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**Report 1 - Theoretical markers
of harm for machine play in a
bookmaker's**

A rapid scoping review

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Executive summary

Aims and objectives

- This report forms part of the Responsible Gambling Trust’s research programme into machines in bookmakers.
- The aim of that programme is to look at whether industry-held data from machines can be used to identify harmful patterns of play.
- As a first step, this report aimed to document a range of patterns or behaviours which may indicate that an individual is playing in a harmful way and to briefly assess the evidence base supporting these. A secondary objective was that once these ‘markers’ were identified they should be tested against industry data to see if these patterns or markers are actually evident in industry data: this process is documented separately in Report 3 of the machines research programme (see Excell et al, 2014).

Approach

- An initial list of potential markers of harm was generated by the lead author, based on prior knowledge and experience. This was reviewed by the second and third authors and refined. The list was further refined based on results from a consultation exercise with key stakeholders.
- The final list of potential markers of harm was subject to a rapid scoping review to assess against empirical evidence and academic literature.
- Finally, each potential marker of harm was assessed against the Bradford Hill criteria for causality in epidemiology. This framework was used to examine the strength of evidence suggesting that this pattern or behaviour may indicate that someone is playing machines in harmful way.

Results

- Nineteen different potential markers of harm were identified. These were categorised into three groups: 1) those where behaviour can be viewed over time (called ‘between-session’ markers), 2) those where behaviour is viewed within a single session of play (called ‘within-session’ markers) and 3) contextual markers of harm, relating to the person, their interactions, the venue, location and so on.
- Assessment against the Bradford Hill criteria shows that the existing evidence base is strongest when looking at between-session markers of harm. For example, increased frequency of play is a plausible marker of harm, displays strong associations with problem gambling in cross sectional surveys, and is coherent with existing knowledge and theory.
- For most markers of harm identified there are notable issues relating to definitions and classification of behaviour. For example, looking at frequency of play, more attention is needed to the question of ‘how much is too much?’. This is important to clarify if certain thresholds are to be used as the ‘trigger’ point for a responsible gambling intervention.

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- Looking at within-session markers of harm, the evidence base is much more sparse. Most markers identified are plausible as potential markers of harm and some are consistent with existing knowledge. For example, increasing stake sizes after a series of losses is a plausible pattern indicating that a person is losing control of their play and is starting to chase their losses.
 - However, there has been relatively little empirical investigation of how these patterns or behaviours perform as a 'marker' of harm; that is how well they separate those experiencing harm from those who do not. It is important to try to assess how many people who are experiencing harm actually display these within-session behaviours and equally how many people who are not experiencing harm also display these behaviours.

Conclusions

- There are significant gaps in knowledge around what patterns of harm are most likely to suggest probabilistically that a person is experiencing harm.
- More work is needed to clarify what is meant by some behaviours (i.e., chasing losses) and what thresholds are most likely to capture those who are experiencing harm whilst excluding those who are not.
- It is evident that identifying harm is likely to require a more holistic approach to understanding behaviour and consideration of several different behavioural markers at the same time.
- Where possible, further contextual information about the individual and their physical behaviours should be considered when attempting to identify those most at risk of harm.

Limitations

- This work was conducted under a tight timescale and therefore we could only conduct a limited evidence scoping review. This report maps the broad themes evident in the literature but is not a comprehensive review.
- The markers of harm listed in this report are unlikely to be comprehensive nor are they intended to be. The process was intended to identify the main patterns or behaviour that may be evident in industry data and to assess how plausible they were as potential markers of harm.
- There is no commonly accepted definition of gambling-related harm or how to measure this. Therefore, we acknowledge that within this report we conflate gambling harm and problem gambling. This is largely because the existing literature and evidence focuses on problem gambling and not gambling-related harm. Problem gambling was used in the re-analysis of the British Gambling Prevalence Survey (BGPS) data as that was the only data available. The results presented in this report using the BGPS data are not intended to be definitive; they are used simply to illustrate the range of issues that need to be considered when attempting to identify harmful patterns of play from industry data.

1 Introduction

1.1 Purpose of report

This report forms part of the Responsible Gambling Trust’s strategic research into Category B gambling machines in bookmakers. It is part of a broader project aimed at examining whether industry data generated by machines can be used to identify potentially harmful patterns of play.¹ To answer this question, a linked series of research was planned. As a first step, the research team decided to document what types of patterns may be considered harmful; that is, to try to document the different patterns of play that may indicate that a player may be at risk of harm from their gambling engagement. The premise was simple: in order to be able to assess whether industry-held data can be used to identify harmful patterns of play, one first needs to document what these patterns may be. The second step was to use this information to see if these patterns are apparent in the data provided by bookmakers. Once steps 1 and 2 were completed, it was agreed to extend analysis by conducting a survey of people holding a bookmaker’s loyalty card and to link their survey responses with machine data to explore patterns of play in more depth. The full research programme is outlined in Figure 1.1.

Figure 1.1 Research project stages and reports

Step 1:	Explore the theoretical markers of harm (this report; report 1)
Step 2:	Preliminary investigation of industry data to explore if markers of harm exist within data (findings in report 3)
Step 3:	Survey of loyalty card holders to link survey data to industry data (report 2)
Step 4:	Analysis of industry data to examine patterns of play among different types of loyalty card holders (report 3)

This report provides information relating to the first step outlined above. A list of the theoretical patterns (or markers) of harm was generated through review of existing gambling research literature and supplemented with information from a consultation of key stakeholders.

This report presents the main markers of harm identified and assesses these against a standardised framework to make some judgements about how robust, plausible and likely

¹ Machines in a bookmakers capture every betting transaction made. This records all the money that is paid into and paid out of a machine. This is called ‘transactional data’ in this research programme. It does not, however, identify who put money into the machine. This is only captured if a loyalty card is presented when an individual is playing the machine.

each marker is as potential flag of harmful play. The findings of this process are documented in this report.

1.2 Context and definitions

The main objective of the machines research programme, as specified by Great Britain's Responsible Gambling Strategy Board (RGSB), is whether industry data can be used to identify harmful patterns of play. The use of the term 'harmful' in this objective warrants further consideration. In recent years the attention of policy makers, regulators and researchers alike has shifted from focusing on pathological (and problem) gambling to considering gambling-related harm more generally. There is a growing acceptance that 'pathological gambling' is a highly medicalised term that frames problems with gambling as something intrinsic to the individual, to the detriment of broader considerations (Castellani, 2000). 'Gambling-related harm' has increasingly been used as an alternative and includes a wide range of harms and consequences that might be experienced by the individual, their family and friends, as a result of excessive engagement. This term has been adopted by the RGSB. Their strategy (2012) focuses on understanding why some people gamble and do not experience harm, on harm prevention and on better understanding of the risks and harms of gambling. They define gambling-related harm as:

'the adverse financial, personal and social consequences to players, their families and wider social networks that can be caused by uncontrolled gambling'

(RGSB, 2012)

However, as for problem gambling, there is no agreed and accepted method of how to measure or identify gambling-related harm. The definition provided by the RGSB offers little further insight into this. In fact, the RGSB definition implies that standardised measurement of gambling-related harm may be difficult to achieve, as harm and its consequences are likely to be experienced for different people in different ways. This may include a range of consequences but also different experiences of harm that vary over different timeframes. For example, for some individuals harm may be experienced in an episodic way, whereas for others it may be a more long-term experience.

Therefore, the concept of gambling-related harm (potentially) recognises the great diversity of experience among different types of gamblers. For this to be useful in an applied sense a research framework is needed which recognises this diversity and seeks to explore it. This framework should recognise that patterns of harm vary for different people under different circumstances and contexts and that a range of different mechanisms can influence outcomes (Pawson & Tilley, 1997). For example, a gambler chasing losses might not always represent a harmful pattern of play. If it is a one-off occasion and the gambler can afford to lose the money, then it may not be necessarily harmful. However, if this is part of a broader pattern of chasing, or the individual can not afford to lose this money, then in these circumstances chasing may be more harmful. Specific mechanisms that may, for some individuals, facilitate the experience of harm could be related to availability of cash to assist play (such as access to

debit and credit payment methods), actions of the operator in terms of marketing and promotions, or even opening hours (these are simply examples).

This example shows that it is necessary to know more about the individual, their circumstances, and the different mechanisms that combine to create harmful patterns of engagement. Recognition of this has been built into the Responsible Gambling Trust's machines research strategy. This states that:

'The reality is that some patterns and behaviours will be harmful for some people under certain circumstances.'

The main objective of the Responsible Gambling Trust's machine research programme is to examine if industry-held data can be used to identify harmful patterns of play. Thinking about the types of data held by industry, even with data generated through use of loyalty cards where play can be tracked over time, broader contextual circumstances are not evident in the information available. Therefore, it needs to be recognised that what we will be attempting to identify is not harmful patterns of play in a definitive sense but patterns of play that suggest **probabilistically** that harm might be experienced; that is, given this pattern of play what is the likelihood that this player may be experiencing some form of harm from their engagement? The challenge is ensuring that this balance of probability is sufficiently robust to (potentially) offer some protection to those who may need it whilst minimising burden on those who are less likely to be experiencing harm.

