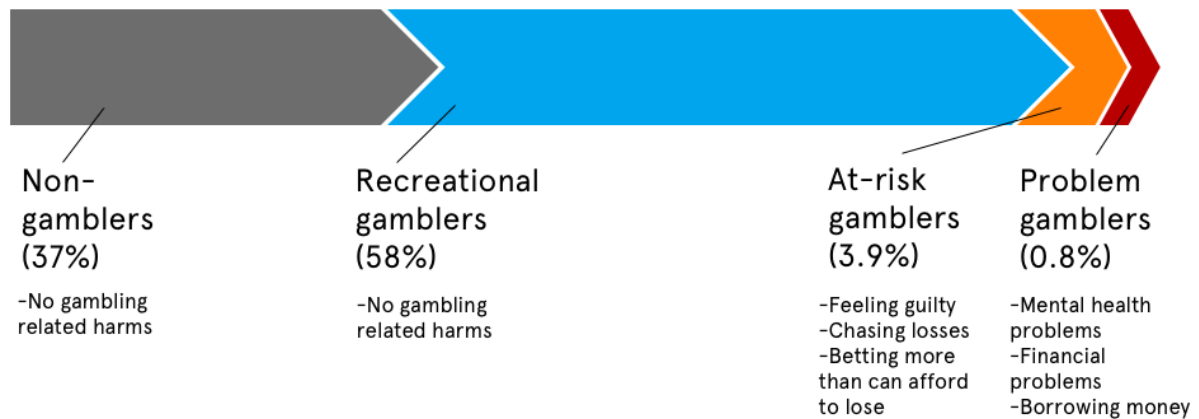## 2.1.2 Problem gambling as a continuum

Non-gamblers (37%)
-No gambling related harms

Recreational gamblers (58%)
-No gambling related harms

At-risk gamblers (3.9%)
-Feeling guilty
-Chasing losses
-Betting more than can afford to lose

Problem gamblers (0.8%)
-Mental health problems
-Financial problems
-Borrowing money

Figure 1: Conceptualisation of gambling behaviour as a continuum[33]

A continuum approach conceptualises gambling behaviours as occurring along a spectrum and individuals can fall anywhere on the spectrum depending on their level of involvement in gambling and the problems they experience as a result (see Figure 1).[34]

At the lowest point of the continuum are those who do not gamble at all and do not experience gambling-related harms. This accounts for 37% of the UK population.[35] Further along the continuum are individuals who gamble recreationally, and may experience gambling benefits, such as fun and enjoyment, and little to no harm.[36] In the UK, this accounts for roughly 58% of the population.[37] As individuals then start to experience an

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[32] Neal, P. N., Delfabbro, P. H., & O'Neil, M. G. (2005). Problem gambling and harm: Towards a national definition.

[33] Prevalence estimates from Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.

[34] Problem Gambling Institute of Ontario. (2016). Level of gambling involvement. Gambling 101. Retrieved from https://www.problemgambling.ca/EN/AboutGamblingandProblemGambling/Pages/LevelofGamblingInvolvement.aspx

[35] Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.

[36] Messerlian, C., Derevensky, J., & Gupta, R. (2005). Youth gambling problems: A public health perspective. *Health promotion international*, *20*(1), 69-79.

[37] Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.

increasing degree of harm related to their gambling, either in their personal, work or social life, they move up along the continuum.[38] These individuals are often conceptualised as 'at-risk' gamblers, and account for 2.5 million people in the UK (approximately 3.9% of the UK population).[39]

Problem gambling describes more severe gambling related difficulties, and affects about 500,000 individuals in the UK (0.8% of the population).[40] These individuals struggle to control their gambling, spending too much money and time on gambling, are likely are to suffer from mental health issues as well as experiencing financial, relationship and occupational difficulties.[41] These individuals are likely to meet criteria for gambling disorder (behavioural addiction) as conceptualised by the DSM-5.[42]

The continuous approach emphasises the importance of the variability in severity that exists both within problem gambling as well as subclinical forms of a disorder, which can be lost with categorical diagnostic assessment. Because of its increased sensitivity, researchers commonly adopt a continuous or dimensional approach to disorders. However, unlike the medical approach to diagnostic assessment, a continuous approach must grapple with greater ambiguity around definitions of what constitutes problem gambling.

In 2005, the Ministerial Council on Gambling in Australia commissioned a literature review of over 150 studies, which also invited feedback from key stakeholders (including clinicians, researchers and regulators), to inform a national definition of problem gambling. The outcome of this research suggested that definitions of problem gambling should contain reference to both gambling behaviours and to harms: "problem gambling is characterised by difficulties in limiting money and/or time spent on gambling which leads to adverse consequences for the gambler, others, or for the community."[43] This is in keeping with empirical evidence that suggests that the problem gambling construct is made up of at least two underlying factors, with some items reflecting gambling behaviour (e.g. such as needing to gamble with larger amounts to get the same excitement), whilst others reflect gambling

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[38] Messerlian, C., Derevensky, J., & Gupta, R. (2005). Youth gambling problems: A public health perspective. *Health promotion international*, *20*(1), 69-79.

[39] Gambling Commission (2017). Gambling participation in 2017: behaviour, awareness and attitudes. Annual Report.

[40] ibid

[41] Griffiths, M. (2014). Problem gambling in Great Britain: A brief review. Report for the Association of British Bookmakers. Available at http://abb. uk. com/wpcontent/uploads/2014/09/Problem-Gambling-in-Great-Britain-A-Brief-Review. pdf.

[42] American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

[43] Neal, P. N., Delfabbro, P. H., & O'Neil, M. G. (2005). Problem gambling and harm: Towards a national definition.

related consequences (e.g. having to borrow money to gamble or pay off gambling debts).[44] [45]

The review also identified over 16 questionnaires of problem gambling.[46] Measures have typically been developed from DSM criteria, which focuses on both gambling behaviours and gambling-related harm. The review found that the 20-item South Oaks Gambling Screen (SOGS) was the most commonly used scale worldwide, which is based on the DSM-3-R criteria.[47] Despite its frequent use the SOGS had been criticised for an over-representation of 'softer' attitudinal and behavioural items, leading to excessive false positives.[48] The 17-item NORC Diagnostic Screen for Gambling Disorders (NODS)[49] is based on DSM-4 criteria (which takes a medical model of addiction approach) and may be more appropriate for use as a diagnostic tool in clinical settings. Unlike the SOGS and the NODS, the 9-item Canadian Pathological Gambling Index (CPGI) has been specifically developed as a measure of community prevalence,[50] and has a 9-item self-assessment version (Problem Gambling Severity Index; PGSI). Both the CPGI and the PGSI have the advantage of brevity (only 9 items) and good psychometric properties, and are commonly used in population-level research. Although the PGSI has been validated in its ability to identify problem gamblers, as is often the case with briefer screening tools, it has been found to be weaker in identifying low to moderate severity.[51] [52]

A weakness of all clinician-assessed and self-report questionnaires is that they require a person to engage in completing the assessment in the first place. From a public health

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[44]Maitland, S., & Adams, G. R. (2005). Assessing the factor structure of the Canadian Problem Gambling Index: Does qualitative stability allow quantitative comparison. A report prepared for the Ontario Problem Gambling Research Centre.

[45] Orford, J., Wardle, H., Griffiths, M., Sproston, K., & Erens, B. (2010). PGSI and DSM-IV in the 2007 British Gambling Prevalence Survey: Reliability, item response, factor structure and inter-scale agreement. *International Gambling Studies*, *10*(1), 31-44.

[46] Neal, P. N., Delfabbro, P. H., & O'Neil, M. G. (2005). Problem gambling and harm: Towards a national definition.

[47] Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American journal of Psychiatry*, *144*(9).

[48] Neal, P. N., Delfabbro, P. H., & O'Neil, M. G. (2005). Problem gambling and harm: Towards a national definition.

[49] Gerstein, D., Volberg, R. A., Toce, M. T., Harwood, H., Johnson, R. A., Buie, T., ... & Hill, M. A. (1999). Gambling impact and behaviour study: Report to the national gambling impact study commission. Chicago: National Opinion Research Center.

[50] Wynne, H. (2003). Introducing the Canadian problem gambling index. *Edmonton, AB: Wynne Resources*.

[51] Miller, N. V., Currie, S. R., Hodgins, D. C., & Casey, D. (2013). Validation of the problem gambling severity index using confirmatory factor analysis and rasch modelling. *International journal of methods in psychiatric research*, *22*(3), 245-255.

[52] Holtgraves, T. (2009). Evaluating the problem gambling severity index. *Journal of gambling studies*, *25*(1), 105.

perspective, this does not enable the identification of those individuals experiencing (or at risk of) gambling-related problems who have not engaged with the relevant services. With the rise of remote gambling, researchers and operators are seeking ways to identify problem gamblers remotely by using their real-time user data. Research using such real-time user data carried out by PricewaterhouseCoopers (PwC) has identified a number of behavioural indicators of risk (associated with higher scores on the PGSI). These include behaviours related to account management (e.g. depositing money more frequently) and betting behaviour (e.g. more bets per day, betting late at night).[53]

Gambling operators are increasingly using data science methods as part of their responsible gambling activities. However, they generally do not have access to PGSI scores for their customers and so approximate this with the risk of self-exclusion. This appears well correlated with risky play and problem gambling.

In summary, depending on the purpose of assessment, there are a range of methods to measure risky play and problem gambling. Most psychometric assessments incorporate both a behavioural dimension as well as a harm dimension. However more recently data-scientific methods have enabled the reliable identification of problem gamblers and risky play using only online gambling activity and comparing it to historic data. Methods taking a behavioural approach, such as those only requiring play data, have the benefit of not requiring self-identification and engagement with services. This means that it is possible to identify a wider group of people and potentially intervene before significant harm occurs.

2.2 Symptom prevalence along the gambling continuum

To better understand qualitative differences in presentation that occur along the continuum of problem gambling, a number of studies have investigated how the prevalence of particular symptoms varies as a function of severity (total number of items endorsed). One study that assessed DSM-4 criteria in a sample of 43,093 adults, found that lower levels of gambling problem severity were characterised by the behaviour of chasing losses, with more moderate presentations being characterised by gambling to escape problems.[54] As individuals endorsed an increasing number of items on the scale, loss of control and

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[53] Remote Gambling Research, Intermin report on Phase II (August 2017) Available at https://about.gambleaware.org/media/1549/gamble-aware_remote-gambling-research_phase-2_pwc-report_august-2017-final.pdf

[54] Strong, D. R., & Kahler, C. W. (2007). Evaluation of the continuum of gambling problems using the DSM-IV. *Addiction*, *102*(5), 713–721.

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jeopardising relationships characterised more severe forms of the disorder. Finally, committing illegal acts to support gambling characterised only the most severe forms.[55]

In another large-scale study, 12,299 responses on the PGSI from individuals who had gambled at least once in the previous year, were used to create a severity index.[56] Items from the PGSI were ranked to indicate the specific types of problems that were more likely to appear as problem gambling severity increased. The items of 'feeling guilty', 'chasing losses' and 'betting more than one could afford to lose' were found to be typical of lower levels of problem gambling severity, whilst 'health' or 'financial problems' and 'borrowing money' were more characteristic of high levels of severity. Although such cross-sectional data cannot demonstrate this, these findings point to a potentially progressive sequence of gambling related problems. It appears likely that due to the nature of gambling odds, as losing streaks begin to occur and losses begin to accumulate, some individuals start chasing losses. Chasing losses then leads to further gambling debts, progressing to more severe consequences.[57]

Longitudinal research provides some evidence for both progression and recovery in problem gambling, by showing that individuals can move in or out of different parts of the spectrum depending on their level of gambling involvement and experience of gambling related harm at any one time.[58] [59] For instance, a large scale cohort study found that 2.7% of low-risk gamblers and 14% of moderate-risk gamblers, as defined by PGSI score, transitioned into problem gambling after four years. In terms of moving in the opposite direction down the continuum, another longitudinal study found that amongst individuals with a lifetime history of problem gambling, 36-39% did not experience any gambling-related problems during the previous year.[60] However, other research has shown that when recovery from problem gambling is defined as the absence of gambling related harms, rather than by only gambling activity, the problem gamblers have a more stable and chronic trajectory.[61] This indicates that whilst problem gamblers can seemingly recover, it might be that this is more a reflection

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[55] ibid
[56] Holtgraves, T. (2009). Evaluating the problem gambling severity index. *Journal of gambling studies, 25*(1), 105.
[57] ibid
[58] LaPlante, D. A., Nelson, S. E., LaBrie, R. A., & Shaffer, H. J. (2008). Stability and progression of disordered gambling: Lessons from longitudinal studies. *Canadian Journal of Psychiatry*, 53, 52–60.
[59] Griffiths, M., Hayer, T., & Meyer, G. (2009). Problem gambling: A European perspective. *Problem gambling in Europe: Challenges, prevention, and interventions*.
[60] Slutske, W. S. (2006). Natural recovery and treatment-seeking in pathological gambling: Results of two US national surveys. *American Journal of Psychiatry, 163*(2), 297-302.
[61] Williams, R. J., Hann, R. G., Schopflocher, D. P., West, B. L., McLaughlin, P., White, N., ... & Flexhaug, T. (2015). *Quinte longitudinal study of gambling and problem gambling*. Ontario Problem Gambling Research Centre.

of their abstinence from gambling and that the accumulation of gambling related harms are harder to recover from. Moreover, there is evidence that there is a high rate of relapse for problem gamblers, suggesting that powerful risk factors exist to maintain an individual's vulnerability.

