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How does the phrasing of house edge information affect gamblers' perceptions and level of understanding? A Registered Report

Philip W. S. Newall^{a,b} , Richard J. E. James^c and Olivia M. Maynard^a 

^aSchool of Psychological Science, University of Bristol, Bristol, UK; ^bExperimental Gambling Research Laboratory, School of Health, Medical and Applied Sciences, CQUniversity, Sydney, Australia; ^cSchool of Psychology, University of Nottingham, Nottingham, UK

ABSTRACT

The provision of information to consumers is a common input to tackling various public health issues. By comparison to the information given on food and alcohol products, information on gambling products is either not given at all, or shown in low-prominence locations in a suboptimal format, e.g. the 'return-to-player' format, 'this game has an average percentage payout of 90%'. Some previous research suggests that it would be advantageous to communicate this information *via* the 'house edge' format instead: the average loss from a given gambling product, e.g. 'this game keeps 10% of all money bet on average'. However, previous empirical work on the house edge format only uses this specific phrasing, and there may be better ways of communicating house edge information. The present work experimentally tested this original phrasing of the house edge against an alternative phrasing that has also been proposed, 'on average this game is programmed to cost you 10% of your stake on each bet', while both phrasings were also compared against equivalent return-to-player information ($N = 3333$ UK-based online gamblers). The two dependent measures were gamblers' perceived chances of winning and a measure of participants' correct understanding. Preregistered Stage 1 protocol: <https://osf.io/5npy9> (date of in-principle acceptance: 28/11/2022). The alternative house edge phrasing resulted in the lowest perceived chances of winning, but the original phrasing had the highest rate of correct understanding. Compared to return-to-player information, the original phrasing had both lower perceived chances of winning and higher rates of correct understanding, while the alternative phrasing had only lower perceived chances of winning. These results replicated prior work on the advantages of the original house edge phrasing over return-to-player information, while showing that the alternative house edge phrasing has advantageous properties for gamblers' perceived chances of winning only. The optimal communication of risk information can act as an input to a public health approach to reducing gambling-related harm.

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The provision of information to consumers is a common input to tackling various public health issues. For example, prominent nutrition and calorie labels on food products can beneficially shift consumer behavior (Bleich et al. 2017; Dubois et al. 2021), as can information about the alcohol content of alcohol products (Blackwell et al. 2018; Hobin et al. 2018). Gambling is another public health issue where related proposals have been made (Eggert 2004; Livingstone et al. 2019; Newall et al. 2023). However, by comparison, gambling information can be criticized on the grounds of a lack of prominence, and suboptimalities with which it is communicated (Newall, Walasek, et al. 2022). This Registered Report contributes to this second issue, by experimentally comparing two equivalent alternatives to some relevant information that is currently given on many gambling products.

One of the most relevant pieces of information about a gambling product is the amount of money that a gambler might expect to lose over time (Harrigan and Dixon 2010;

Woolley et al. 2013). As gambling products are programmed to only pay-out a percentage of all money bet on average, this amount is typically communicated as a percentage. When this information is communicated to gamblers, it is typically shown *via* what is called the 'return-to-player' format, e.g. 'This game has an average percentage payout of 90%' (Collins et al. 2014). This example of 90% means that for every £100 bet, an average of £90 will be paid-out as winnings, for a net loss of £10, and this figure of 90% is roughly representative of the average payouts of electronic gambling machines internationally (Harrigan and Dixon 2009; Schwartz 2013; Woolley et al. 2013). However, previous research suggests that the return-to-player is misunderstood by most gamblers (Collins et al. 2014; Harrigan et al. 2017; Beresford and Blaszczynski 2020). Contrastingly, there are advantages to flipping the percentages, by instead focusing on the average loss *via* the 'house edge' format, e.g. 'This game keeps 10% of all money bet on average'. A return-to-player of 90% and a house edge of 10% are

CONTACT Philip W. S. Newall  Philip.Newall@bristol.ac.uk  School of Psychological Science, University of Bristol, Bristol, UK

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therefore statistically equivalent. However, it has been shown that in comparison to the return-to-player, that the house edge format is understood better by gamblers (Newall, Walasek, and Ludvig 2020a, 2020b), results in lower perceived chances of winning (Newall, Walasek, Ludvig, et al. 2020; Newall, Walasek, and Ludvig 2020a, 2020b; Newall et al. 2023), and also translates into reductions in gambling behavior (Newall, Byrne, et al. 2022). Overall, this research demonstrates several advantages of the house edge format over the equivalent return-to-player format that is currently used on some products in certain jurisdictions (Collins et al. 2014; Beresford and Blaszczynski 2020; Newall, Walasek, et al. 2022).