This report seeks to build upon this perspective to theorise about the different patterns that might be evident in machine data that could indicate harmful patterns of play. We are aware that the theorised patterns will be harmful for some under certain circumstances, yet these circumstances are largely unknown to us. Therefore, attention needs to be given to how sensitive and specific these measures might be. This means assessing whether a particular pattern of play is evident among all people experiencing harm (e.g., high sensitivity with few false positives) and whether this particular pattern of play is something which is not experienced by those not experiencing harm (e.g., high specificity with few false negatives). A challenge for this report, however, is that there is no standardised measure of harm against which to assess this. Therefore, when attempting to illustrate these points, we instead have to rely on measurements of problem gambling according to screening instruments administered via surveys. These instruments are designed to measure gambling problems rather than gambling harms and are a more conservative measure of difficulties. We note the limitation of this approach.

1.3 Limitations

There are a number of limitations to consider when reading this report. The first is that in order to meet research deadlines, the rapid scoping review was conducted within a two-week period in February 2014. This means the list of theorised markers of harm may not be exhaustive but does, we believe, cover the main themes.

The second limitation is that the lack of consensus on how to define and measure gambling-related harm means that much of the literature reviewed tends to focus on problem gambling or at-risk gambling. The aim set out by the RGSB for this project was to explore whether industry-held data could identify harmful patterns of play. Brief review of the literature shows that most studies published to date focus on whether industry-held data can identify problem gambling (sometimes using self-exclusion as a proxy). We recognise that ‘harm’ and ‘problem gambling’ are not the same. Harm may be short-lived, episodic, a one-off experience, something that impacts more broadly on the health and happiness of the individual and/or their family and friends. In short, harm is broader than problem gambling. However, as this report is a review of current literature and evidence, we are constrained by the lack of evidence relating to what gambling-related harm means and how to measure it. Therefore, we acknowledge that this review tends to focus more on problem and at-risk gambling largely because this is the focus of the existing evidence base: this does not mean that we consider these to be the same thing, but rather that this is the only evidence currently available to us. A final limitation is that any assessment of how plausible or robust a pattern is requires an element of subjective judgement. The content of this report was discussed and agreed between all three authors, especially where the theory or evidence was unclear, but we recognise the subjectivity of the exercise.

1.4 Report structure

In the sections that follow, a range of theorised markers of harm are presented. These theorised patterns are reviewed against existing literature and also against the Bradford Hill criteria for identifying causal patterns in epidemiology. Where possible, issues of sensitivity and specificity are considered. For simplicity, the report is split into two sections. **Section 3.1** deals with patterns that might be observed between sessions of play on machines. **Section 3.2** deals with patterns that might be observed within the same session of play. However, there is overlap and interaction between the two. Information is presented in this way because this report informed the analytic strategy for interrogating machine data which can be split into two types:

- player tracking data where patterns of play between sessions can be identified;
- proxy session data which identifies patterns of play within single session of play.

(See Wardle et al., 2013 for more detailed information about the types of data held by industry). Therefore, the distinction made in this report is an artificial one made for practical purposes and substantive importance should not be attached to this.

2 Approach

2.1 Rapid scoping review²

An initial list of potential markers of harm was generated by the lead author, based on prior knowledge and experience. This was reviewed by the second and third authors and the list expanded and categories collapsed where there was significant overlap. The research team then conducted a rapid scoping review to assess their list against research evidence from other jurisdictions and to refine the list.

The potential markers of harm documented at the end of this process were:

- frequency of play
- duration of play
- net expenditure
- levels of play engagement (interactions between expenditure and time)
- number of activities undertaken
- chasing behaviour
- number and type of games played within a session of play
- debit card reload/cash and debit card switching
- debit card payment declines
- variability in staking behaviour
- use of repeat bets functions
- play of multiple machines simultaneously
- stake size
- game volatility
- cash-out behaviour.

This list is unlikely to be comprehensive. It was generated based on knowledge of what kinds of data and patterns are likely to exist within the transactional data records. The authors also recognise that there are likely to be complex patterns and interactions between these markers: this is discussed further within this report.

The listing was further refined based on review of consultation responses (see Section 2.2). Once this final listing was agreed within the team, each aspect was assessed against the Bradford Hill criteria for causality in epidemiology and where possible was analysed against data from existing surveys such as the BGPS series.

2.2 Consultation with stakeholders

A short web-based consultation was sent to key stakeholders: this included staff representing the five major bookmakers in the UK, members of the Responsible Gambling Strategy Board, treatment providers and counsellors and other UK-based academics. Invitees were encouraged

² A rapid scoping review is a brief review of existing literature to map the available evidence on a given topic but typically does not seek to evaluate the quality of that evidence. It is typically used when timescales are compressed, as with this study. It is an approach endorsed by the UK government's Social Research Unit.

to forward the consultation to others who might be interested. One operator sent this to their shop managers and encouraged them to complete it. The consultation asked for information on three areas:

- 1) what specific patterns of play might indicate that someone is experiencing harm;
- 2) what evidence this was based on;
- 3) what other behavioural or contextual markers might indicate that someone was experiencing harm.

Overall, 37 people participated in the consultation. They were from a mix of industry employees, counsellors and treatment providers and academic researchers, with industry employee being the largest group of respondents. The results of the consultation supported the markers identified through the evidence scoping review. These are summarised in the Appendix. However, behavioural markers such as observed aggression and agitation were also noted as being of key importance.

As a result of this consultation the following markers were added to the list for review:

- staff interactions;
- irrational or aggressive behaviour;
- venue location.

2.3 The Bradford Hill criteria

This review draws on the Bradford Hill criteria for identifying causality in epidemiological studies. This is a broadly accepted logical structure aimed at identifying possible causal processes in epidemiology. In particular, it is concerned with the circumstances under which one might move from evidence of an observed association to a 'verdict of causation' (Bradford Hill, 1965).

First proposed in 1965, the criteria include the following:

- 1) **Strength** – Bradford Hill suggested that the larger the association evident, the more likely it is that the association is causal. Therefore, the more strongly related a pattern of behaviour is to harmful play, the more likely it is that this relationship is causal in nature.
- 2) **Consistency** – if the association has been repeatedly observed among different population groups, in different places, circumstances and times, then the association is more likely to be causal in nature. For the purposes of this study, has the pattern of play been observed among different people, times and contexts?
- 3) **Specificity** – is the association limited to specific groups in certain circumstances, with limited evidence of association among other groups in similar circumstances? If it is very specific to a particular group, Bradford Hill argued this was a strong argument in favour of causation.
- 4) **Temporality** – is there any evidence of the direction of association and which came first? Bradford Hill argued that this might be particularly relevant to diseases with slow development. This criterion is arguably less useful for our review.
- 5) **Biological gradient** – Bradford Hill argued that if the association showed any biological gradient, such as a dose response curve, this may be further evidence that the relationship is causal. For this review, this means examination of the shape of relationships between predictors of harm and experience of harm, whilst accepting that the shape of these associations may be influenced by a number of other factors.
- 6) **Plausibility** – is the association (biologically) plausible? For this study, this relates to whether the relationship between the pattern and the outcome seems plausible.

-
- 7) **Coherence** – any cause and effect explanation should not seriously conflict with the known facts of the issue and does not require a serious rethink of the existing evidence to date (McCartney et al., 2011).
 - 8) **Experiment** – is there any experimental or quasi-experimental evidence? If so, Bradford Hill argued this would provide strong evidence of causality.
 - 9) **Analogy** – If a similar exposure causes a similar outcome, this increases the plausibility of the causal hypothesis.

The Bradford Hill criteria should be regarded as a framework for guiding and assessing associations, rather than as prescriptive and dogmatic criteria. Our purpose is not to demonstrate that the specific patterns observed in industry data cause harm to be experienced, but rather that people who exhibit these patterns are more likely to be experiencing harm. The patterns we are looking at are not necessarily causal (although in some instances, this may be the case) but could be considered potential indicators of harm. Our task is to consider the range of different patterns evident and ask how reliable are these patterns likely to be as an indicator of harm?

The Bradford Hill criteria provide a useful and systematic framework to help guide this assessment as we can ask how consistent the relationship is, how strong, how plausible, how coherent and so on, to evaluate this.

Bradford Hill was also keen to stress that we should recognise the obverse situation with each criterion. For example, simply because an association may be weak does not necessarily mean that this is not causal. This emphasis on the obverse is helpful as it reminds us that indicators of harm are likely to vary for different people under different circumstances. Considering criteria relating to specificity and consistency together are useful in this respect as it encourages focus on whether patterns are consistent for certain groups (and what these groups might be) and/or specific to certain groups in certain contexts. Finally, we have also added sensitivity to this list. This relates to Bradford Hill's specificity measure but we felt it would be useful to split sensitivity and specificity into separate domains. This is to enable us to examine how well a measure performs in capturing all people experiencing harm and how well it performs in excluding all those who do not experience harm.

In this review, we use these criteria as a guide to help assess which patterns have a strong theoretical and/or evidence base as a potential predictor of harm. We accept that this is a subjective assessment. However, we believe it is a useful framework to help guide our review and shape future stages of this work.