In summary, gambling can be conceptualised as a continuum of behaviours from no gambling at one end to addiction at the other, with some evidence of symptom progression. However, there appears to be a gap in the literature on the precursors to problem gambling, as measures place greater emphasis on items that identify the end-stages of problematic gambling. There is a need for increased measurement sensitivity to identify low to moderate-risk gamblers, for instance by adding in new items that reflect validated symptoms characteristic of these groups. Further research to identify the additional gambling behaviours and consequences that may mark the initial stages of problem gambling severity would be valuable to aid the detection of gamblers who are approaching the clinical threshold for problem gambling.

2.3 The aetiology of problem gambling

When considering how individuals develop problem gambling behaviours in the first place, it is clear that the aetiology of problem gambling is highly complex. This complexity is captured by biopsychosocial models which acknowledge the interacting role of multiple biological, psychological and cultural factors in the development of addiction.[62]

In terms of biological risk factors, studies show that 50-60% of the variation in risk for problem gambling is accounted for by heritable factors.[63][64] In line with this, gambling problems tend to run in families, with higher concordance rates of problem gambling between identical twins than non-identical twins.[65] In terms of neurobiological risk factors, multiple neurotransmitter systems have been implicated in the pathophysiology of behavioural addictions and substance use disorders. In particular, serotonin, which is involved with inhibition of behaviour, and dopamine, which is involved with learning, motivation and salience of rewards, may contribute significantly to the development of

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[62] Griffiths, M. (2005). A 'components' model of addiction within a biopsychosocial framework. *Journal of Substance use*, *10*(4), 191-197.

[63] Lobo, D. S., & Kennedy, J. L. (2009). Genetic aspects of pathological gambling: a complex disorder with shared genetic vulnerabilities. *Addiction*, *104*(9), 1454-1465.

[64] Xuan, Y. H., Li, S., Tao, R., Chen, J., Rao, L. L., Wang, X. T., & Zheng, R. (2017). Genetic and Environmental Influences on Gambling: A Meta-Analysis of Twin Studies. *Frontiers in psychology*, *8*, 2121.

[65] Slutske, W. S., Zhu, G., Meier, M. H., & Martin, N. G. (2010). Genetic and environmental influences on disordered gambling in men and women. *Archives of general psychiatry*, *67*(6), 624-630.

addictions.[66] Psychological risk factors include the presence of a psychiatric disorder, which is associated with being approximately 17 times more likely to develop problem gambling.[67] Other psychological risk factors include impulsivity and sensation seeking or risk taking.[68] Social and cultural risk factors for problem gambling include having a low socio-economic status and living in disadvantaged neighbourhoods.[69] [70] Research also has shown that individuals who are widowed, separated or divorced,[71] and individuals who begin gambling at a young age are more susceptible to gambling problems.[72]

Given the wide variety of risk factors involved in the development and maintenance of problem gambling, Blaszczynski and Nower (2002) proposed a model that conceptualises three different pathways into problem gambling. Each of the pathways is proposed to have different aetiological underpinnings, and include a behaviourally conditioned pathway, an emotionally vulnerable pathway and an anti-social impulsive pathway.

The model describes a behaviourally conditioned pathway which characterises individuals with no pre-existing psychiatric illness who engage in problematic gambling behaviour primarily because of faulty cognitions related to gambling (such as misunderstanding randomness). For these individuals the variable reinforcement schedules of many gambling activities are a powerful factor in habit formation. Variable reinforcement schedules have been shown to, through the process of operant conditioning, produce states of arousal similar to that induced by recreational drugs.[73] Then with repeated pairings, this arousal is also classically conditioned to stimuli associated with the gambling environment.[74] A second form of reinforcement is the negative reinforcement produced when aversive mood and

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[66] Potenza, M. N. (2008). The neurobiology of pathological gambling and drug addiction: an overview and new findings. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *363*(1507), 3181-3189.

[67] Slutske, W. S. (2006). Natural recovery and treatment-seeking in pathological gambling: Results of two US national surveys. *American Journal of Psychiatry*, *163*(2), 297-302.

[68] Johansson, A., Grant, J. E., Kim, S. W., Odlaug, B. L., & Götestam, K. G. (2009). Risk factors for problematic gambling: A critical literature review. *Journal of Gambling Studies*, *25*(1), 67-92.

[69] Barnes, G. M., Welte, J. W., Tidwell, M. C. O., & Hoffman, J. H. (2013). Effects of neighborhood disadvantage on problem gambling and alcohol abuse. *Journal of behavioural addictions*, *2*(2), 82-89.

[70] Welte, J. W., Barnes, G. M., Tidwell, M. C. O., & Hoffman, J. H. (2008). The prevalence of problem gambling among US adolescents and young adults: Results from a national survey. *Journal of gambling studies*, *24*(2), 119-133.

[71] Petry, N. M., & Steinberg, K. L. (2005). Childhood maltreatment in male and female treatment-seeking pathological gamblers. *Psychology of Addictive Behaviors*, *19*(2), 226.

[72] Kessler, R. C., & Wang, P. S. (2008). The descriptive epidemiology of commonly occurring mental disorders in the United States. *Annual. Review. Public Health*, *29*, 115-129.

[73] Limbrick-Oldfield, E. H., Mick, I., Cocks, R. E., McGonigle, J., Sharman, S. P., Goldstone, A. P., ... & Nutt, D. (2017). Neural substrates of cue reactivity and craving in gambling disorder. *Translational psychiatry*, *7*(1), e992.

[74] Sharpe, L., Tarrier, N., Schotte, D., & Spence, S. H. (1995). The role of autonomic arousal in problem gambling. *Addiction*, *90*(11), 1529-1540.

anxiety states are reduced by the arousal state induced by gambling, further increasing the probability of continued gambling. This reduction in negative mood and anxiety states when gambling has been linked to a form of dissociation or "zoning out" - and it has been argued that whilst some gamblers gamble for the increased levels of arousal, others may be more motivated by the induced feelings of dissociation.[75] Finally, it has also been shown that as the frequency of gambling progresses, strong biased and distorted cognitions around attribution, personal skill and control over outcome, start to appear.[76] The strength and pervasiveness of distorted cognitions then increase with increasing levels of gambling involvement.[77]

The second pathway refers to an emotionally vulnerable pathway, where gamblers are believed to suffer from a variety of distorted gambling cognitions and conditions, but additionally have pre-existing anxiety or mood disorders which leads to gambling being a form of escaping or modulating negative affective states. This is consistent with findings that roughly one-third of problem gamblers report at least one form of childhood abuse or neglect and many studies have found links between childhood adversity and gambling related issues.[78] There is also a lot of cross-sectional evidence that gambling is associated with escaping negative mood states.[79]

Finally, an anti-social impulsivity pathway is proposed to include the same risk factors as the behaviourally conditioned and emotional vulnerability pathways but also additional risk around high levels of impulsivity and antisocial personality traits. This subtype is proposed to be more likely to experience boredom, suicidal thoughts and substance abuse and also more likely to start gambling at an earlier age. Both younger age of starting and impulsivity have been linked to problem gambling.[80] [81]

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[75] Griffiths, M. D., Wood, R. T. A., Parke, J., & Parke, A. (2006). Dissociative states in problem gambling. *Current issues related to dissociation*, 27-37.

[76] Fortune, E. E., & Goodie, A. S. (2012). Cognitive distortions as a component and treatment focus of pathological gambling: a review. *Psychology of Addictive Behaviors*, *26*(2), 298.

[77] Nicholson, R., Graves, C., Ellery, M., & Afifi, T. O. (2016). The temporal relationship between faulty gambling cognitions and gambling severity in young adults. *Journal of gambling studies*, *32*(4), 1215-1229.

[78] Hodgins, D. C., Schopflocher, D. P., el-Guebaly, N., Casey, D. M., Smith, G. J., Williams, R. J., & Wood, R. T. (2010). The association between childhood maltreatment and gambling problems in a community sample of adult men and women. *Psychology of Addictive Behaviors*, *24*(3), 548.

[79] Wood, R. T., & Griffiths, M. D. (2007). A qualitative investigation of problem gambling as an escape- based coping strategy. *Psychology and Psychotherapy: theory, research and practice*, *80*(1), 107-125.

[80] Alessi, S. M., & Petry, N. M. (2003). Pathological gambling severity is associated with impulsivity in a delay discounting procedure. *Behavioural processes*, *64*(3), 345-354.

[81] MacLaren, V. V., Fugelsang, J. A., Harrigan, K. A., & Dixon, M. J. (2011). The personality of pathological gamblers: A meta-analysis. *Clinical Psychology Review*, *31*(6), 1057-1067.

In each of these pathways (behaviourally conditioned pathway, the emotionally vulnerable pathway and the anti-social impulsivity pathway) there is a strong role of context that serves to increase a person's chance of developing problematic gambling behaviours. Below we outline the role of these contextual factors and how they can lead to escalated play.

3. Role of behavioural influences in problem gambling

Summary

- Gambling behaviour is profoundly influenced by context

- Many features of the remote gambling environment will influence gambling behaviour including the high ease of access, variable degrees of friction when engaging in different activities, use of defaults, immersive interfaces, lack of tangible currency and targeted communications

The field of behavioural science recognises that individuals do not have perfect self-control and are profoundly influenced by the context of a decision. This can be explained by 'dual process theory', which was popularised by Daniel Kahneman, and states that we use two types of thinking in our everyday lives – which he names System 1 and System 2.[82] System 1 is the 'fast' system that is automatic and intuitive, with no sense of effort or voluntary control. It is the system that is used when someone asks, "What's 1 + 1?". System 2 is the slower and more deliberative system that requires active attention. The deliberative thinking capacity of System 2 enables individuals to consider and evaluate relevant information, weighing pros and cons, to make the best choice for themselves. In reality, due to limited attentional resources, we cannot make every decision in this way, and more often than we might expect, we end up relying on System 1. Most of the time this fast system, that relies on rules of thumb and heuristics, serves us fine. However, it can also lead to systematic biases in the way we think and behave.

Companies and governments often offer choices in a way that assumes that we are using the kind of deliberative thinking associated with System 2. For example, a service might provide people with a lot of information to inform their decision making, whether about good schools or mortgage plans. However, in practice, due to constraints such as limited time or mental capacity we do not use all the information we may have access to. People often choose to satisfice; to get a 'good enough' outcome rather than the 'economically optimal' one. This means we rely on other sources of information (e.g. what we think others are doing or our own previous decisions) that help people make a decision quickly. For the purpose of this report we refer to these heuristics but also wider behavioural factors (such as emotional

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[82] Kahneman, D., & Egan, P. (2011). *Thinking, fast and slow*(Vol. 1). New York: Farrar, Straus and Giroux.

state) as 'behavioural influences', which lead to behaviour choices that may appear suboptimal in the economic sense.

3.1 Features of remote settings that influence behaviour

As discussed in Section 1, gambling is increasingly shifting to remote settings, and it has been established that problem gambling is disproportionately common among those who gamble online.[83] [84] [85]

The precise relationship between online gambling and problem gambling is not yet clear, and some have argued that it is best explained by level of gambling involvement.[86] [87] [88] However, limited longitudinal evidence provides some insight into the temporal development of problem gambling, and suggests a possible causal role of remote use, in that it is common for internet gambling to occur before (or during) the development of problem gambling.[89]

When considering the risks of remote environments, naturally online operators aim to maximise profit by attracting customers to their sites and encouraging time and money spent. Consequently, whilst the underlying game-mechanics may differ little between land-based and online play (especially for casino games), remote environments might increase the risk of problem gambling due to a number of additional features.[90] We divide these features conceptually into those that are part of the online gambling environment which make it harder for individuals to exercise self-control, and those that are used by operators to increase gambling.

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[83] Griffiths, M. D., Wardle, H., Orford, J., Sproston, K., & Erens, B. (2008). Sociodemographic correlates of Internet Gambling: Findings from the 2007 British gambling prevalence survey. *CyberPsychology & Behavior, 12*, 199–202.