One limitation of this literature is that previous experimental research on the house edge format uses the same way of phrasing this information. This issue is important, as at least one alternative phrasing has been proposed: ‘on average this game is programmed to cost you [10]% of your stake on each bet’ (Livingstone et al. 2019; p.3). This phrasing is longer, at 16 words compared to nine words, and contains additional words which might either increase the perceived severity of the resulting average gambling losses, or improve gamblers’ comprehension of this information. Previous work suggests that added explanation can alter how gamblers evaluate this information. For example, the addition of a 32-word ‘volatility warning’ significantly decreased gamblers’ perceived chances of winning with both return-to-player and house edge information (Newall, Walasek, and Ludvig 2020b). In order to maximize the present research’s usefulness to policymakers, an experimental comparison will therefore be made between these two exact phrasings of house edge information from the previous literature. We are aware that they differ across several dimensions, which means that any significant differences found here should be subject to follow-on work exploring precise mechanisms. While there is some reason to think that the longer alternative phrasing may be more effective, we do not believe that there is sufficient evidence to support a strong directional prediction at this time.

The present research aims primarily to experimentally compare these two phrasings of house edge information, using a hypothetical gambling scenario which closely follows previous research comparing the house edge with the return-to-player (Newall, Walasek, and Ludvig 2020a, 2020b), using a large sample of UK-based online gamblers. The two outcome measures used are gamblers’ perceived chances of winning measured on a 7-point scale, and rates of accurate responding on a multiple-choice question measuring correct understanding of this information. Effective gambling information should result in a low perceived chance of winning (hence encouraging people not to gamble), and be correctly understood by as many gamblers as possible (ensuring that any decisions to gamble are based on an accurate understanding of the statistical outcomes). Furthermore, seeing as how replication is an important aspect of gambling psychology research (Heirene 2021), a secondary aim of the present research is to attempt to replicate previous findings showing that house edge information

results in higher rates of understanding and lower perceived chances of winning than equivalent return-to-player information. As in previous research, this study will do so *via* a direct replication using the original phrasing of the house edge (Newall, Walasek, and Ludvig 2020a, 2020b), and also a conceptual replication using for the first time the alternative phrasing of the house edge.

The following nondirectional hypotheses are therefore made, that there will be some difference between the two phrasings of house edge information in terms of:

H1. gamblers’ mean perceived chances of winning.

H2. gamblers’ rates of correct understanding.

Furthermore, in following our research aim to replicate previous findings, we make a secondary directional hypothesis comparing each of the two house-edge conditions to a third condition where participants will be given equivalent return-to-player information:

H3. Each of the two house-edge conditions will result in lower perceived chances of winning and higher rates of understanding than equivalent return-to-player information.

Method

Data, materials, an analysis script, and copy of the Stage 1 accepted manuscript are available on the Open Science Framework at <https://osf.io/6hbyp/>. Ethics approval for this study was obtained from the University of Bristol’s School of Psychological Science Research Ethics Committee (#12102). The PCI RR study design template is shown in Table 1. Preregistered Stage 1 protocol: <https://osf.io/5npy9> (date of in-principle acceptance: 28/11/2022).

Participants

Participants were recruited for this study *via* the crowdsourcing platform Prolific. It has been suggested that Prolific can yield superior data quality compared to other crowdsourcing platforms such as MTurk (Eyal et al. 2021). Participants were paid £0.50 each (with an average response time of 2.9 min, this resulted in pro-rata payments of £10.34 an hour). We aimed for an average sample size of 1000 participants passing data quality checks per-condition, as this was the closest round number which exceeded the required sample size in each of the below power analyses. Overall, 3453 participants completed the experiment as planned (see below for discussion of data quality checks used). Of these, 62 (1.8%) participants completed the study in under one minute, and a further 58 participants (1.7%) indicated that we should not use their data, resulting in a final sample size of 3333 participants (1099 in return-to-player condition; 1118 in original house edge condition; 1116 in alternative house edge condition).

Prolific’s balanced sample feature was used in order to obtain an equal number of females and males (50.2% female after exclusions; four participants with missing data). The minimum age was set at 18 ($M = 39.3$, $SD = 12.3$ after exclusions; 11 participants with missing data). In order to obtain

Table 1. The PCI RR study design template.