3 Metrics

3.1 Between-session metrics

These are patterns of behaviour that occur across multiple sessions of play which suggest, on aggregate, that someone may be experiencing harm. It has been suggested this needs to be benchmarked against usual play behaviour to look at what represents a deviation from an individual's norm, whilst accepting that some people may have a consistently problematic pattern of play. Therefore, we are also interested in exploring what patterns, on average, represent potential experience of harm at a broader population level.

3.1.1 Frequency of gambling on machines

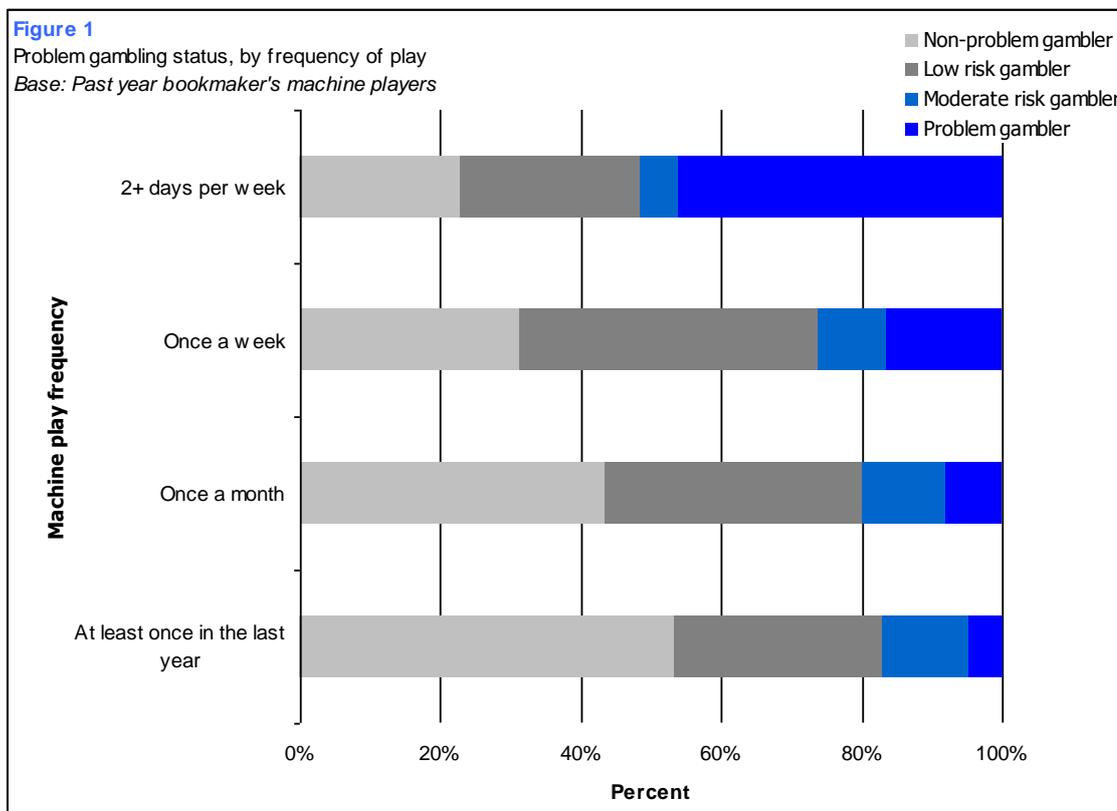
Problem gambling is typically defined as gambling to an extent that compromises recreational, professional and personal pursuits. Implicit within this definition is the idea that an individual gambles to the detriment of other activities, which implies that frequency of gambling is an important determinant of problems. There is some evidence to suggest that frequency of gambling is a key indicator that someone may be experiencing harm from gambling (Hafeli and Schneider, 2005; Delfabbro et al., 2007).

However, there is little consensus over how frequent is too frequent in terms of the experience of gambling harm or gambling problems. Indeed, this is likely to vary from person to person based on their personal circumstances. The difficulty with using industry data to assess this is that this background context is unknown. Therefore, the challenge is to understand what frequency of machine gambling is *most likely* to indicate that someone is experiencing harm with their gambling behaviour.

To illustrate this point, the BGPS 2010 shows that there is a strong association between those who play machines in bookmakers more frequently and the experience of problem gambling or at-risk gambling. Of those who gambled on these machines on two or more days per week, 46% were classified as problem gamblers and a further 31% were classified as either low risk or moderate risk gamblers (according to the Problem Gambling Severity Index (PGSI)). Some caution should be taken with these results as they are based on very small base sizes; less than 40 participants had played these machines on two or more days per week. However, it indicates a strong positive association between frequency of sessions and gambling-related problems. This pattern was also evident in the BGPS 2007, providing some consistency of this finding.

Because of small base sizes, it was not (statistically) possible to look at problems among those who gambled on these machines even more regularly than this. It is likely that the optimum threshold indicating greater likelihood of experiencing harm is more frequent than two or more days per week. For example, among those who gambled on machines in bookmakers on more than two days per week, 48% were low risk or non-problem gamblers. This means this threshold is not very sensitive and is likely to include a number of false positives (i.e., classify people as experiencing problems when they do not) if it were used as an indicator of harm (see Figure 1). It is also plausible that greater frequency of gambling offers limited specificity, since players who have higher levels of disposable leisure time and income could engage in a higher frequency of sessions without experiencing harm, though this does not appear to be the case using the BGPS 2010 data. Sensitivity and specificity analysis for those playing machines in a

bookmakers shows that a threshold of two or more gambling days per year is not a very sensitive measure (0.44) meaning that it captures just 44% of problem gamblers who were machine players. However, specificity was good (0.90) meaning that it correctly excludes 90% of non-problem gamblers.



In short, increased frequency of play is a plausible and coherent indicator of harm. There is evidence of a strong association between increased frequency of gambling and the experience of harm that is consistent over time. The relationship between the two appears to have a linear component (i.e., as frequency increases, more problems are reported). However, the threshold of two or more days per week does not appear to be sufficiently sensitive and further exploratory work is needed to define a more reliable threshold for frequency. That said, frequency of consumption also implies a temporal relationship and has analogies with other public health behaviours, such as tobacco or alcohol consumption, where greater levels of consumption produce a greater likelihood of harm.

3.1.2 Duration of play

If frequency of gambling represents how often someone gambles on machines, then duration of play represents how much time someone spends gambling over a given period. This is likely to have a strong interaction with frequency of gambling in terms of how reliable it is as a potential marker of harm. It is this potential interaction which is considered here.

From a theoretical perspective, the argument relating to how plausible this is as a marker of harm is similar to that given for frequency, in that the longer an individual plays for, the more likely they may be to experience problems with the way in which they play (i.e., longer play could be an indication of preoccupation or needing to gamble for longer to gain the same level of excitement, dereliction of other duties, or loss of control). However, this needs to be carefully contextualised alongside overall patterns of frequency of play. One single very long

session of play may not itself be problematic, but it could be if it is a repeated pattern or it is a very unusual pattern of play for that person. There is some evidence to suggest that long sessions of play may be indicative of harm for some individuals. Schellinck and Schrans (2004) reported that playing for more than three hours in one session was a significant predictor of whether someone had a gambling problem among Video Lottery Terminal players in Nova Scotia. In the same study, when duration of session was used in conjunction with negative mood or 'feeling sick or sad', it was the strongest predictor of problem gambling status. Delfabbro and colleagues found similar support for duration as a predictor of harm among 700 casino customers in Australia.

It is also increasingly acknowledged that some individuals can have episodic patterns of higher engagement where problems are particularly acute for a short and intense period of time (Delfabbro, 2013; Jackson et al., 2010; Reith & Dobbie, 2012). This evidence suggests that duration alone may be an inconsistent marker of harm and needs to be contextualised with frequency and, where possible, normal patterns of play. This approach has been taken in consideration of online gambling, whereby a combination of frequency of bets and duration of play have been used to create an index of time spent gambling. This index has been used as a proxy measure of gambling intensity (Braverman, Toms & Shaffer, 2013).

Following this approach, evidence from the BGPS 2010 provides some limited insight into this. Individuals who regularly played machines in a bookmaker's (monthly or more) reported the amount of time they spent playing machines on a typical day. This can be combined with their reported frequency of play to estimate the number of hours spent playing machines in a year. This analysis shows that those who spent more than 39 hours gambling on machines per year had the highest proportion of problem gamblers (c.32%). The equivalent estimate for those who spent less than 12 hours per year playing machines was 7%. The difference was significant at the 99% level ($p < 0.001$), providing evidence of a strong association. It is not possible to replicate this finding from other data, so consistency of the association is unknown. Because of small base sizes it was not possible to produce sensitivity or specificity estimates for this.

Therefore, total duration of play (across a number of sessions) may be a plausible marker of harm. It displays a strong, and relatively linear association and is coherent with research in other fields. Its consistency, sensitivity and specificity in a UK context are, however, unknown.