[84] McBride, J., & Derevensky, J. (2009). Internet gambling behaviour in a sample of online gamblers. *International Journal of Mental Health and Addiction, 7*(1), 149–167.

[85] Petry, N. M. (2006). Internet gambling: An emerging concern in family practice medicine? *Family Practice, 23*, 421–426.

[86] Halme, J.T. (2011). Overseas Internet poker and problem gambling in Finland 2007: A secondary data analysis of a Finnish population survey. *Nordic Studies on Alcohol and Drugs, 28*, 51-63.

[87] LaPlante, D.A., Nelson, S.E., LaBrie, R.A., & Shaffer, H.J. (2009). Disordered gambling, type of gambling and gambling involvement in the British Gambling Prevalence Survey 2007. *European Journal of Public Health, 21*(4), 532-537

[88] Vaughan-Williams, L., Page, L., Parke, J., & Rigbye, J.L. (2008). *British Gambling Prevalence Survey 2007: Secondary Analysis*. Gambling Commission, Great Britain.f

[89] Wood, R.T., Williams, R.J., & Parke, J. (2012). The relationship between problem gambling and Internet gambling. In *Routledge International Handbook of Internet Gambling* by Williams, R.J., Wood, R.T., & Parke, J. (eds). Routledge: London. pp. 200-211.

[90] Gainsbury, S. M. (2015). Online gambling addiction: The relationship between internet gambling and disordered gambling. *Current addiction reports*, *2*(2), 185-193.

- 3.1.1 Features of remote settings that reduce self-control and self-awareness
  - increase availability and ease of access to gambling activities and relative lack of social control (gambling can be completely anonymous)
  - highly immersive interfaces
  - use of purely cashless payment systems
- 3.1.2 Features of operator websites that aim to maximise time and money spent on gambling activities
  - smart use of defaults that are likely to increase spending
  - access to a broad range of riskier (e.g. high speed) gambling activities
  - multiple communication channels with, their users, offering greater opportunity to influence behaviour

Below we discuss how these features influence gambling behaviour.

3.1.1 Features of remote settings that reduce self-control

Remote settings increase availability and ease of access to gambling activities
The internet has enabled gambling to be accessible from any location, at any time of day. Although individuals most commonly gamble from home using their laptops and tablets, as smartphones become increasingly sophisticated the availability of gambling opportunities have further expanded.[91] This means that whilst previously gamblers would have been limited by the opening times of their local bookmaker, or the distance to gaming venues, they are now within arms-reach of potential plays at all times. This is important given that we know how even small frictions (such as whether a bowl of chocolates is within arm's reach or not) can have a disproportionate impact on whether we engage in that behaviour or not.[92] Mobiles mean that more than 10% of online gamblers gamble whilst commuting, which is particularly common amongst young adults.[93]

The rise in gambling whilst commuting is also an indication of the extra risk posed by mobile gaming - which is that these devices are also associated with habitual behaviours.[94] For example, people tend to open certain apps frequently, such as during moments of

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[91] Griffiths, M. (2007). Mobile phone gambling. In *Encyclopedia of mobile computing and commerce* (pp. 553-556). IGI Global.

[92] Maas, J., de Ridder, D. T., de Vet, E., & De Wit, J. B. (2012). Do distant foods decrease intake? The effect of food accessibility on consumption. *Psychology & Health*, *27*(sup2), 59-73.
[93] Gambling participation in 2017: behaviour, awareness and attitudes.
[94] James, R. J., O'Malley, C., & Tunney, R. J. (2017). Understanding the psychology of mobile gambling: A behavioural synthesis. *British Journal of Psychology*, *108*(3), 608-625.

boredom,[95] [96] [97] and this behaviour often becomes habitual or 'checking' in nature.[98] While this may not lead to prolonged engagement with the (gambling) app each time it is opened, the regular intermittent engagement (even for a few minutes at a time) can increase the craving to engage and could lead users to acquiring problem gambling behaviours.[99]

The easy remote access on a personal device also means that a gambler does not need to have a social interaction with another person (e.g. a teller or other member of the general public) when gambling. This means that any friction associated with the risk of facing negative social judgement is greatly reduced.[100]

Overall, such easy access to gambling is concerning, as studies show positive correlations between the prevalence of problem gambling and accessibility of casinos[101] [102] [103] and fixed-odds betting terminals (FOBTs).[104] However, there is some longitudinal evidence that whilst populations near newly built casinos (or in areas where gambling legislation was liberalised) are more likely to develop problematic gambling behaviours in the short and medium term,[105] it is only those who gamble most frequently that are more likely to exhibit enduring problematic gambling behaviours.[106] This fits with research showing that high availability of gambling is a risk factor for those with certain genetic vulnerability factors, leading to the

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[95]Griffiths, M. (2007). Mobile phone gambling. In *Encyclopedia of mobile computing and commerce* (pp. 553-556). IGI Global..

[96] The Nielsen Company (2014b). Tech-or-treat: Consumers are sweet on mobile apps.

[97] Walker, J. (2012). A look at how people use mobile apps. *The Wall Street Journal.* Retrieved from http://blogs.wsj.com/digits/2012/06/26/a-look-at-how-people-use-mobile-apps/

[98] Oulasvirta, A., Rattenbury, T., Ma, L., & Raita, E. (2012). Habits make smartphone use more pervasive. *Personal and Ubiquitous Computing*, 16(1), 105–114.

[99] Blaszczynski, A., Cowley, E., Anthony, C., & Hinsley, K. (2016). Breaks in play: Do they achieve intended aims?. *Journal of Gambling Studies*, *32*(2), 789-800.

[100] Gainsbury, S. M., Wood, R., Russell, A., Hing, N., & Blaszczynski, A. (2012). A digital revolution: Comparison of demographic profiles, attitudes and gambling behavior of Internet and non-Internet gamblers. *Computers in Human Behavior*, 28, 1388–1398.

[101] Slutske, W. S., Deutsch, A. R., Statham, D. J., & Martin, N. G. (2015). Local area disadvantage and gambling involvement and disorder: Evidence for gene-environment correlation and interaction. *Journal of Abnormal Psychology, 124*, 606–622.

[102] St-Pierre, R. A., Walker, D. M., Derevensky, J., & Gupta, R. (2014). How availability and accessibility of gambling venues influence problem gambling: A review of the literature. *Gaming Law Review and Economics*, 18(2), 150–172.

[103] Welte, J. W., Barnes, G. M., Tidwell, M.-C. O., Hoffman, J. H., & Wieczorek, W. F.(2016). The relationship between distance from gambling venues and gambling participation and problem gambling among U.S. adults. *Journal of Gambling Studies*, 32(4), 1055–1063.

[104] Wardle, H., Keily, R., Astbury, G., & Reith, G. (2012). 'Risky Places?': Mapping gambling machine density and socio-economic deprivation. *Journal of Gambling Studies*, 30(1), 201–212.

[105] LaPlante, D. A., & Shaffer, H. J. (2007). Understanding the influence of gambling opportunities: Expanding exposure models to include adaptation. *American Journal of Orthopsychiatry, 77*, 616–623.

[106] ibid

development of problematic gambling in a way that would not have occurred in a context of lower availability.[107]

The ease of access to gambling afforded by remote gambling is also likely to impact the success of efforts to abstain from gambling. We know, for instance, that close proximity to tobacco outlets reduces the success of smoking cessation interventions.[108] [109] Self-exclusion schemes are an important means of supporting abstinence from gambling - which involves an individual entering into an agreement with an operator resulting in the closing of their account, returning any remaining money in their account as well as removing that person's name and details from any marketing databases. Whilst land-based gambling settings have multi-operator exclusion schemes (a single request to self-exclude can ensure that a person is excluded from all premises in a particular area), for online operators an individual must self-exclude from each operator individually, thus imposing a high friction cost on users.[110] Additionally, due to the many websites and operators it would be easy to find and use a platform you have not self-excluded from. The development of GAMSTOP,[111] a National online self-exclusion scheme, will hopefully go some way to address this issue, which will provide a means of self-excluding from multiple sites using just one platform. However, this will still require an individual to have awareness of and register with GAMSTOP, and it currently is only able to exclude the individual from operators they have already signed up with, which means that they are still able to sign up with a site they have not yet got an account with.

In summary, for certain groups of people there is reason to be concerned about the increased ease of access to gambling activities afforded by remote gambling.

Dynamic digital interfaces increase immersion

As discussed in Section 1, gambling is associated with changes to a person's state of consciousness - either due to inducing higher states of arousal or inducing dissociative states. When considering dissociative states, there are a number of different terms that can be used to describe the subjective experience of high engagement in a particular activity and

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[107] Slutske, W. S., Deutsch, A. R., Statham, D. J., & Martin, N. G. (2015). Local area disadvantage and gambling involvement and disorder: Evidence for gene-environment correlation and interaction. *Journal of Abnormal Psychology*, 124, 606–622.

[108] Reitzel, L. R., Cromley, E. K., Li, Y., Cao, Y., Dela Mater, R., Mazas, C. A., ... & Wetter, D. W. (2011). The effect of tobacco outlet density and proximity on smoking cessation. *American Journal of Public Health*, *101*(2), 315-320.

[109] Halonen, J. I., Kivimäki, M., Kouvonen, A., Pentti, J., Kawachi, I., Subramanian, S. V., & Vahtera, J. (2014). Proximity to a tobacco store and smoking cessation: a cohort study. *Tobacco control*, *23*(2), 146-151.

[110] http://www.gamblingcommission.gov.uk/for-the-public/Safer-gambling/Self-exclusion.aspx

[111] https://www.gamstop.co.uk/

the consequent feeling of disengagement with one's surroundings. Immersion, flow, and psychological absorption all describe non-pathological forms of a kind of altered consciousness that occurs when deeply focused on a particular activity or thought, whilst dissociation is a clinical term that has come to describe more severe forms of detachment from reality.[112] However, in the gambling literature the term dissociation can used to describe anything from losing track of time to 'blacking out' and not having any recollection of a period of time at the other.[113]

Dissociation has regularly been implicated in problem gambling, both because of the negative effects of losing track of time and money (meaning that more time and money is spent on gambling than intended), but also because of the positive effect of the feelings of dissociation themselves.[114] Studies have found that that dissociative experiences are reinforcing in that they appear to offer escape from psychological distress.[115] A lab study found that higher levels of dissociation were linked to greater cravings to continue play, an effect which was mediated by higher levels of negative arousal/mood.[116] In this way, gambling represents a form of mood regulation, or an escape from emotional distress. That is, escaping from problems and chronic feelings existing prior to the onset of gambling (such as a pre-existing mental health problem) as well as escaping from problems and negative feelings derived from gambling's consequences.[117]

Whilst the propensity to experience dissociation from deep engagement in an activity such as gambling may be determined in part by individual differences - characteristics of the gambling environment also play a powerful role. For instance, the interactive nature of online behaviour in and of itself (in comparison to a more passive behaviour such as watching television) has been found to support feelings of escape.[118] Additionally, although not a well-

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[112] Brockmyer, J. H., Fox, C. M., Curtiss, K. A., McBroom, E., Burkhart, K. M., & Pidruzny, J. N. (2009). The development of the Game Engagement Questionnaire: A measure of engagement in video game-playing. *Journal of Experimental Social Psychology*, *45*(4), 624-634.

[113] Griffiths, M. D., Wood, R. T. A., Parke, J., & Parke, A. (2006). Dissociative states in problem gambling. *Current issues related to dissociation*, 27-37.

[114] Stewart, M. J., & Wohl, M. J. (2013). Pop-up messages, dissociation, and craving: How monetary limit reminders facilitate adherence in a session of slot machine gambling. *Psychology of Addictive Behaviors*, *27*(1), 268.

[115] Fang, X. & Mowen, J. C. (2009). Examining the trait and functional motive antecedents of four gambling activities: Slot machines, skilled card games, sports betting, and promotional games. *Journal of Consumer Marketing,* 26(2), 121–131

[116] Blaszczynski A, Cowley E, Anthony C, Hinsley K. Breaks in play: Do they achieve intended aims? *Journal of Gambling Studies.* 2015

[117] Rosenthal, R. J., & Lesieur, H. R. (1992). Self-Reported Withdrawal Symptoms and Pathological Gambling. *American Journal on Addictions*, *1*(2), 150-154.

[118] Griffiths, M. (2003). Internet gambling: Issues, concerns, and recommendations. *CyberPsychology & Behavior*, *6*(6), 557-568.

researched area, some forms of gambling, such as those supported by video lottery terminals (e.g. electronic games of poker, black-jack, and keno) are particularly associated with dissociative states.[119] From the video gaming literature, the level of immersion felt by gamers has been found to positively correlate with the extent of stimuli and attentional resources needed whilst playing,[120] [121] indicating that the presence of visual, auditory, and sometimes tactile stimuli (e.g. use of buttons or using a joystick) may enhance immersion.

The characteristics of games and environments that might lead to higher levels of immersion or dissociation is an area that warrants further research. The rise of virtual reality technology and virtual reality gambling (such as virtual poker rooms to virtual sports events) means that the environments in which individuals gamble are becoming even more immersive. For those vulnerable to experiencing dissociation during gambling sessions, it might be that these highly immersive environments might lead to more prolonged and problematic play. [122]

Cashless payment systems reduce financial self-monitoring and enable more continuous play

A key difference between remote settings and land-based settings is that remote settings use purely intangible forms of payment. This has implications both in terms of ability to keep track of spending, but also in terms of disruption to play. In land-based settings, a key disruption to play is needing to insert more funds into whatever machine is being used. The introduction of bill acceptors in gambling machines (which prevented the need to handle large amounts of change and reduced the number of interruptions to feed money in) led to a significant increase in revenues from the machines.[123] When Norway banned bill acceptors

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[119] Kofoed, L., Morgan, T., Buchkowski, J. & Carr, R. (1997). Dissociative Experiences Scale and MMPI-2 scores in video poker gamblers, other gamblers and alcoholic controls. *Journal of Nervous and Mental Disease*, 185, 58-60.

[120] Wood, R. T., Griffiths, M. D., & Parke, A. (2007). Experiences of time loss among videogame players: An empirical study. *Cyberpsychology & behavior*, *10*(1), 38-44.

[121] Murray, C. D., Fox, J., & Pettifer, S. (2007). Absorption, dissociation, locus of control and presence in virtual reality. *Computers in Human Behavior*, *23*(3), 1347-1354.

[122] Kuley, N. B., & Jacobs, D. F. (1988). The relationship between dissociative-like experiences and sensation seeking among social and problem gamblers. *Journal of Gambling Behavior*, *4*(3), 197-207.

[123] Williams, R. J., West, B. L., & Simpson, R. I. (2012). *Prevention of problem gambling: A comprehensive review of the evidence and identified best practices*. Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care.

this was followed by a 16% reduction in the number of calls to the problem gambling helpline as well as a 24% drop in the number of people seeking help with problem gambling.[124] [125]

In the remote gambling environment, there is no requirement for the insertion of money, but rather deposits are placed electronically at the start of a session, with no interruption to play. The requirement to use intangible forms of currency (e.g. credit and debit cards) rather than coins, chips or cash can also reduce financial self-monitoring. For instance, there is evidence that less tangible forms of money increase spending and reduce decision making time,[126] and an experimental study found that participants gambling with intangible currency were significantly worse at keeping track of their balance.[127]

3.1.2 Features of operator websites that aim to maximise time and money spent on gambling activities

Platforms may optimise friction costs to encourage certain activities over others
The amount of friction a person encounters when trying to complete a task can have a large impact on the likelihood of whether the task is successfully completed or not. For example, legislation that added friction to accessing and consuming large amounts of paracetamol (e.g. use of blister packs rather than bottles and multiple packs not being able to be bought at the same shop) led to an estimated 43% reduction in suicides in the 11 years following the legislation, equivalent to 765 fewer deaths.[128]

There is qualitative evidence to suggest that remote gambling platforms are optimised so that certain activities encounter little friction (such as placing a bet) whilst other activities encounter significantly more friction (such as using responsible gambling tools). For instance, our mystery shopping exercise found that just a few clicks were needed to place a bet from receiving an interruptive mobile notification suggesting to place that bet. Conversely trying to close an account required multiple logins.[129]

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[124] Engebø, J., & Gyllstrøm, F. (2008). *Regulatory changes and finally a ban on existing slot machines in Norway: What's the impact on the market and problem gambling? A short presentation of various data.* Paper presented at the 2008 International Gambling Conference: Looking Forward: New Directions in Research and Minimising Public Harm.

[125] Gotestam, K.G., & Johansson, A. (2009). Norway. In G. Meyer et al. (eds), *Problem Gambling in Europe: Challenges, Prevention, and Interventions*. Pp 209-218. Springer.

[126] Feinberg, R. A. (1986). Credit cards as spending facilitating stimuli: A conditioning interpretation. *Journal of consumer research*, *13*(3), 348-356.

[127] Siemens, J. C., & Kopp, S. W. (2011). The influence of online gambling environments on self-control. *Journal of Public Policy & Marketing*, *30*(2), 279-293.

[128] Hawton K, Bergen H, Simkin S, Dodd S, Pocock P, Bernal W & Kapur N. Long term effect of reduced pack sizes of paracetamol on poisoning deaths and liver transplant activity in England and Wales: Interrupted time series analyses. BMJ, 2013; 346: f403. Available at: www.bmj.com/content/346/bmj.f403 35.

[129] See mystery shopping section of this report

Platforms use high defaults which may increase spending

We know that people have a broad tendency to 'go with the flow' of pre-set options such as defaults. For example, the roll-out of automatic pension savings (with the option of opting out) as opposed to opt-in schemes saw large increases in the number of savers.[130] In this way, how operators choose what pre-set options are displayed when consumers are making decisions about the size of their deposit, their deposit limits or bet-size, will have an important impact on behaviour.

Our qualitative research shows that operators will often provide a set of pre-set options or defaults for deposit amounts (e.g. '£50' '£100') next to a free text box for the customer to enter their desired amount.[131] Since individuals tend to be heavily influenced by the presence of previously presented information (also known as 'anchoring'), even if a gambler chooses to reduce the deposited amount to one that is lower than the pre-set option, the default is still likely to influence how much is chosen to be deposited.

Access to a broad range of high-speed forms of gambling

With 1,135 active online operators and many thousands of gambling activities available to choose from, there is no difficulty in accessing high-speed forms of gambling.[132]

High-speed games, which provide higher frequency of reinforcing outcomes (wins or near misses) are also referred to as 'continuous forms' of gambling - and are associated with the development of problematic gambling behaviour.[133] [134] Examples of games that provide rapid

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[130] Cribb, J. & Emmerson, C., (2017) What happens when employers are obliged to nudge? Automatic enrolment and pension saving in the UK. Report by the Institute of Fiscal Studies for Royal Economics Society Conference 2017. Available at https://www.ifs.org.uk/uploads/Presentations/Jonathan%20Cribb%20RES%202017.pdf

[131] See mystery shopping section of this report

[132] From a search of active licensed remote operators using Gambling commission website (https://secure.gamblingcommission.gov.uk/PublicRegister/Search?Search=&Sector=Remote&Status=Granted)

[133] Parke, J., & Griffiths, M. (2007). The role of structural characteristics in gambling. In G. Smith, D. C. Hodgins & R.J. Williams (Eds.), *Research and measurement issues in gambling studies* (pp. 217-249). Burlington, MA: Elsevier.

[134] Welte, J.W., Barnes, G.M, Wieczorek, W.F., Tidwell, M-C, O., Hoffman, J.H. (2007). Type of gambling and availability as risk factors for problem gambling: A tobit regression analysis by age and gender. *International Gambling Studies, 7*(2), 183-198.

reinforcement are slot machines and fixed odds betting terminals,[135] [136] [137] and online gambling environments tend to offer faster speeds of play.[138]

Even types of gambling that have traditionally been limited in terms of frequency, such as betting on the outcomes of sports matches, or on features such as who scores first, now allow for much greater frequency thanks to in-game or 'live' betting. This enables individuals to continue placing bets (with varying odds) during the game and has been associated with an increased risk of harm.[139] [140]

Multiple communications channels offering greater opportunity to encourage gambling
An important feature of remote gambling environments is the greater ability for operators to collect significant amounts of behavioural data on their users. Whilst there is limited evidence on how operators use this information to increase play, targeted advertisements are a well-established online practice.[141]

A study investigating online advertising on a random sample of 71 online poker sites, found that dominant messages centred on poker as an everyday rather than occasional practice, gambling as a route to social and financial success, and poker as a skilled activity rather than a game of chance as well as skill.[142] These marketing strategies therefore aim to normalise online gambling and appeal to the egos of potential consumers. More sinisterly, it has been reported that advertising agencies use a method called "dynamic retargeting" to

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[135] Dowling, N., Smith, D., & Thomas, T. (2005). Electronic gaming machines: Are they the 'crack-cocaine' of gambling? *Addiction, 100*(1), 33-45

[136] Meyer, G., Hayer, T., & Griffiths, M. (Eds.). (2009). *Problem gambling in Europe: Challenges, prevention, and interventions*. Springer Science & Business Media.

[137] Williams, R.J., Volberg, R.A., & Stevens, R. (2012). *The Population Prevalence of Problem Gambling: Methodological Influences, Standardized, Rates, Jurisdictional Differences, and Worldwide Trends.* Report prepared for the Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care. May 8, 2012..

[138]Harris, A., & Griffiths, M. D. (2017). The impact of speed of play in gambling on psychological and behavioural factors: a critical review. *Journal of gambling studies*, 1-20.

[139] Brosowski, T., Meyer, G., & Hayer, T.(2012). Analyses of multiple types of online gambling within one provider: An extended evaluation framework of actual online gambling behaviour. *International Gambling Studies*, 12, 405–419. doi:10.1080/14459795.2012.698295

[140] LaPlante, D. A., Nelson, S. E., & Gray, H. M. (2014). Breadth and depth involvement: Understanding Internet gambling involvement and its relationship to gambling problems. *Psychology of Addictive Behaviors*, 28, 396–403. doi:10.1037/a0033810

[141] Boerman, S. C., Kruikemeier, S., & Zuiderveen Borgesius, F. J. (2017). Online behavioral advertising: A literature review and research agenda. *Journal of Advertising*, *46*(3), 363-376.

[142] McMullan, J. L., & Kervin, M. (2012). Selling Internet gambling: Advertising, new media and the content of poker promotion. *International Journal of Mental Health and Addiction*, 10, 622–645.

single out individuals who may not have gambled for a while and try to entice them to gamble again.[143]

Another analysis of 40 large poker, casino and betting sites, found that recruitment strategies included advertising on search engines, as well as pop-ups and banner displays on websites. Registration strategies included welcome bonuses and free games. Retention was encouraged through referral bonuses, random draws and other reward systems (e.g. for making the largest deposit of the day, deposit credits, loyalty programmes, happy hour events).[144]

In addition to many forms of communication (whether offering free bets or advertising a new game), the online environment can also make use of multiple communication channels. For instance, operators can make use of emails, text messages and 'push notifications' through gambling apps - to alert customers of upcoming bets and offers.

Currently little is known about the impact of these communications and offers on gamblers, although qualitative research in both adolescents and adults suggests that online advertisements prompt those who already gamble to gamble,[145] [146] particularly problem gamblers.[147] Gamblers also report receiving communications such as receiving promotional offers from gambling operators after barring themselves from their sites, communications to discourage them from closing accounts, and promotions encouraging them to chase losses - marketing strategies that weakened some of this group's resolve to stop gambling.[148] Thus, the ability of online environments to target advertisements and promotions to vulnerable gamblers is concerning, as it appears that these tactics are disproportionality effective on this group.

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[143] Busby, M. (2017). Revealed: how gambling industry targets poor people and ex-gamblers. *The Guardian.*

[144] Weibe, J. (2008). Internet gambling: Strategies to recruit and retain customers. Guelph: Ontario Problem Gambling Research Centre.

[145] Derevensky, J., Sklar, A., Gupta, R., & Messerlian, C. (2010). An empirical study examining the impact of gambling advertisements on adolescent gambling attitudes and behaviors. *International Journal of Mental Health and Addiction, 8*(1), 21-34.

[146] Hing, N., Cherney, L., Blaszczynski, A., Gainsbury, S. M., & Lubman, D. I. (2014). Do advertising and promotions for online gambling increase gambling consumption? An exploratory study. *International Gambling Studies, 14*(3), 394-409.

[147] ibid

[148] ibid

4. The effectiveness of behaviourally informed interventions to promote responsible gambling in remote environments

Summary

Information-only interventions tend not to be effective unless information is highly salient, comprehensible and meaningful

- Voluntary use of pre-commitment tools is low - and barriers to uptake include lack of insight into gambling problems, lack of awareness of the existence of such tools and inconvenience of using them
- There is need for more experimental research in real world gambling environments to test the effectiveness of responsible gambling interventions

This section reviews the evidence on the use of behaviourally informed interventions to reduce problem gambling and risky play. We do not review evidence for interventions that alter the structural characteristics of the specific games themselves (e.g. speed),[149] nor do we review psychotherapeutic approaches such as Cognitive Behavioural Therapy, as these are outside the scope of this work. We therefore consider how changes to the remote gambling environment could support responsible gambling. We primarily consider interventions that aim to increase informed choice and self-control, with a focus on online gambling research where possible, but where evidence is limited due to lack of studies, we also draw upon research in other areas of public health.