3.1.3 Net expenditure

Elevated levels of expenditure on gambling may also be indicative of gambling-related harm (Delfabbro et al., 2012). Many of the criteria for the assessment of gambling-related problems are underpinned by financial losses (i.e., chasing losses, increasing expenditure over a given period, experiencing financial difficulty because of expenditure, and committing crime to fund gambling) giving this coherence as a potential marker of harm. As with frequency and duration, levels of expenditure and 'affordability' to the person are likely to vary considerably. Unlike other policy areas (e.g., how much of disposable income one spends to be considered to be experiencing fuel poverty), there is no accepted standard relating to how much expenditure is too much. Interestingly, Norway have mandated global limits on net losses, restricting players from engaging if they go beyond their daily or monthly limits (these limits are the equivalent of \$75 per day or \$390 per month), though the rationale for choosing these thresholds is uncertain.

With focus on machine play specifically, a number of international studies have concluded that a disproportionate amount of money spent on machines comes from problem gamblers (Blaszczynski et al., 2005; Williams & Wood, 2007). In Britain, similar findings (albeit with

notable caveats) have been confirmed using the BGPS data (Orford, Wardle & Griffiths, 2012). The Gambling Commission has noted that this is consistent with other problem consumption areas, where 20% of consumers contribute to 80% of consumption/revenue. Known as the Pareto Principle, this states that for many phenomena 80% of consequences stem from 20% of the causes (Gambling Commission, 2008).

Therefore, one application of net expenditure patterns to the identification of gambling-related harm would be an attempt to identify those players who contribute the highest levels of expenditure, based on the 80/20 rule. This could also be considered for individual sessions of play within a given timeframe. The pattern that a disproportionate amount of expenditure comes from problem gamblers is plausible, has a strong association, is coherent and is consistent. However, further work would need to be undertaken to assess how specific and sensitive this measure is.

For this study, we are also interested in the obverse situation: that is, not how much total expenditure comes from problem gamblers, but rather what level of expenditure is more likely to indicate that someone is experiencing harm. On this question, there is rather less evidence. This may in part be related to the difficulty of measuring expenditure within survey settings (see Wardle et al., 2007, Chapter 2, for discussion of this). However, there is some consistent survey evidence that those with problem gambling symptoms report higher levels of expenditure on gambling (Gonnerman & Lutz, 2011). This may, in part, be a function of increased frequency (and/or duration) of play; this needs to be considered as a possibility. Evidence from the BGPS 2010 also showed a similar pattern, although base sizes were very small and therefore should not be relied upon as evidence of a strong association.

Therefore, increased levels of net expenditure seem a plausible indicator that an individual may be experiencing harm. This is both coherent and consistent with knowledge relating to the Pareto Principle. However, the strength of the association is unknown, as is any information about what threshold of expenditure is more or less likely to indicate that someone is experiencing problems. Therefore, how specific and sensitive this measure may be is also unknown.

3.1.4 Number of activities undertaken

This has two distinct components in relation to its potential use as a marker for harm. The first relates more broadly to the number of gambling activities undertaken, which is discussed more fully in Section 3.1.5, as a component of gambling involvement. The second relates to the number of different types of games available on machines in bookmakers. This second component is considered in Section 3.2.1.

The first aspect, looking at the number of different gambling activities undertaken more broadly, requires a number of considerations. The first is practical and relates to whether it is possible to discern this from industry-held machine data. The second relates to what threshold for participation should be used and over what time period (i.e., is it number of activities undertaken in the last week, last month or year that is important?). The answer to the first questions is both yes and no. For player tracked data, it will be possible to see if a machine player is also a horse race bettor, other sports bettor, and depending on data integration models, it may be possible to see what they do online with a specific operator. Therefore, it seems there is some utility in exploring this further. Combined data from the BGPS 2007 and 2010 allow us to explore this further, from a theoretical perspective.

Figures 2 and 3 show problem gambling prevalence among bookmaker's machine players by the number of activities engaged in. As can be seen from these charts, problem gambling prevalence increases as the number of activities increases, though a steeper gradient is evident when looking at number of activities undertaken in the past week.

Figure 2

Problem gambling prevalence by number of activities undertaken in past 12 months

Base: Those who played machines in bookmakers, 2007; 2010

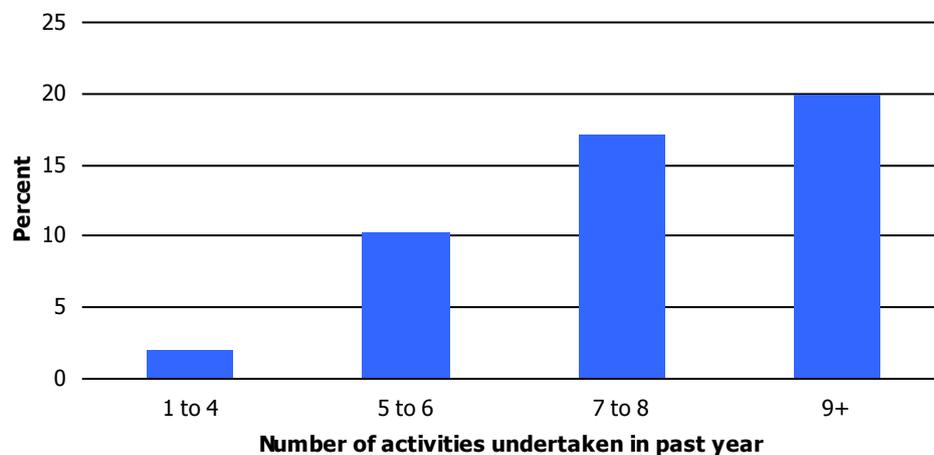
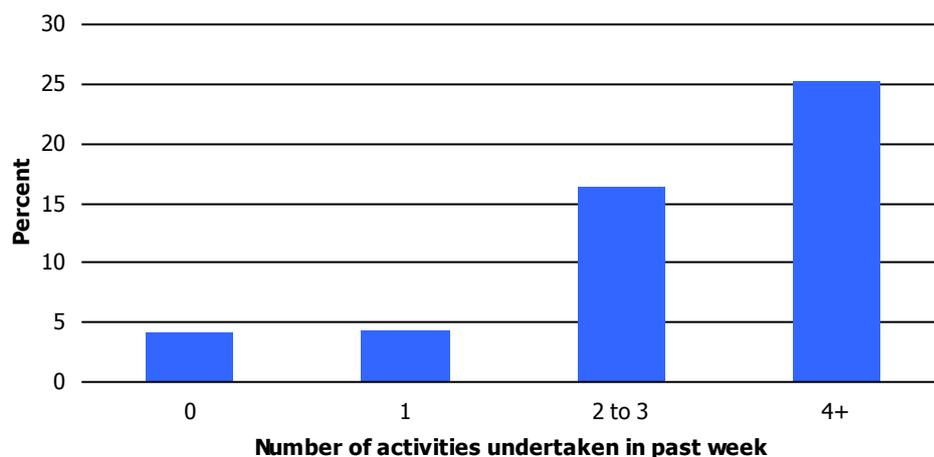


Figure 2

Problem gambling prevalence by number of activities undertaken in past 7 days

Base: Those who played machines in bookmakers, 2007; 2010



This shows that whilst the prevalence of problem gambling is highest among those who engage in more activities, some problem gamblers also engage in fewer activities (specifically, around 4% of machine players who had not gambled at all in the past week were problem gamblers). Using number of activities alone as indicator of harm would result in some classification error. This can be assessed by looking at sensitivity and specificity probabilities for this data.

For the purposes of this study, these figures assume that a threshold is identified whereby those above the threshold would experience a responsible gambling intervention and those below would not. The trick is to try to ensure that the threshold is sufficiently robust to capture as many 'true' cases as possible (i.e., problem gamblers) and correctly exclude as many 'false' cases as possible (i.e., non-problem gamblers). To illustrate this, we assume the following arbitrary thresholds represent high engagement:

- nine or more activities in the past year;
- four or more activities in the past week;
- three or more activities in the past week.

Sensitivity and specificity probabilities for each threshold are shown in Table 1.

Table 1: Sensitivity and specificity estimates for different thresholds of number of activities undertaken		
	Sensitivity (i.e., the proportion of problem gamblers correctly identified)	Specificity (i.e., the proportion of non-problem gamblers correctly excluded)
Past year (nine activities or more)	0.48	0.76
Past week (four or more activities)	0.50	0.80
Past week (three or more activities)	0.73	0.63

This illustrates that using nine or more activities per year as a threshold for an intervention would only correctly capture 48% of problem gambling machine players, meaning its sensitivity is poor, though it does correctly exclude 76% of non-problem machine players. Using four or more activities per week marginally improves both sensitivity and specificity; whilst using a threshold of three or more activities per week vastly improves the sensitivity of the measure, with 73% of problem gamblers being correctly captured, but reduces its specificity to 0.63 (meaning only 63% of non-problem machine players would be correctly excluded).

Therefore, number of activities undertaken is a plausible marker of harm; there is a strong association between increased number of gambling activities and the experience of harm. When looking at very regular engagement, there does appear to be some evidence of a dose-response relationship but there are some reservations around how sensitive and specific different thresholds might be as a marker of harm.