We acknowledge that although operators hold vast amounts of behavioural data on their customers, the amount of publicly available data is very limited. So whilst there is an emerging literature on what works in responsible gambling, it is likely that greater use and analysis of operator data is required to reveal important insights.

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[149] Williams, R.J., West, B.L., & Simpson, R.I. (2012). *Prevention of Problem Gambling: A Comprehensive Review of the Evidence, and Identified Best Practices*. Report prepared for the Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care. October 1, 2012.

4.1 Improving informed choice

We first consider interventions aimed to increase informed choice, with respect to providing comprehensible information about risks associated with gambling and information about the game characteristics (e.g. likelihood of winning or losing).

When considering the effectiveness of general warnings about the risks of gambling, empirical evidence from other areas of public health (such as smoking or alcohol consumption) suggests that these have limited impact on modifying behaviour.[150] [151] Despite the limited evidence, much of the public health efforts to promote responsible gambling focuses on the provision of information on the potential risks of gambling.[152]

Researchers have demonstrated that increasing awareness of probability and randomness in gambling is not sufficient in changing behaviour - as there is evidence of discordance between statistical understanding and gambling involvement and decision making.[153] Moreover, whilst pop up messages aiming to correct erroneous beliefs about gambling may correct biased thinking, this does not follow through to actual changes in gambling behaviour.[154]

One explanation for such findings is the preference individuals have for engaging in behaviour derived through autonomous values and desires rather than being consciously shaped though external influences.[155] This line of thinking draws upon self-determination

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[150] Hammond, D., Fong, G. T., McNeill, A., Borland, R., & Cummings, K. M. (2006). Effectiveness of cigarette warning labels in informing smokers about the risks of smoking: findings from the International Tobacco Control (ITC) Four Country Survey. *Tobacco control*, *15*(suppl 3), iii19-iii25.

[151]Hing, N., & McKellar, J. (2004). Challenges in responsible provision of gambling: Questions of efficacy, effectiveness and efficiency. *UNLV Gaming Research and Review*, *8*(1), 43.

[152]Monaghan, S., & Blaszczynski, A. (2010). Impact of mode of display and message content of responsible gambling signs for electronic gaming machines on regular gamblers. *Journal of Gambling Studies*, *26*(1), 67-88.

[153]Monaghan, S., & Blaszczynski, A. (2007). Recall of electronic gaming machine signs: A static versus a dynamic mode of presentation. *Journal of Gambling Issues*, (20), 253-267; Williams, R. J., & Connolly, D. (2006). Does learning about the mathematics of gambling change gambling behavior?. *Psychology of Addictive Behaviors*, *20*(1), 62.

[154] Cloutier, M., Ladouceur, R., & Sévigny, S. (2006). Responsible gambling tools: Pop-up messages and pauses on video lottery terminals. *The Journal of Psychology*, *140*(5), 434-438.Floyd, K., Whelan, J. P., & Meyers, A. W. (2006). Use of warning messages to modify gambling beliefs and behavior in a laboratory investigation. *Psychology of Addictive Behaviors*, *20*(1), 69.

[155] Williams, G. C., McGregor, H. A., Sharp, D., Levesque, C., Kouides, R. W., Ryan, R. M., & Deci, E. L. (2006). Testing a self-determination theory intervention for motivating tobacco cessation: Supporting autonomy and competence in a clinical trial. *Health Psychology*, *25*(1), 91.

theory and explains why interventions that harness support and autonomy are more effective than information-only interventions.[156]

Another reason why information can be less effective than expected is because individuals can fall prey to 'othering' - which is when they believe that a warning is not relevant to them. For instance, individuals may not self-identify as problematic gamblers (e.g. due to not yet experiencing serious harm or due to lack of insight) meaning that any intervention reliant on self-identification of problem gambling is unlikely to be effective for these individuals.[157]

Furthermore, information may not always impact behaviour because individuals may be unable to process the information in the first place. For instance, those experiencing difficult life circumstances, such as poverty or mental health issues, are more likely to experience limitations in mental capacity or 'cognitive bandwidth'.[158] [159] This means that those gamblers who are experiencing the most difficulty are often the least likely to use any information aimed at increasing informed choice.[160] This has also been found in other areas of public health, whereby purely information-based obesity interventions can be less effective for those with lower socio-economic status, which could mean that simplicity of information is especially important in at risk groups.[161]

Presenting information in a way that is more meaningful to users, such as nutrition labels that use traffic light systems can be more effective at driving behaviour change - and helping consumers to select the healthier choice.[162] In gambling it might be that presenting game information in terms of average cost in pounds per 10 minutes of play might be easier to understand. Given the promise of digital comparison tools in helping consumers make better choices[163] - standardising comprehensible product information and enabling easy

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[156] ibid

[157] Parke, A., Harris, A., Parke, J., Rigbye, J., & Blaszczynski, A. (2014). Facilitating awareness and informed choice in gambling. *The Journal of Gambling Business and Economics*, *8*(3), 6-20.

[158] Schilbach, F., Schofield, H., & Mullainathan, S. (2016). The psychological lives of the poor. *American Economic Review*, *106*(5), 435-40.

[159] Trivedi, J. K. (2006). Cognitive deficits in psychiatric disorders: Current status. *Indian journal of psychiatry*, *48*(1), 10.

[160] Parke, A., Harris, A., Parke, J., Rigbye, J., & Blaszczynski, A. (2014). Facilitating awareness and informed choice in gambling. *The Journal of Gambling Business and Economics*, *8*(3), 6-20.

[161] Beauchamp, A., Backholer, K., Magliano, D., & Peeters, A. (2014). The effect of obesity prevention interventions according to socioeconomic position: a systematic review. *Obesity reviews*, *15*(7), 541-554.

[162] Mhurchu, C. N., Eyles, H., Jiang, Y., & Blakely, T. (2018). Do nutrition labels influence healthier food choices? Analysis of label viewing behaviour and subsequent food purchases in a labelling intervention trial. *Appetite*, *121*, 360-365.

[163] Competition and Markets Authority (2017). Digital Comparison Tools Market Study. Available at https://assets.publishing.service.gov.uk/media/59c93546e5274a77468120d6/digital-comparison-tools-market-study-final-report.pdf

comparison across products is a promising avenue to help nudge consumers to less harmful gambling activities.

Finally, in addition to being comprehensible and meaningful, information also needs to be presented at timely moments in order to have the best chance of impacting decision making. In this way, researchers have looked at within-play pop up messaging as a potentially effective means of encouraging responsible decision making - which we explore further below.

4.2 Increasing self-control through pop up messaging

Use of pop up messages to interrupt play is one of the most researched interventions to reduce excessive play. Pop up messages have been used for a number of reasons:

- To disrupt play and force a break
- To provide information and advice (e.g. on probability and randomness)
- To encourage self-reflection and awareness through feedback on play (e.g. time spent)

Studies conducted on university participants have found that messages to correct erroneous beliefs can support more rational thinking[164] [165] and that dynamic pop up messages (or ones that move across the screen) are more likely to be remembered by players than static ones.[166]

There is less evidence from studies in real-world settings that consider the impact of messages on actual gambling behaviour. One real-world study found that adding a pop-up message to a land-based video lottery terminal, which informed players of how long they had been playing for (after 60 minutes of continuous play, and every 30 minutes thereafter), brought about a small reduction in session length and expenditure (particularly among higher-risk players, who would be more likely to receive such messages).[167]

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[164] Cloutier, M., Ladouceur, R., & Sévigny, S. (2006). Responsible gambling tools: Pop-up messages and pauses on video lottery terminals. *The Journal of Psychology*, *140*(5), 434-438.Floyd, K., Whelan, J. P., & Meyers, A. W. (2006). Use of warning messages to modify gambling beliefs and behavior in a laboratory investigation. *Psychology of Addictive Behaviors*, *20*(1), 69.

[165] Floyd, K., Whelan, J. P., & Meyers, A. W. (2006). Use of warning messages to modify gambling beliefs and behavior in a laboratory investigation. *Psychology of Addictive Behaviors*, *20*(1), 69.

[166] Monaghan, S. & Blaszczynski, A. (2007). Recall of electronic gaming machine signs: A static versus a dynamic mode of presentation. *Journal of Gambling Issues, 20*, 253-268.

[167] Schellinck, T., & Schrans, T. (2002). *Atlantic Lottery Corporation video lottery responsible gaming feature research Final report: Conclusions and recommendations*. Focal Research Consultants Ltd. report to the Atlantic Lottery Corporation, Market & Research Development, Halifax, Nova Scotia.

Another study using real online gambling data compared gambling behaviour before and after the introduction of a pop-up message that was triggered if a gambler reached 1,000 consecutive slot-machine spins in a single gambling session. The pop-up message read "You have now played 1,000 slot games. Do you want to continue? (YES/NO)". When comparing a random sample of 400,000 sessions with no pop up message, with another random sample of 400,000 after the pop up message had been introduced, those sessions which received a pop up message were 9 times more likely to terminate at the 1,000 spin mark.[168] However, overall numbers were low indicating a need for caution when interpreting this finding.

The same authors then tested the effectiveness of this original message against an 'enhanced message' that included social norm feedback, information to correct erroneous beliefs about gambling and also advised players to take a break: "We would like to inform you, that you have just played 1,000 slot games. Only a few people play more than 1,000 slot games. The chance of winning does not increase with the duration of the session. Taking a break often helps, and you can choose the duration of the break." The enhanced pop-up message led to 1.39% of these highly involved gamblers to immediately cease their gambling session compared to 0.67% of gamblers who only saw the simple pop-up messaging.[169] This indicates that feedback can have an impact (albeit relatively modest) on actual gambling behaviour, even for those who are engaging in excessive play.

More research that adopts experimental methods (ideally randomised control trials) in real world gambling environments is needed. This could test the effectiveness of pop up messages both for those engaging in excessive levels of gambling (e.g. 1,000 spins on a slot machine) as well as those at risk of doing so.

4.3 Improving self-control through use of pre-commitment devices

Given that it is harder to monitor and control behaviours when in a state of high arousal[170] or in a dissociative state,[171] many gamblers adopt strategies to limit their gambling behaviour. For instance, qualitative research with gamblers found that these methods might involve only

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[168] Auer, M., Malischnig, D., & Griffiths, M. (2014). Is" pop-up" messaging in online slot machine gambling effective as a responsible gambling strategy?. *Journal of Gambling Issues*, (29), 1-10.
[169] Auer, M. M., & Griffiths, M. D. (2015). Testing normative and self-appraisal feedback in an online slot-machine pop-up in a real-world setting. *Frontiers in psychology*, *6*, 339.
[170] Wilkes, B. L., Gonsalvez, C. J., & Blaszczynski, A. (2010). Capturing SCL and HR changes to win and loss events during gambling on electronic machines. *International Journal of Psychophysiology*, *78*(3), 265-272.
[171] Wanner, B., Ladouceur, R., Auclair, A. V., & Vitaro, F. (2006). Flow and dissociation: Examination of mean levels, cross-links, and links to emotional well-being across sports and recreational and pathological gambling. *Journal of Gambling Studies*, *22*(3), 289.

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taking cash to a casino, keeping chips visible on the table to help keep track of spending, or only going with another person and agreeing to leave together at a pre-arranged time.[172] These very tangible methods of behavioural control are less available in the online environment. However, limit setting responsible gambling tools are available, that ask players to pre-commit to certain limits, for example on the amount they want to bet or the time they want to spend playing. Pre-commitment can be voluntary or mandatory ("full pre-commitment") with the most common types including:

- Deposit limits (e.g. daily, weekly, or monthly)
- Bet size limits
- Loss limits (e.g. weekly, monthly, yearly)
- Session time
- Short-term exclusion from certain game types (e.g. 6 months), and
- Short-term account suspension (e.g. 6 months)

The idea behind such limits is that players can make an informed choice about their gambling before actually starting,[173] which harnesses the fact that individuals are not yet in a state of high emotional arousal.

Self-reported qualitative and survey data suggests that between 50-80% of land-based gamblers voluntarily set monetary limits whilst few set time limits.[174] [175] [176] This is in contrast with real-world data from online gamblers which found that just 1.2% of online gamblers make use of limit-setting responsible gambling tools.[177] The effectiveness of these tools is currently uncertain, since problem gamblers tend to set higher limits and report that they are likely to exceed these.[178] Additionally a study of online gambling found that over a two year

[172] Siemens, J. C., & Kopp, S. W. (2011). The influence of online gambling environments on self-control. *Journal of Public Policy & Marketing*, *30*(2), 279-293.

[173] Parke, J. Rigbye, J., & Parke, A. (2008). *Cashless and card-based technologies in gambling: A review of the literature.* December 2008. Commissioned by the U.K. Gambling Commission.

[174] Lalande, D. R., & Ladouceur, R. (2011). Can cybernetics inspire gambling research? A limit-based conceptualization of self-control. *International Gambling Studies*, *11*(2), 237-252.

[175] Schellinck, T., & Schrans, T. (1998). Nova Scotia VL Players' Survey. *Report completed by Focal Research Consultants Ltd. for the Nova Scotia Department of Health, Halifax, Nova Scotia*; Phillips, M. (2006). Analysis of gambler pre-commitment behaviour. *Gambling Research Australia: Melbourne*.

[176] Schottler Consulting. (2010). Major findings and implications: Player tracking and pre-commitment trial.

[177] Nelson, S. E., LaPlante, D. A., Peller, A. J., Schumann, A., LaBrie, R. A., & Shaffer, H. J. (2008). Real limits in the virtual world: Self-limiting behavior of Internet gamblers. *Journal of gambling Studies*, *24*(4), 463-477.

[178] Schellinck, T., & Schrans, T. (1998). Nova Scotia VL Players' Survey. *Report completed by Focal Research Consultants Ltd. for the Nova Scotia Department of Health, Halifax, Nova Scotia*; Phillips, M. (2006). Analysis of gambler pre-commitment behaviour. *Gambling Research Australia: Melbourne*.

period, 80% of online gambling subscribers continued gambling even after receiving messages informing them that their daily limit had been exceeded.[179] Finally, whilst some have found that setting limits can reduce monetary spending by even the most intense players and across different types of gambling (with poker being the exception),[180] others have found it can lead to greater spending.[181] This points to the need for further research to understand how best to support individuals to set reasonable limits as well as how to stick to them.

The most extreme form of limit setting is self-exclusion, which involves a person entering a voluntary agreement with an operator that restricts their gambling for a chosen period of time, usually at least six months.[182] Self-exclusion tends to be precipitated by increasing monetary losses,[183] and is associated with younger gamblers.[184] An investigation into the effectiveness of self-exclusion for online gamblers found that self-excluders were more likely to abstain from their most problematic form of gambling and fewer had harm consequences.[185] It was also found that self-excluders had similar outcomes to those who also had counselling (as well as self-excluded).

Like other limit-setting devices, uptake of self-exclusion schemes is low, with 6% of gamblers reporting to have ever self-excluded.[186] Qualitative research with problem gamblers has identified some of the perceived barriers to accessing self-exclusion facilities: lack of insight into the severity of their gambling problem, lack of knowledge about the existence of such tools, stigma of being part of such a programme and the inconvenience of having to register at each site (for land-based settings).[187] Lack of awareness of self-exclusion was also

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[179] Broda, A., LaPlante, D. A., Nelson, S. E., LaBrie, R. A., Bosworth, L. B., & Shaffer, H. J. (2008). Virtual harm reduction efforts for Internet gambling: effects of deposit limits on actual Internet sports gambling behavior. *Harm reduction journal*, *5*(1), 27.

[180] Auer, M. & Griffiths, M.D. (2013). Voluntary limit setting and player choice in most intense online gamblers: An empirical study of gambling behaviour. *Journal of Gambling Studies, 29*, 647-660.

[181] Schottler Consulting. (2010). Major findings and implications: Player tracking and pre-commitment trial.

[182] Gambling Commision (2017) Gambling Participation in 2017 behaviour awareness and attitudes.

[183] Xuan Z, Shaffer HJ. (2009). How do gamblers end gambling: longitudinal analysis of Internet gambling behaviors prior to account closure due to gambling related problems. *Journal of Gambling Studies*. 25:239–252.

[184] Dragicevic S, Percy C, Kudic A, Parke J. (2015). A descriptive analysis of demographic and behavioral data from internet gamblers and those who self-exclude from online gambling platforms. *Journal of Gambling Studies*. 31:105–132.

[185] Hing N, Russell A, Tolchard B, Nuske E. (2015b). Are there distinctive outcomes from self-exclusion? An exploratory study comparing gamblers who have self-excluded, received counselling, or both. *International Journal of Mental Health Addiction*. 13:481–496.

[186] Gambling Commision (2017) Gambling Participation in 2017 behaviour awareness and attitudes.

[187] Hing N, Tolchard B, Nuske E, Holdsworth L, Tiyce M. (2014). A process evaluation of a self-exclusion program: a qualitative investigation from the perspective of excluders and non-Excluders. *International Journal of Mental Health Addiction*. 12:509–523.

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identified in recent research by the Gambling Commission, which found that 59% of gamblers were not aware of self-exclusion.[188]

In summary, from the available data, pre-commitment devices are not used regularly by players in real world online environments. Moreover, there is mixed evidence on their effectiveness. Further research is needed to understand the most effective means of implementing these devices and encouraging their uptake, for example whether they can be exceeded or revoked, what their optimum duration is (e.g. hourly, daily or weekly limit), and whether they apply across games and platforms. [189] [190]

5. Conclusion

Problem gambling emerges when an individual's gambling involvement leads to experience of harm. There are many features of remote gambling that are likely to increase gambling involvement, most notably the greatly increased ease of access to gambling activities. Additionally, qualitative research suggests that online platforms are optimised to encourage greater amounts of money and time spent on gambling - with features including low levels of friction to gamble (e.g. placing bets), often higher friction when reducing gambling (e.g. using responsible gambling tools), use of relatively high anchors when making deposits or setting limits, and targeted communications that encourage ongoing engagement.

Previous research investigating responsible gambling interventions has mainly been around the provision of information, including through use of pop-up messaging, and use of pre-commitment devices. There is greater need for research using real-world data and experimental designs. There is also more scope for testing interventions that change the choice architecture of the online gambling environment to make responsible gambling easier. The best opportunities for this will be collaborating with operators who are interesting in responsible gambling.

In this way, while online gambling carries risks for gamblers it also presents opportunities. An improved understanding of the remote gambling behaviours that indicate risky or problematic play will help identify those individuals who require intervention. For the small proportion of gamblers who would meet criteria for gambling addiction, remote identification

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[188] Gambling Commission (2017) Gambling Participation in 2017 behaviour awareness and attitudes.
[189] Blaszczynski, A., Parke, A., Harris, A., Parkes, J., & Rigbye, J. (2015). Facilitating player control in gambling. *The Journal of Gambling Business and Economics, 8*(3), 36-51.
[190] Williams, R.J., West, B.L., & Simpson, R.I. (2012). *Prevention of Problem Gambling: A Comprehensive Review of the Evidence, and Identified Best Practices*. Report prepared for the Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care. October 1, 2012.

via data-analytics can help them receive appropriate treatments such as exclusion and psychological therapies. For the segment of gamblers who are engaging in risky or are at risk of developing more severe problem gambling behaviours, there is opportunity to improve the choice architecture in place so support them to stay below the problem gambling threshold. This is what we aim to test in the second stage of our project. We outline specific behavioural interventions in our solutions note for GambleAware.

Appendix IV. Additional information related to our data science work

Background

We used data on self-reported problem gambling behaviour, as well as individual-level bet and payment data to predict which gamblers are likely to be problem gamblers. While this does not isolate the *causes* of problem gambling, it does allow us to see which patterns of behaviour occur with problem gambling and therefore where sensible intervention points might be.

We deployed computer algorithms to find patterns in the data that would be impractical or impossible for a human to find, and then used those patterns to both understand problem gambling and create predictions for who is likely to be a problem gambler. The machine-learning technique we used is called 'gradient boosted decision trees', which was deployed as it produces accurate models and controls the risk of finding false patterns. These models start with the idea of decision trees (see Figure 25). A decision tree is a flexible object that can describe many real-world processes and allows different data to be used as predictors depending on the context. In the example below, the decision tree predicts the PGSI score of individuals involved in online gambling based on a mixture of betting behaviour, transaction behaviour, and demographic information:
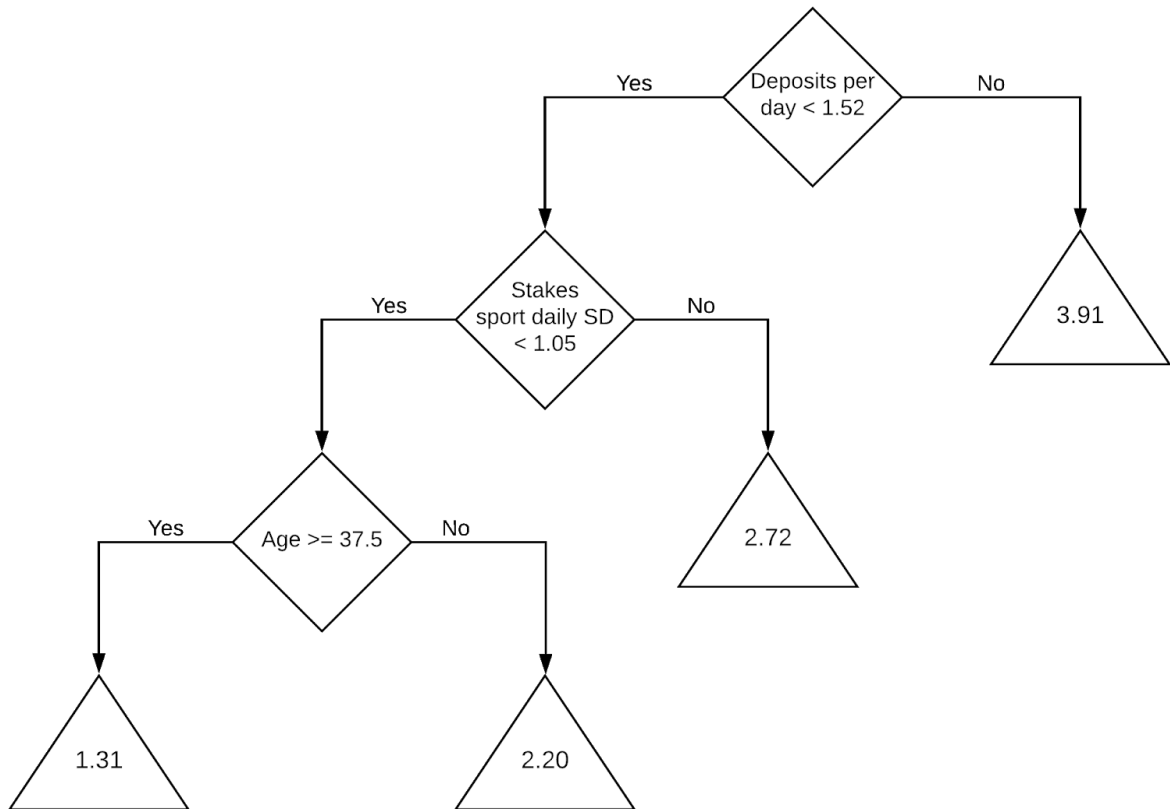
Figure 25. A simple decision tree predicting the PGSI score based on a combination of behavioural and demographic features.

Notice how the 'age' variable is only used for gamblers with rather low variation of stakes in sports betting. Such subdivisions of the population are not possible with many other techniques and allow us to achieve high predictive power in large and complex problems, as here.

However, the algorithm's real edge is that we improve it by building a new tree and focusing it on the cases where its predictions were least accurate (and repeating this process until we have a 'forest' of decision trees!). As an analogy, imagine a teacher giving a child homework: if the teacher is setting follow-up work, it is better for this to cover the material the student got wrong than the topics the student didn't struggle with. This process is called 'boosting', and 'gradient boosted decision trees' are the result of applying this process to a decision tree model. The result of this is a large collection of different decision trees, which are then averaged to produce predictions.

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How well can we predict problem gambling?