3.1.5 Levels of play engagement (i.e., how often, how long, how much money, etc.)

In the past few years, academic literature has started to examine how broader levels of gambling engagement may be related to the experience of problem gambling. Gambling involvement has been used as a broad-ranging term and taken to include combination of how many activities people engage in, how much time and/or money is spent and how often they play. Because of a lack of operational definitions, proxies for gambling involvement have been derived by using the number of activities undertaken in the past year (LaPlante et al., 2009). This has since been extended to include domains of breadth and depth of engagement – where breadth represents the number of activities undertaken and depth represents the number of days that someone engages in gambling (LaPlante, Nelson & Gray, 2013). Empirical examination has focused on the ‘involvement effect’, a phenomenon which shows that levels of gambling involvement are a more powerful predictor of gambling problems than engagement in single activities alone (LaPlante et al., 2009; LaPlante et al., 2013; Afiffi et al., 2013). This has led to the conclusion that:

‘broader patterns of gambling behavior, particularly the number of types of games played over a defined period, contribute more to problem gambling than playing

specific games’ and that ‘focusing on a narrow direct cause (e.g., game type) for gambling problems needs to shift towards a more complex model that also includes the level of gambling involvement’

(Afiffi et al., 2013)

The theory of the ‘involvement effect’ is both plausible and coherent with existing knowledge. It has also been shown to be consistent, with similar findings evident using UK, Canadian and European data. However, there has been relatively little empirical examination of the mechanisms of how this works or examination into how much is too much. LaPlante et al. (2013) reported a steep linear relationship between breadth of gambling involvement and their measurement of problem gambling, that levels off at four activities (those playing four or more games at that site were around four times more likely to be identified as problem gamblers).

Brief examination of different measures of gambling involvement (i.e., number of activities vs number of gambling days per year) as a predictor of gambling problems showed varying results depending on which measure of gambling involvement was used (Wardle et al., 2011). Therefore, accurate definition of higher or lower engagement among machine players is relatively underexplored, as are thresholds that might more accurately represent greater risk. Involvement is a useful concept in terms of identifying potential risk as it fundamentally deals with clusters of behaviours across a range of spectrums, but more work needs to be done to define this and examine its relationship to harmful behaviour.

3.1.6 Chasing

Chasing losses is a key characteristic of problematic gambling behaviour and there is evidence to suggest that it is a useful predictor of gambling-related harm (Hafeli and Schneider, 2005), particularly chasing strategies by placing higher bets at shorter odds (Xuan & Shaffer, 2009). The DSM-IV screening instrument asks individuals to report how often they go back *another day* to win back money that they have lost (note the emphasis on another day, clearly implying loss-chasing behaviour between sessions). The PGSI includes a similar item. Chasing losses is therefore broadly accepted as a harmful gambling behaviour. Of the problem gambling criteria, chasing losses is typically the most highly endorsed. This finding has been demonstrated repeatedly within the BGPS series and also within surveys such as the Adult Psychiatric Morbidity Survey and the England and Scottish Health Surveys. Typically, between 2%-4% of adults living in private households report chasing their gambling losses. Estimates are higher among past year gamblers, where around 15% reported chasing losses at least sometimes when they lost (Wardle et al., 2011).

Among those playing machines in bookmakers, chasing losses was a highly endorsed behaviour. Between 10%-18% of those who play machines in bookmakers reported chasing their losses at least most of the time that they lost. However, among this group of gamblers, this item was not always the most highly endorsed problem gambling criterion. In 2010, preoccupation (i.e., thinking about gambling, reliving gambling experiences, etc.) was the most highly endorsed item (17%) among those who played machines in bookmakers (Wardle et al., 2013a). See Table 2 (reproduced from Wardle et al., 2013a).

Table 2: Endorsement of DSM-IV items among those playing machines in a bookmaker's, by survey year

DSM-IV item	2007 %	2010 %
Chasing losses	17	10
A preoccupation with gambling	18	17
A need to gamble with increasing amounts of money	8	8
Being restless or irritable when trying to stop gambling	7	7
Gambled as escapism	9	6
Lying to people to conceal extent of gambling	10	5
Having tried but failed to cut back on gambling	7	4
Having committed a crime to finance gambling	2	1
Having risked or lost a relationship/job/educational opportunity because of gambling	5	3
Reliance on others to help a financial crisis caused by gambling	7	8

In the BGPS 2010, 8.8% of those playing machines in bookmakers were categorised as problem gamblers, yet 10% endorsed chasing losses. This suggests some variation around how sensitive and specific chasing is as a measure of gambling-related harm.

Sensitivity and specificity analyses have been produced using the DSM-IV items and screening instrument (see Table 3). This shows that using the chasing losses item (where endorsement is classified as gamblers doing this at least most of the time that they lost) as the threshold for an intervention correctly identifies 67% of problem gamblers; meaning that 33% of problem gamblers would be excluded from any intervention. However, specificity is high as 96% of non-problem gamblers would be correctly excluded from an intervention measure. If the threshold of endorsement is lowered (i.e., to include those who sometimes chase losses) sensitivity increases to 1.00 but specificity reduces to 0.64. This shows that there are trade-offs to consider about the balance of sensitivity and specificity when thinking about what patterns may plausibly represent that harm is being experienced.

Table 3: Sensitivity and specificity estimates for chasing losses as a marker of problems

	Sensitivity (i.e., the proportion of problem gamblers correctly identified)	Specificity (i.e., the proportion of non-problem gamblers correctly excluded)
DSM chasing only (i.e., reporting chasing most of the time they lost)	0.67	0.96
DSM chasing only (i.e., reporting chasing some of the time they lost)	1.00	0.64

Chasing losses between sessions of play is a plausible, coherent and consistent marker of harm. There is a reasonably strong relationship between this and the experience of problems, especially among those who chase losses more frequently. Some thought needs to be given to specificity, as lower frequency chasing is a pattern of behaviour reported among those not defined as problem gamblers.

It is also likely that what constitutes ‘chasing’ behaviour may manifest itself in different ways in different gamblers. For example, a ‘loose’ form of chasing might include ‘extended engagement holding out for a high value win’ (something that most gamblers would do on occasion) through to a more precise definition capturing a more dedicated and systematic attempt at financial reparation, particularly when expenditure exceeds affordability. This too needs further consideration, as different patterns of chasing may be evident in industry-held machine data. More consideration of what chasing losses means and how it varies for different people in different circumstances is needed.

3.2 Within-session metrics

Within-session metrics are events that occur within a specific session of play that might indicate that an individual is experiencing harm in that single session of play. As noted in the introduction, splitting the presentation of analysis is an artificial construct as it relates to the types of data we have. The vast majority of industry data only shows a single (proxy) session of play that does not link between sessions.³ Therefore, it is useful to consider what patterns might be evident that show harm *within* a single session of play. We recognise, of course, that there is interplay between within-session and between-session patterns of harm. The key is that with player tracked data, we can look at both within and between sessions of play. However, with proxy session data we can only ever look at a single session of play.

3.2.1 Number and type of games played

A within-session behaviour which could be considered a marker of harm is increased engagement with a number of different games available on the machine terminals themselves. Machines in bookmakers typically offer dozens of games which are different game varieties (i.e., variants of roulette and blackjack, slot-style games, instant draw-based games). To our knowledge, there is no evidence which looks at how engagement in a number of different types of games within the same gaming terminal is related to the experience of gambling harm. However, one might theorise that the mechanisms of this relationship are similar to those hypothesised for engagement in other gambling activities more generally. The BGPS sheds some limited light on this. In 2010, every respondent who reported playing machines in a bookmaker’s was asked what types of games they played: this included roulette, poker, blackjack, slot-style and jackpot games. The vast majority of players reported that they only played one game type on these machines (75%) and problem gambling rates did not vary according to the number of different types of games machine players reported engaging in. However, caution should be applied as this is based on small number of people, and a larger sample of more machine players may show different results. There is some evidence however that players will persist, within-session, with some games until a large prize is won (Delfabbro et al., 2007), particularly in relation to slot-style games (Parke and Griffiths, 2007) in jurisdictions where compensated technology⁴ currently exists. There may also be an interaction between the number and type of game engaged in; this too should be explored.

In summary, it is plausible, coherent and analogous with other knowledge that increased engagement with a number of different game types on a machine may be a marker of

³ The term proxy session refers to a process by which industry data is divided into discrete ‘chunks’ based on what is most likely to represent individual sessions of play. This usually relies on some consideration of the length of time a machine has not been in use and/or cash in and out status.

⁴ Compensated technology implies that the outcomes of gambling games may be influenced by the outcomes of previous play. It may be the case that even when customers are playing on random gaming machines, misunderstandings may develop and then be applied to such machines.

gambling-related harm. However, there is little evidence about the strength of this association or how consistent or specific it is. Furthermore, it may be difficult to disentangle the effects of changing games within sessions from chasing behaviour. There may be a case for a shift in games within-session to enable chasing where the new game represents an increase in stake size, e.g., moving from slot-style B3 games, with a maximum £2 stake to £100 stakes in B2 games. This should be explored and requires focus on motivations for switching games.

3.2.2 Debit card payment, ‘reloading’ and ‘switching’

This section covers the way in which people may pay for their session of play and how that varies. In a bookmaker’s, debit cards can only be used for payment to play a machine via the cashier’s counter. There is no published evidence showing how many players load cash onto machines via their debit card or at what stage in play this happens (i.e., whether players start with their debit card, or use cash first and then switch to a debit card). Therefore, there is no evidence about whether this could be a potential marker for harm.