We can use the available data to compare the model's predictions of who is a problem gambler with the actual data and produce rates of false positives (where the model predicts an outcome which does not happen) and false negatives (where the model predicts no outcome when one does happen). Different sensitivity thresholds can be set to manipulate the rates of false positives and false negatives. We look at the number of correctly identified positive cases over all the possible values of this threshold, and plot that against the number of cases where the model predicts a positive outcome (regardless of the truth). For a strongly predictive model, this curve will arc up strongly, as in the left-hand example below. For a weakly predictive model, it will only be slightly above the diagonal line representing the average behaviour of selecting cases at random. This curve is usually called a 'gain curve' and the area under the curve (AUC), ranging from 0 to 1, is a common measure of how strong a model is.
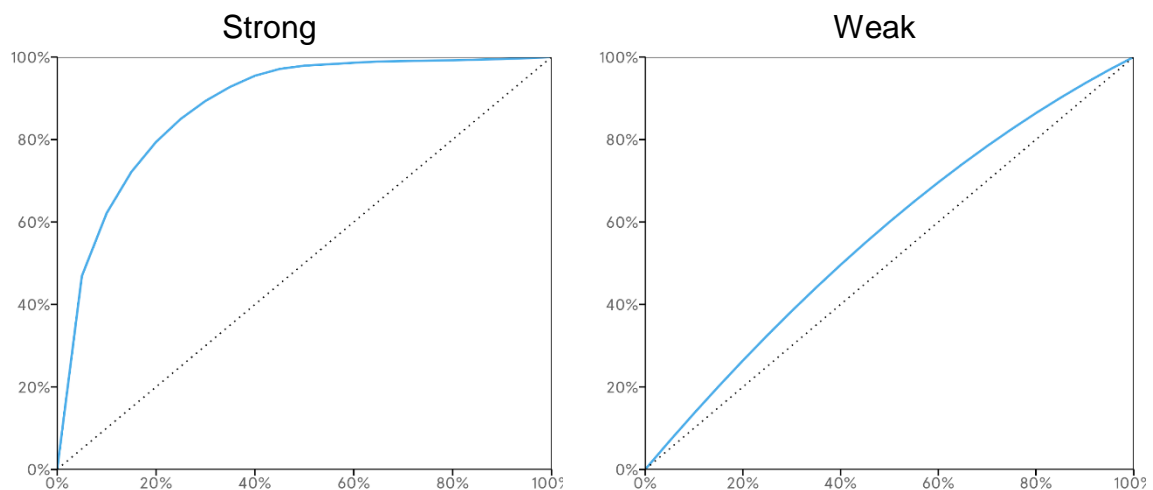
Figure 26. Representative gain curves of two models

Description of the data

The dataset used for our analyses consisted of online betting and transaction (deposit and withdrawal) data from 10,656 individuals collected between 1 May 2014 and 30 April 2016 by four operators: bet365, Ladbrokes, Sky Betting & Gaming, and William Hill. Each individual's data was matched with a PGSI score collected as a part of a survey administered by PwC between April and May 2016. 679 individuals (6.4%) had a score of 8 or more, corresponding to self-reported problem gambling.

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The data sets contained basic demographics (age, gender); the value and time of bets, including what type they were (single/double/accumulator) and what section of gambling they were in (casino/games/sports betting); and the value and time of deposits and withdrawals, including an indication of whether the payments were successful. From these data, we constructed 321 features summarising behaviour in different ways and capturing different aspects of it.

These included groups of features describing the distributions of certain values – such as the mean, variance, and skewness of bet and transaction values – as well as capturing specific behavioural features we hypothesised might be indicative of problem gambling. These were:

- Size of bets following a big loss
- Time lag after a big win or a big loss
- Trend in bet value over the course of a day of betting
- Trend in the value of deposits over time

Identifying problem gambling

We then built a large model that combined 158 features in a way that achieved a predictive power with AUC of 0.8117. However, such a large model is hard to interpret and many of the features in it only have a negligible contribution to the overall prediction. Therefore, we built a second, smaller model with only 35 features, which only had a slightly lower AUC of 0.8097. Figure 27 below shows the gain curve of this model. Depending on the chosen sensitivity levels (reflected on the horizontal axis), the curve shows the proportion of true high-risk gamblers detected. We can, for instance, find 39% of all high-risk gamblers if we select the top 10% individuals identified as highest-risk by the model, or 62% of all high-risk gamblers by selecting 20%.
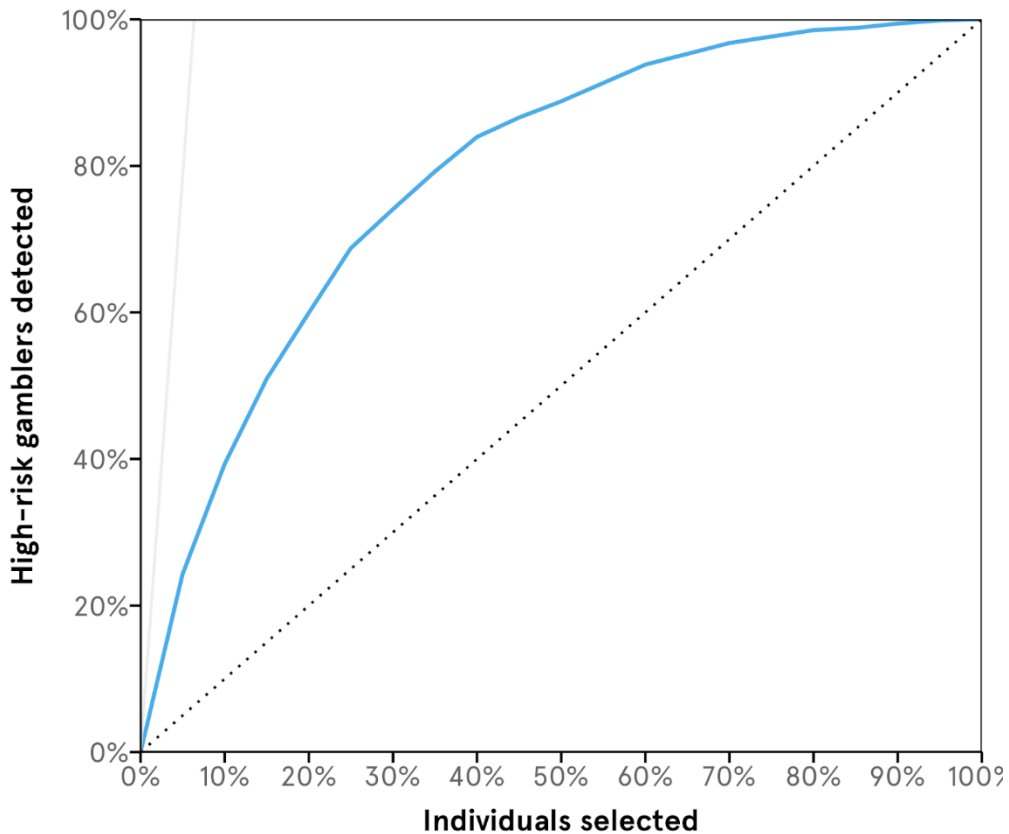
Figure 27. Gain curve of a model with 35 features. The dotted line shows how a randomly-guessing model would perform; the grey line shows the curve of the best possible model (where all identified users actually are high-risk gamblers).

Explaining problem gambling

We quantify which variables are the most predictive by measuring their *importance*, that is, the proportion of the predictive power that is due to that variable. The most important predictors in our model were those associated with stakes, namely the mean monetary amount staked in a betting day and the variation of those amounts.

The chart below visualises the importance scores of the 20 most highly predictive features (see Figure 28). Table 4 lists all the features used in our model and explains their meaning.
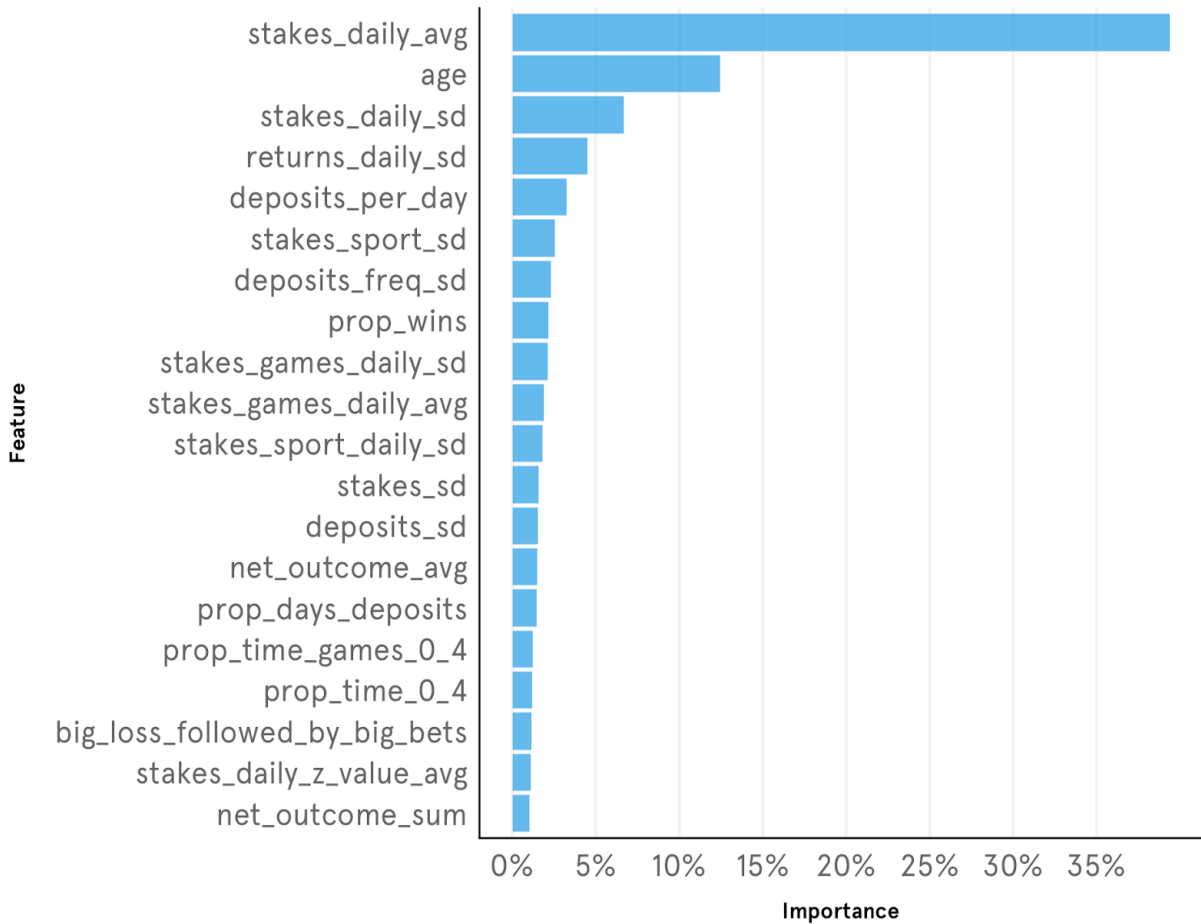
Figure 28. The 20 features with the highest importance.

Name	Meaning	Importance
stakes_daily_avg	Mean value of stakes in a day of betting (DoB)	39.37%
age	Age in years	12.47%
stakes_daily_sd	Standard deviation (SD) of stakes within a DoB	6.70%
returns_daily_sd	SD of returns within a DoB	4.49%
deposits_per_day	Mean number of deposits per DoB	3.26%
stakes_sport_sd	SD of stakes in sports betting	2.53%
deposits_freq_sd	SD of frequency of depositing	2.31%
prop_wins	Proportion of bets with a net gain	2.16%

stakes_games_daily_sd	SD of stakes in 'games' (i.e. slots and gaming machines) within a DoB	2.13%
stakes_games_daily_avg	Mean stakes within a DoB in 'games'	1.89%
stakes_sport_daily_sd	SD of stakes in sports betting within a DoB	1.80%
stakes_sd	SD of stakes	1.57%
deposits_sd	SD deposits	1.53%
net_outcome_avg	Mean value of outcome, i.e. returns minus stakes	1.48%
depos_freq	Deposit frequency	1.47%
prop_time_games_0_4	Proportion of 'games' bets placed between midnight and 4 am	1.23%
prop_time_0_4	Proportion of bets placed between midnight and 4 am	1.18%
big_loss_followed_by_big_bets	Proportion of big monetary losses followed by high stakes	1.14%
stakes_daily_z_value_avg	Mean relative value of stakes (compared to other gamblers) in a DoB	1.12%
net_outcome_sum	Total value of returns minus stakes	1.05%
withdrawals_freq	Frequency of withdrawals	1.02%
withdrawals_skew	Skewness of withdrawals	0.92%
withdrawals_sd	SD of withdrawals	0.76%
time_betw_bets_games_skew	Skewness of delay between bets in 'games'	0.75%
time_betw_deposits_avg	Mean delay between deposits	0.74%
returns_daily_avg	Mean value of returns in a DoB	0.69%
prop_bets_fri	Proportion of bets placed on Friday	0.69%
time_betw_bets_sport_avg	Mean delay between bets in sports betting	0.64%
daily_stakes_trend_avg	Mean trend in stakes within a DoB	0.62%
deposits_skew	Skewness in deposit value	0.58%
prop_thursday	Proportion of bets placed on Thursday	0.48%
returns_daily_sport_skew	Skewness of returns in sports betting within a DoB	0.49%
prop_depos_incr	Proportion of increases among the values of successive deposits	0.40%
time_betw_bets_games_sd	SD of delay between bets in 'games'	0.39%

Table 4. All features used in the final model.

It is worth noting that many of these features are correlated with each other – for instance, one cannot bet and lose money without having first deposited it. Small differences in the way the machine-learning model is created can thus lead to slightly different individual importance scores, even if the overall predictive power remains the same. In consequence, the specific order of features in Table 4 should not be over-interpreted.

Combining features – interactions

As indicated in the main body of the report, we built a separate predictive model in order to explore the importance of feature interactions, i.e. whether combinations of specific values of multiple features are important for identifying problem gamblers. In the context of decision trees, interactions are constructed by multiple levels of branching (see Figure 25); therefore, we built a model whose trees were not allowed to branch more than once, thereby preventing the use of feature interactions.

We found that interactions were not of great importance when detecting online gamblers at high risk of problem gambling. Nevertheless, there are certain instances where the propensity to be a problem gambler is dependent on combinations of specific values of predictive features. Table 5 provides the 5 strongest such interactions.

	Feature 1	Feature 2	Interaction (simplified description)	Importance of interaction with respect to the total importance of all two-feature interactions
1	Mean value of stakes in a day of betting (DoB)	Age	The relationship between age and PGSI scores (displayed in Figure 6) is stronger for gamblers who on average bet more than £250 per day	25.89%
2	Mean value of stakes in DoB	Variation of stakes within a DoB	The relationship between the variation of stakes and PGSI scores (Figure 3) is much weaker for those who bet less than £70 per day, but stronger for those who bet over £250.	15.26%

3	Mean value of stakes in DoB	Standard deviation of returns within a DoB	Highly variable returns are associated higher PGSI scores (see Figure 4), though this pattern is stronger for those who bet over £250 per day and weaker for those who bet less	4.22%
4	Mean value of stakes in DoB	Variation of deposit value	For gamblers who bet less than £50 per day, highly variable deposit values are associated with higher PGSI scores but the relationship disappears for those who bet more.	4.11%
5	Variation of stakes within a DoB	Variation of stakes in sports betting within a DoB	High variation is overall stakes and sport-betting stakes is associated with higher PGSI scores but the effect of the two variables isn't fully additive.	3.64%

Table 5. The five strongest two-way interactions and their meaning.

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Appendix V. Messaging used in the SBG and bet365 trials conducted by BIT

SBG messages

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sky bet

3 SIMPLE TOOLS
TO HELP YOU GAMBLE RESPONSIBLY

You have spent much more time or money than most SkyBet users.
Only 1% of customers are receiving this message.

We offer you three simple tools that help you manage the amount of time and money you spend gambling.

Deposit Limits

Cool Off

Self Exclusion

Find out more

126

sky bet

3 SIMPLE TOOLS
TO HELP YOU GAMBLE RESPONSIBLY

You have spent much more time or money than most SkyBet users.
Only 1% of customers are receiving this message.

We offer you simple tools that help you manage the amount of time and money you spend gambling.

Step 1: Click "My Account"

My Account

Step 2: Select an option from the menu.

Deposit	Withdraw
Open bets	Settled bets
Deposit Limits	Take a break
Back to Sky Bet	Log out

Find out more

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sky bet
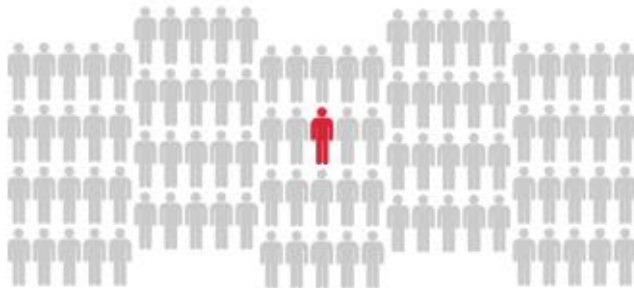
3 SIMPLE TOOLS
TO HELP YOU GAMBLE RESPONSIBLY
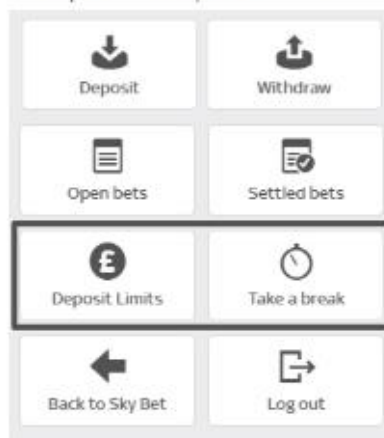
You have spent much more time or money than most SkyBet users.
Only 1% of customers are receiving this message.

Take a moment to consider how you feel about your gambling. Are you still in control? Has the fun stopped?

We offer you simple tools that help you manage the amount of time and money you spend gambling.

Step 1: Click "My Account"

My Account

Step 2: Select an option from the menu.

Deposit	Withdraw
Open bets	Settled bets
Deposit Limits	Take a break
Back to Sky Bet	Log out

Find out more

128
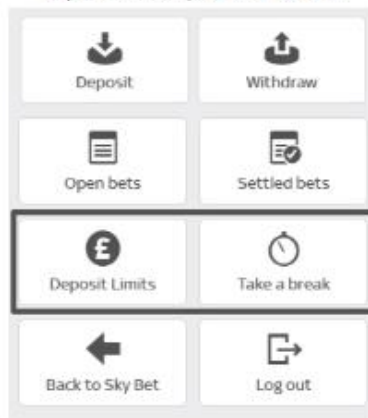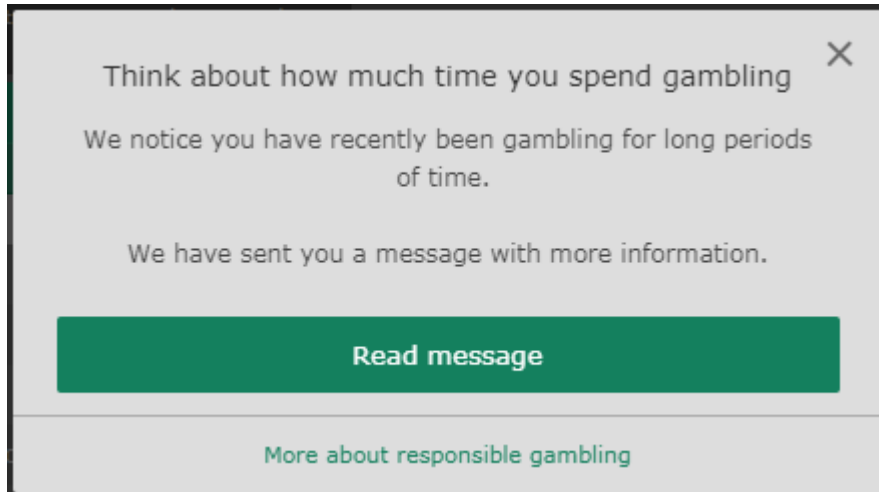
bet365 Messages
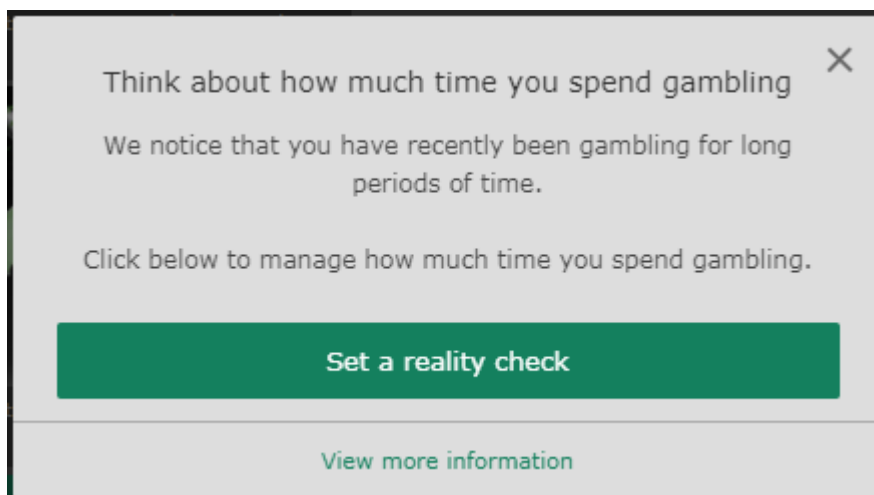
Time spent gambling

Arm 1 - Control
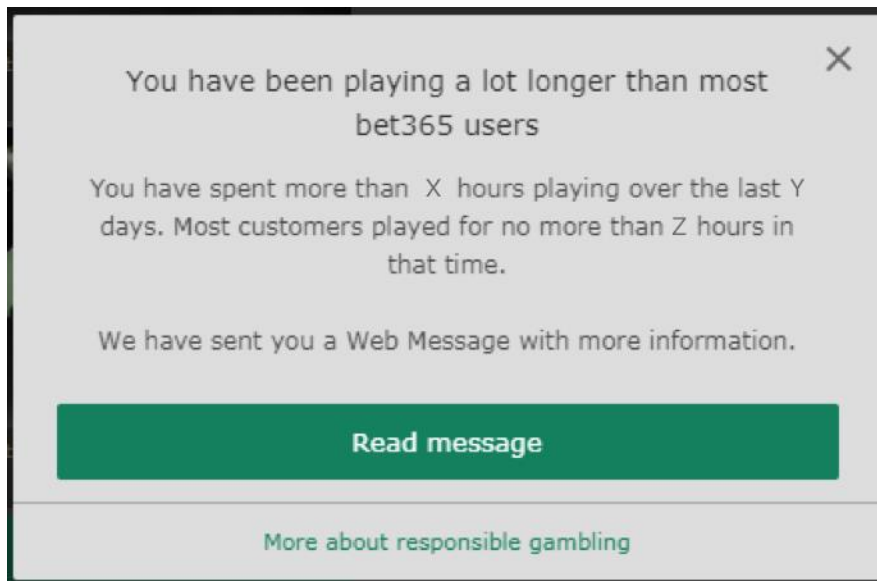
Arm 2 - Reducing friction

129

Arm 3 - Social norm feedback

You have been playing a lot longer than most
bet365 users

You have spent more than X hours playing over the last Y
days. Most customers played for no more than Z hours in
that time.

We have sent you a Web Message with more information.

Read message

More about responsible gambling

Arm 4 - Reducing friction + feedback

You have been playing a lot longer than most
bet365 users

You have spent more than X hours playing over the last Y
days. Most customers played for no more than Z hours in
that time.

Click below to manage how much time you spend gambling.

Set a reality check

View more information

130

Multiple payment methods

Arm 1 - Control
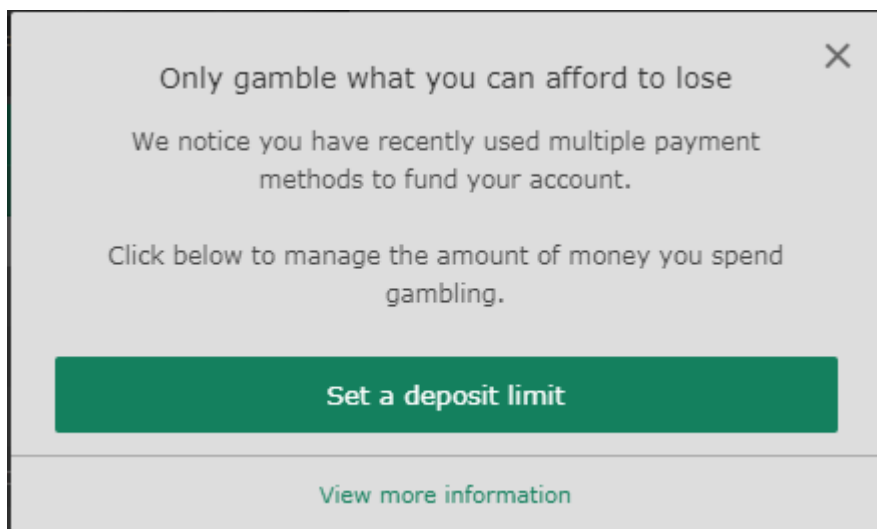
Arm 2 - Reducing friction

131

Arm 3 - Social norm feedback

You have been using more payment methods
than most bet365 users

You have used at least X different ways of funding your
account in the last Y days. Most customers used only Z
payment method during that time.

We have sent you a Web Message with more information.

Read message

More about responsible gambling

Arm 4 - Reducing friction + feedback

You have been using more payment methods
than most bet365 users

You have used at least X different ways of funding your
account in the last Y days. Most customers used only Z
payment method during that time.

Click below to manage the amount of money you spend
gambling.

Set a deposit limit

More about responsible gambling

132