However, using a debit card to load credits onto gaming machines could, to some extent, be viewed as being analogous to using an ATM in the venue, in that it is a means to access additional funds to continue gambling once cash has been exhausted. There is evidence to suggest that problem gamblers are more likely to use ATM facilities in gambling venues or to use other means (e.g., borrowing) to raise funds for continued gambling (Delfabbro et al., 2007; Hafeli & Schneider, 2005; Ladouceur, Blaszczynski & Moodie, 2008; Schellinck & Schrans, 2004; White et al., 2006), and that problem gamblers are more likely to use such facilities more than once within the same session (Delfabbro et al., 2007; Hafeli & Schneider, 2005; McMillen, Marshall & Murphy, 2004) a process referred to in the industry as ‘reloading’. While it is less clear whether using a debit card once represents a risk, it is plausible that repeated debit card deposits for gaming machine play signifies spending more than originally intended. Given the inconvenience of enacting multiple debit card transactions within one session (e.g., breaking play, leaving the machine, going to the customer service desk, having multiple gambling transactions on one’s bank statement), it could be argued that customers will initially deposit an amount no less than they intend to spend in that particular session.

Reloads may be more indicative of harm when the reload amount is higher than the original deposit for the same reason, and/or when the number of reloads within a session increases, and/or when the payment methods change. However, there has been little empirical examination of this, and exploration of the pattern of ‘reloading’ and potential ‘switching’ of payment types within a session warrants further consideration. Within an online environment it has been suggested that those who deposit greater amounts of money within a session may be more likely to be problem gamblers, as this might indicate poor planning and could be an indicator that a player is starting to chase (Griffiths, 2010; 2012). Griffiths has also suggested, within an online environment, that switching deposit payment methods may also indicate poor planning and be indicative of chasing behaviour, though to our knowledge this has not been empirically substantiated.

Therefore, it is somewhat plausible that ‘reloads’ could indicate harm if the ATM analogy is correct; it is somewhat coherent with existing knowledge but there is no evidence about the strength of this association, its consistency or how specific or sensitive it is. In particular, the evidence about the pattern of reloading or switching behaviour and whether this is associated with gambling-related problems is unknown.

3.2.3 Debit card payment decline

A debit card payment decline may be an indicator that funds in a particular bank account have been exhausted. The usefulness of this indicator depends on whether it is specified that the decline reflected insufficient funds, and/or whether the individual has multiple accounts, and whether the account in question represents the individual's main account. Clearly, if an individual is exhausting all remaining funds in their primary bank account, it is likely to be one of the strongest indicators that they are experiencing harm as a consequence of their gambling.

Therefore, this is highly plausible as a marker of harm and is coherent with other knowledge about excessive engagement being related to money and debt problems, with common definitions of harm including gambling more than one can afford to lose.

3.2.4 Variability in staking behaviour

Most games on machines in bookmakers allow players to change their stakes within-session, between set minimum and maximum amounts (B3 games allow stakes between 25p to £2 and B2 games allow stakes of 20p up to £100). High variability in staking behaviour has also been shown to characterise 'high-risk' internet gambling (Braverman & Shaffer, 2010; Dragicevic et al., 2013; LaBrie & Shaffer, 2011, Xuan & Shaffer, 2009). Examination of online self-excluders has also shown that prior to closing an account, self-excluders increased their stake size per bet (Xuan & Shaffer, 2009). This adds some coherence to this theory and provides a reasonable analogy with other behaviours.

However, individual changes in stake sizes need to be contextualised in terms of what else is happening within the session. For example, is increasing stake size an issue if the player is financially 'up'? Is increasing stake size an issue if the player is playing with the money from the 'house' rather than their own money? How do patterns in staking vary based on whether the funds are the player's own or those of the 'house'? It is plausible that increasing stake size may be more problematic when the player has just experienced a losing streak. Likewise, some increases in stake may be part of a consistent betting strategy (i.e., the Martingale system of doubling stakes after losses). These issues have not been examined. Therefore, is it most plausible to say that increases in stake sizes may indicate that a player is losing control or chasing *if* they are losing within a session. The use of this as an indicator may be plausibly improved when considered alongside patterns of reload and/or switching types of reload patterns.

3.2.5 Use of repeat bets/autoplay

The ability to repeat bets is a function offered by machines whereby a player can choose to repeat the exact bet previously placed on a game simply by pressing a button. This function is similar to the autoplay function of some machines whereby the player can choose a game and stake level and allow the machine to play automatically without the need to press any further buttons to initiate a game. However, the main difference is that the repeat bet button still needs to be pressed to initiate the game.

There has not been, to our knowledge, any empirical examination of the use of the 'repeat bet' button. While Parke and Griffiths (2007) identify that autoplay is a risk factor for gambling-related harm, there has also been limited actual empirical evidence available to support this claim. It is not clear how players use the autoplay function on machines and whether this is

something which might indicate that a player is experiencing a loss of control or not. One study examined this among amusement arcade machine players; this showed some interesting results (Husain et al., 2013). First, those machine players who were classified as ‘more controlled’ (that is, they had clear intentions about how much money and time they wanted to spend in a session and stuck to them) tended not to use autoplay, as they felt autoplay would give them less control over their session of play. Some ‘less controlled’ players (those who had preset intentions about how much money and time to spend in a session but did not stick to them) used autoplay when they had been playing for a long time and when they were tired. Some also used autoplay when they had lost money and used it to see if the machine would pay out. Finally, this study noted that ‘not controlled’ players believed that using the autoplay button would increase their chances of winning by changing how the ‘machine felt’ or by giving out more wins compared with manual play.

This study was conducted among machine players in amusement arcade venues, playing on a different range of machines to those in bookmakers. Therefore, it is not certain whether similar views and practices would be held among machine players in a bookmaker’s. However, this evidence suggests that some machine players hold specific beliefs around use of autoplay and levels of control within a session. There are also some specific (erroneous) beliefs that using autoplay will change the way the machines plays. It remains to be seen if similar patterns of engagement and belief are evident among those using the ‘repeat bet’ functions on machines in bookmakers.

It is also plausible that use of the repeat bet function increases speed of play (i.e., it take less time to place the bet), which may have implications for increasing the rate of monetary expenditure and reducing reflection time for considering implications of actions. It may also be that the point within a session that players switch to repeat bets indicates a shift in motivation, from seeking fun and focusing on the experience of game play (experiential) to simply discovering the gambling outcome for the purposes of winning their money back (financial reparation). Therefore, use of repeat bets is a plausible marker of loss of control, but further examination is needed to explore this.

3.2.6 Play of multiple machines simultaneously

Playing more than one machine at a time has been identified as a potential indicator for problem gambling (Delfabbro et al., 2007; Hafeli and Schneider, 2005; Schellinck and Schrans, 2004). This approach may suggest the need for more excitement and risk. Alternatively, this approach could plausibly be used as a way to augment stake size or expedite chasing by permitting more money to be risked within a given timeframe.

Therefore, it is plausible that playing multiple machines simultaneously could potentially indicate risk of harmful play and this is coherent with existing knowledge. However, the strength of the association, its consistency, specificity and sensitivity are all unknown.

3.2.7 Stake size

There are plausible arguments why higher staking behaviour may be indicative of more harmful patterns of play. First, ‘tolerance’ (i.e., needing a higher ‘dose’ to maintain the same experience) has been identified as a key component of addiction generally (Marlatt, Baer, Donovan & Kivlahan, 1988), and gambling specifically (Griffiths, 1993). Second, stake size remains the main mechanism by which players modify cost of play, and therefore how much money they can lose. All things being equal, at higher stakes, players lose more money (although we recognise that with games like roulette, there is an important interaction with

bet type, i.e., high stakes on red or black is arguably less risky than a lower stake on a single number).

There is empirical evidence that suggests that higher levels of staking may be indicative of harm (Blaszczynski, Sharpe & Walker, 2001; Sharpe, Walker, Coughlan, Enersen & Blaszczynski, 2005; Xuan & Shaffer, 2009). Specifically in relation to gaming machines, Blaszczynski and colleagues, in an ecologically-valid experiment in real gaming venues, found problem gamblers were more likely than non-problem gamblers to bet amounts greater than one dollar per spin (Blaszczynski, Sharpe & Walker, 2001; Sharpe, Walker, Coughlan, Enersen & Blaszczynski, 2005). In a study examining actual internet gambling behaviour, larger stake sizes were also found to be predictive of whether a responsible gambling alert was triggered at an internet gambling operator (Gray, LaPlante & Shaffer, 2012).

However, stake size as a marker may have lower specificity since harm may also be done at low to moderate staking levels (Blaszczynski, Sharpe & Walker, 2001; Sharpe, Walker, Coughlan Enersen & Blaszczynski, 2005) over longer periods of time or among those with lower levels of disposable income.

3.2.8 Game volatility

Game volatility exists on a spectrum spanning games which offer smaller, more frequent wins (low volatility) to games which offer less frequent, less predictable wins but at higher value (high volatility).

According to learning theory, the delivery of rewards most likely to induce persistence in any given behaviour is a variable ratio schedule of reinforcement (Skinner, 1953). This means that the target behaviour (in this case placing a bet) is not always rewarded (hence 'ratio') in a predictable way (hence 'variable'). A game with higher volatility is more likely to operate on a variable ratio schedule of reinforcement because of the less frequent and more unpredictable rewards. Therefore, in theory, playing high volatility games may be a plausible indicator of greater risk of harm. This is coherent with existing theory, though this has yet to be empirically examined. It could plausibly be argued that if players come to expect longer periods of sustained losses followed by larger wins, some players could understandably be willing to persevere longer and be more resistant to 'extinction' (i.e., learning from past losses). Players may even view expenditure within that session as a 'sunk cost'⁵ which may encourage perseverance during periods of sustained losses; similar to why some lottery players choose the same numbers for fear that their previous numbers may be at some point be the winning numbers (Arkes & Blumer, 1985; Rogers, 1998).

One of the most plausible indicators of harm is likely to be looking at the different types of play within a session and also what happens on the 'journey' within a session. Some of this relates to aspects already discussed in Section 3.1 but is worth repeating here. For example, a higher level of expenditure may be a plausible marker of harm (i.e., higher stakes). This may be combined with how long an individual plays for and how many bets they place. In short, using these variables in combination may help to identify different clusters of session types which range on a scale of engagement. Of course, a single session of high engagement may not of itself indicate harm but it may be a useful marker of potential harm – this needs to be explored.

⁵ As the term suggests, 'sunk cost' refers to the increased likelihood to continue a behaviour after a significant investment of time or money.

Another aspect of this is mapping what happens within a session and how the player progresses through play. For example, there has been much critical focus on the £100 maximum bets on B2 games. However, little is known about how many people bet at this maximum level or how they progress to maximum bets. For example, if someone starts with small stakes and progressively increases their stakes to a £100 maximum, then this may be indicative of chasing behaviour. Likewise, some people may display a step change rather than a progression in stakes, switching suddenly to a much higher amount. There is no evidence to prove that these are markers of harm, but they are plausible and coherent with some existing knowledge.

There are a number of different patterns in the session journey that it may be useful to consider:

- increasing stake sizes (either progression, step change or volatility within the session);
- changing the type of games played and the point in the session journey at which this happens;
- increasing the number of bets placed – making more risky/volatile bets or increasing the number.

3.2.9 Cash-out

The act of cashing out or withdrawing funds from a gaming terminal could (plausibly) be considered a behaviour displayed by individuals less likely to experience harm. Withdrawing funds before they are depleted during a session may indicate at least some level of control over play. It may indicate that a player will not necessarily continue playing to the point where they exceed affordable levels of time or money. This also indicates that the gambler is able to stop gambling voluntarily rather than because they exhausted their funds (Hafeli & Schneider, 2005; Delfabbro et al., 2007), or because the venue had closed (Hafeli & Schneider, 2005; Delfabbro et al., 2007), or, at the very least, that they were able to self-impose breaks in play (Hafeli & Schneider, 2005; Delfabbro et al., 2007) even if they did continue gambling on the same or different machines following the cash-out. Regarding the last point, one potential limitation with this marker is that it may not, in reality, indicate a termination of the session in some instances, but rather a brief break in play on the same machine or a move to a different machine in the same venue.

3.3 Contextual metrics

These are potential metrics which may or may not be recorded in industry data but that could add contextual understanding and might indicate that an individual is experiencing problems.

3.3.1 Staff interactions, such as requests for information about gambling problems or complaints to staff

It feels self-evident that if a player requests information about gambling problems, they may be experiencing problems. Triggering responsible gambling interventions by staff has been used as a proxy for the experience of gambling-related harm in online research (Gray, LaPlante & Shaffer, 2012; Hafeli et al., 2011). It is therefore plausible and coherent that this could be a reasonable proxy for the experience of gambling-related harm in bookmakers.

There are a number of different types of staff interactions that could also be considered, aside from request for or triggers for responsible gambling information. Complaints to staff about

the nature/outcome of a session may also plausibly be viewed as something which indicates that someone has experienced harm, at least in the short term (Hafeli et al., 2011).

3.3.2 Irrational or aggressive behaviour documented by staff

It is possible that staff may document any irrational or aggressive behaviour displayed either towards them or the machine by players. Hafeli and colleagues (2011) reported that among a sample of internet gamblers threatening tone was the most significant predictor of whether a player was going to self-exclude. The authors suggested that this may reflect stress felt by the player as a result of the gambling-related harm being experienced and an absence of adaptive coping techniques. This evidence provides a reasonable analogy for machine play. This type of behaviour was one of the most consistently noted behaviours from the consultation, therefore making this both a plausible and coherent potential marker of harm.

3.3.3 Venue location

In public health, it is accepted that spatial factors can affect behaviour. Wardle et al. (2013b) have demonstrated that there are areas of high density of gambling machines in Great Britain. These areas are high density relative to both the resident population and to geographic space. These high density machine zones tend to have greater levels of income deprivation, have a younger resident population, and to be more ethnically diverse. These factors have been demonstrated to be associated with the experience of gambling problems. Whilst this evidence has not looked at the relationship between greater availability of machines and behaviour, it does show the possible presence of a spatial relationship.

It is therefore plausible that venues situated in areas of very high deprivation, for example, may serve a population that is more 'at-risk' of the experience of harm. This relationship is plausible and is coherent with existing knowledge, especially similar public health issues which have shown a relationship between consumption and outlet density for products such as alcohol or fast food. However, the shape of this relationship is unknown and some academics have argued that there is not a linear (dose/response) relationship between availability and problems (LaPlante & Shaffer, 2007). How behaviours vary at this venue/area level is unknown, but based on research from other public health areas, this could be a promising area of investigation.

Finally, venue location does not need to be restricted to density; accessibility is also an important component. This might include opening hours, ease of accessibility (e.g., presence of local parking, ease of access via public transport), the type of location of a specific venue (i.e., high street indicating that it may be positioned to appeal to passing trade, users of night time economy or local workers, or more local and suburban (indicating serving a more resident population)). Access and availability were highlighted as key ecological determinants in the pathways model of problem gambling (Blaszczynski & Nower, 2006). Therefore there may be some interesting interactions to explore between accessibility of a single venue and availability within a broader area and its relationship to gambling-related harm.

3.3.4 Location of machine within venue

Machines can be located in various places around bookmakers. In a recent initiative the Association of British Bookmakers has announced that it will attempt, where possible, to move machines closer to the cashier's counter so that staff have more opportunity to run age verification checks. This is an example of how machine location may affect who chooses to play them; in this case, underage gamblers choose machines that are furthest away from staff.

There is no evidence which suggests that people who experience harm are more or less likely to have certain preferences for playing machines in particular locations, though industry representatives have noted that machine players tend to be quite superstitious, which might influence their choice. Therefore, whilst it is not especially plausible that there is a systematic pattern evident relating to this, it is worthy of further exploration.

3.3.5 Other behaviours

There is a range of other behaviours to consider that could indicate the possible presence of harm. There is very little evidence available for each, and indeed it is unlikely that we could include them within our analysis of industry data. They are documented here for completeness.

- Asking for a certain machine to be reserved – machine players are highly superstitious and can display different preferences for certain machines (Hafeli & Schneider, 2005; Reith, 2005; Schull, 2012). It is possible that players exhibiting particular attachments to certain machines could be playing in an unhealthy way. It could also mean the players are chasing losses from a particular machine and wish to prevent someone from playing their machine while they seek additional funds or use the restroom. However, equally it could be part of the enjoyment of play. This needs further exploration.
- Players who are difficult to remove from the premises at the end of the day may be experiencing harm. Whilst this is plausible, there are also certain groups of people who may legitimately want to stay for as long as possible (e.g., those who are homeless).
- Observations of other behaviour – such as ignoring other social interactions, phone calls or interactions via mobile phones, etc. – may indicate that a player is preoccupied with their gambling. This is plausible but generally unproven.

4 Summary of markers against the Bradford Hill criteria

The table below summarises the markers outlined in Section 3 against the Bradford Hill criteria. The criteria for each marker are coded on a scale of high, medium, low or unknown. ‘Unknown’ means there is not enough evidence or theory to make an informed judgement. ‘High’, ‘medium’ and ‘low’ relates to how much evidence or theory supports this. For example, if there are a number of studies or theories potentially supporting a criterion, it is marked as high. Fewer studies or less theoretical strength are marked as either medium or low depending on quantity and quality. As noted in the introduction, this is a subjective exercise and the rankings presented below are intended as a guide to help identify gaps rather than providing objective quantifiable data.

Table 3a: Summary of between-session markers of harm against the Bradford Hill criteria						
Criteria	Markers of harm: between-session					
	Freq. of play	Duration of play	Net expenditure	Involvement	No. of activities	Chasing
Strength	High	High	High	High	High	Medium
Consistency	Medium	-	High	High	High	High
Specificity	High	-	-	-	Low	Medium
Sensitivity	Medium	-	-	-	Medium	Medium
Temporality	-	-	-	-	-	-
Biological	High	High	Medium	-	Medium	Medium
Plausibility	High	High	High	High	High	High
Coherence	High	High	High	High	High	High
Experiment	-	-	-	-	-	-
Analogy	High	-	-	-	-	-

Table 3b: Summary of within-session markers of harm against the Bradford Hill criteria

Criteria	Markers of harm: within-session								
	No. of games	Debit-card reload/switching	Debit card decline	Changing stakes	Repeat bet use	Playing multiple machines	Stake size	Game volatility	Way games are played
Strength	-	-	-	-	-	-	Medium	-	-
Consistency	-	-	-	-	-	-	High	-	-
Specificity	-	-	-	-	-	-	Low	-	-
Sensitivity	-	-	-	-	-	-	High	-	-
Temporality	-	-	-	-	-	-	-	-	-
Biological	-	-	-	-	-	-	-	-	-
Plausibility	Medium	Medium	High	Medium	Medium	High	High	High	High
Coherence	Medium	Medium	High	High	High	High	High	High	High
Experiment	-	-	-	-	-	-	-	-	-
Analogy	Medium	Medium	-	Medium	Medium	-	Medium	-	-

Table 3c: Summary of contextual markers of harm against the Bradford Hill criteria				
Criteria	Markers of harm: within-session			
	Staff interactions about problem gambling	Aggression/agitation	Spatial/geography	Machine layout preferences
Strength	High	-	-	-
Consistency	High	-	High	-
Specificity	-	-	-	-
Sensitivity	-	-	-	-
Temporality	-	-	-	-
Biological	-	-	-	-
Plausibility	High	High	High	Low
Coherence	High	High	High	Medium
Experiment	-	-	-	-
Analogy	-	Medium	-	-

5 Conclusions

5.1 Gaps in knowledge

This report has shown that whilst there are many plausible markers of harm, few are supported by a range of evidence that means they could be reliably used **alone** as a marker of harm. The summaries presented in Section 4 show that when assessed against the Bradford Hill criteria for causality in epidemiology, the body of evidence supporting between-session markers of harm is more developed than that for within-session markers of harm. In particular, there appears to be little evidence relating to the strength, specificity or sensitivity of within-session markers of harm. Most of the markers or patterns discussed tend to be only plausible and coherent, though in some cases there are analogies with evidence from other areas of gambling research (such as online gambling behaviour). This lack of robust research evidence in relation to within-session markers is particularly important for the Responsible Gambling Trust's broader research programme. This programme aims to assess whether industry data can be used to identify potentially harmful patterns of play. The most complete data available to do this is what we term 'proxy session' data which presents information for a single session of anonymous play only that cannot be linked to either people or to other sessions. We have demonstrated the sparsity of the evidence base in relation to the identification of within-session markers of harm. Therefore, part of the Responsible Gambling Trust's ongoing research programme should aim to fill some of these gaps in knowledge and improve the evidence base.

5.2 Multiple indicators and interactions

The gaps in knowledge identified above and review of the existing research literature suggests that it is unlikely that individual markers alone will be sufficiently robust to identify harm. For example, Section 3.1 discussed how frequency of play needs to be contextualised with duration of play to better understand play patterns. Equally 'involvement theory' suggests that a more holistic view of behaviour is needed to predict harm. Therefore, whilst markers of potential harm were discussed separately in this report, it is likely that greater utility in examining patterns of harmful play will come from looking at how different markers cluster together. However, greater understanding is required about how many variables are needed to predict harm. As Delfabbro, King and Griffiths (2012) outline in their review of various harm identification studies in land-based venues, while a multivariate approach is likely to be needed to identify problem gambling with a high level of accuracy, an additional one or two variables may be sufficient. For example, in their assessment of a Nova Scotia based study (Schellinck and Schrans, 2004), the use of two indicators ('strong emotional response' and 'preoccupation with gambling') was sufficient to be 90% confident of identifying gambling problems for females in the sample. This needs to be assessed in a UK context.

Furthermore, there will be few markers that on their own will yield high specificity and sensitivity. For example, even debit card payment decline, which could plausibly be suggested to offer high specificity (i.e., there will be few circumstances whereby a player exhausts all available funds in their account and would not be experiencing some kind of harm), this measure will likely offer low sensitivity. In other words, players may still experience harm even if they do not 'empty their bank account' so that simply relying on this alone as marker of gambling-related harm might miss a number of people. A reliable method of identifying gambling-related harm with high specificity and sensitivity will most probably require

numerous markers including behavioural markers identified between- and within-session, and other contextual markers where available.

5.3 The need for context

The introduction to this report stated that harm may be experienced differently for different individuals under certain circumstances. This suggests that interpretation of markers or patterns of harm needs contextual understanding of who the individual is and what their circumstances are. For example, it could be argued that aggression displayed towards a machine or member of staff may be insufficient on its own to suggest a player may be experiencing harm. This could reflect individual differences (e.g., high trait levels of aggression) and the nature of the activity itself. For example, losing is inevitably part of the gambling experience and there will be few players who enjoy losing, regardless of whether they can afford it. If a football fan expresses aggression or frustration while attending a football match, it does not necessarily mean they are experiencing harm. However, if additional markers are also considered, such as increasing stake size, faster rate of play, use multiple debit cards, reload with increasing amounts within-session, and payment declines, one may be able to deduce with greater confidence that this particular player is experiencing harm. A further example is that of expenditure, in that interpreting high volume of losses may need some understanding as to what extent spending exceeds the player's level of disposable income.

5.4 Trade-offs and definitions

Whilst understanding context is clearly important, it is unlikely that this level of contextual information will be available to operators and analysts (though we suggest there is potential utility in exploring whether staff could code behavioural observations and interactions and link this to player data). Therefore, we have to rely on statistical models and probabilities to attempt to identify behavioural markers which are more likely on the whole to indicate that someone may experience harm. This means trade-offs will have to be made: in particular, it is likely that there may be some trade-offs to be made between sensitivity and specificity. Brief analysis presented in Tables 1 and 3 showed how using different definitions and thresholds of harm altered the specificity and sensitivity estimates. Whilst the objective of industry data analysis will be to identify patterns that maximise both, the reality is that gambling behaviour is complex and varied, and not all the information needed to interpret patterns is available. Therefore, it is likely that difficult decisions will need to be made about what level of sensitivity and specificity is acceptable to a broad range of stakeholders. These decisions may vary based on what type of intervention is anticipated. For example, if the intervention is not particularly intrusive then potentially capturing more non-harmful gamblers in the 'treatment' group may well be a trade-off worth making. However, if the intervention is much more intrusive (e.g., involving stopping play) then one would want to make sure as few non-harmful gamblers were subject to this 'treatment' as possible. Therefore, there are trade-offs to be made depending on the context of the intervention, further demonstrating the complexity of attempting to define and measure 'gambling-related harm' in general.

Finally, whilst there is a paucity of research evidence relating to individual markers of harm, there is also a lack of clear definition of what types of patterns or thresholds should be considered as markers of harm. For example, what types of behaviours within-session constitute chasing, what do these patterns look like? Could this include persistence following a sustained and/or statistically less probable series of losses? Does it mean increasing stake size? Does it include changing games and specifically changing game volatility? Is it some combination of these patterns? In some ways, it is likely that the answer to these questions will be data-led as analysis of industry data will permit, for the first time, these patterns of play

and their prevalence to be documented. In short, more conceptual clarity is needed about how to define certain patterns of play. The next stage of the Trust's research programme should be able to contribute towards this.

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Appendix: Consultation responses

The tables below summarise the consultation responses to each question. Responses have been coded thematically from the open text responses. Overall, 37 people responded to the consultation, though not everyone responded to each question

Q1: Among machine players, what types (or patterns) of play do you think are more likely to indicate that someone is experiencing problems with their machine play?

N = 37 respondents

Table A1: Responses to consultation question 1	
Pattern	N
Chasing losses	13
Aggression	12
Agitation/irritable	10
Increasing stake (if losing)	9
Long duration of play	8
Increased speed	6
Change to normal behaviour	4
Getting more cash	4
Increased frequency of play	3

Other behaviours mentioned included:

- use of the repeat bet button;
- concealment of behaviour from others;
- borrowing money from others;
- changing to higher prize games;
- reducing stake to increase duration on machine;
- displacement from reality;
- reserving machines.

Q2: What evidence (if any) do you have to support this?

N = 29 respondents

Table A2: Responses to consultation question 2	
Pattern	N
Direct observation	22
Experience of treating problem gamblers	2
Academic literature	2
Anecdotal evidence	2
Industry report forms	1

Q3: Are there any other contextual factors, which might be captured by betting operators, that you think might indicate that someone is experiencing problems with their machine play?

N = 27 respondents

Table A3: Responses to consultation question 3	
Pattern	N
Agitation/irritable	5
Aggression	3
Using variety of payment methods	3
Change to normal play, behaviour or appearance	3
Repeat credit loading	2
Complaints machines are fixed	2
Damage to machines	2
Returning/attempting to return after exclusion	2

Other factors mentioned included:

- increased frequency of play;
- increased duration of play;
- increased stakes;
- the environment and location of the venue.

Some respondents also wrote about the Know Your Customer initiatives and mentioned that staff were best placed to understand the context of their regular customers' play and to intervene if necessary. However, other respondents also noted how difficult this is to achieve in practice because of single staffing practice, and in some cases the location of machines in shops making it difficult to see who is playing the machines.