Question	Hypothesis	Sampling plan	Analysis plan	Rationale for deciding the sensitivity of the test	Interpretation given different outcomes
How does the phrasing of house edge information affect gamblers' perceptions and level of understanding	There will be a difference in gamblers' mean perceived chances of winning between the original and alternative format conditions	Collection of 2000 UK-based online gamblers <i>via</i> Prolific	Ordinary least squares regression. Perceived chances of winning DV (7 = 'very high chance of coming out ahead'). Dummy variable (1 for alternative condition) as single IV. Interpretation based on $p < .05$. Sensitivity analysis planned if $p \geq .05$.	In order to detect a change on this outcome from 4.1 in the original condition to 3.8 or 4.4 in the alternative condition (SD = 1.6), with 95% power and an alpha of 0.05, we would require 741 participants in each condition.	A lower mean level in either condition would support usage of that format. Equivalence testing used to reject effect sizes beneath the SESOI.
	There will be a difference in gamblers' level of correct understanding of the information given between the original and alternative format conditions		Logistic regression. DV = 1 if correct response selected ('For every £100 bet on this game about £90 is paid out in prizes'), otherwise 0. Dummy variable (1 for alternative condition) as single IV. Interpretation based on $p < .05$. Sensitivity analysis planned if $p \geq .05$.	Sample size of 1000 per-condition chosen in order to detect a change in accuracy of 6% (accuracy moving from 50% to 44% or 56%, OR = 1.27), with an alpha of 0.05 and 95% power, which would require 771 participants per-condition	A higher mean rate of understanding in either condition would support usage of that format. Equivalence testing used to reject effect sizes beneath the SESOI.
How does house edge information compare to equivalent return-to-player information	Gamblers will have a lower perceived chances of winning when given house edge information than return-to-player information	Collection of 3000 (full sample) UK-based online gamblers <i>via</i> Prolific	Ordinary least squares regression. Perceived chances of winning DV (7 = 'very high chance of coming out ahead'). Dummy variable (1 for alternative condition) as single IV. Interpretation based on $p < .05$.	Power calculation not performed here; should be adequate given that previous literature has used sample sizes as small as 250 per-cell	A lower perceived chance of winning in the house edge conditions would further support the use of the house edge. Equivalence testing used to reject effect sizes beneath the SESOI.
	A higher proportion of gamblers will provide the correct response to the item of correct understanding in the house edge conditions compared to the return-to-player condition		Logistic regression. DV = 1 if correct response selected ('For every £100 bet on this game about £90 is paid out in prizes'), otherwise 0. Dummy variable (1 for alternative condition) as single IV. Interpretation based on $p < .05$.		A higher mean rate of understanding in the house edge conditions would further support the use of the house edge. Equivalence testing used to reject effect sizes beneath the SESOI.

participants with experience in relevant online gambling games, Prolific's relevant prefilter was used. Only participants who had previously responded to the following question with one or more of these options will be eligible to take part: 'What types of online gambling/casino games have you played? Choose all that apply.' Potential answers, 'Baccarat/bingo/blackjack/craps/lottery/roulette/slots/video poker/virtual sports betting'. There were over 15,000 people based in the UK on the Prolific platform who met these prescreening requirements. On average, participants reported having engaged in between 3 and 4 gambling activities ($M = 3.5$, $SD = 2.4$). The descriptive statistics for gambling activity are reported in Table 2. The majority of respondents reported playing lottery and bingo, and just under half of respondents (44.9%) reported having gambled on a slot machine.

Table 2. Descriptive statistics of participants' gambling behavior.

Activity	Percent endorsing type of gambling
Baccarat	2.2
Bingo	50.2
Blackjack	34.7
Craps	2.0
Lottery	74.1
Roulette	37.8
Slots	44.9
Video poker	10.7
Video sports betting	25.2
Sports betting	29.1
Pachinko	2.2
Poker	31.5

At the end of the experiment, participants completed the Problem Gambling Severity Index (PGSI; Ferris and Wynne 2001), and the sample contained the following breakdown: recreational gamblers (score 0; 39.3%), low-risk gamblers

(score 1–2; 31.7%), moderate-risk gamblers (score 3–7; 21.0%), high-risk gamblers (score 8+; 8.0%).

Design

Following previous research (Newall, Walasek, and Ludvig 2020b), participants were given some short information about a hypothetical gambling scenario:

Imagine that you are a member of an online casino. You have played many of this online casino's games over the last year.

You know that gambling games are designed so that most gamblers lose money over time. Only a percentage of all the money bet gets paid back out as winnings. Or, in other words, that casino games come with a house edge.

You are about to start playing a new online casino game, when you read the following message about the game:

Participants were given this information in one of three formats below this (format manipulated between participants). In the original house edge format condition, participants were told, 'This game keeps 10% of all money bet on average'. While in the alternative house edge format condition, participants were told, 'On average this game is programmed to cost you 10% of your stake on each bet'. In the return-to-player condition, participants were told, 'This game has an average percentage payout of 90%'. The screen then showed a dependent measure immediately below that. Once participants completed that dependent measure, they proceeded to the next screen, which showed the same text and then the other dependent measure (with the information given in the same way as on the previous screen). The order of the two measures was counterbalanced.

Two data quality checks were planned. First, we planned to exclude data from participants completing the experiment in under one minute. Based on data from a similar previous study, we expected this to lead to around 3.5% of all data collected being excluded (Newall, Walasek, and Ludvig 2020b). Second, methodologists have recommended the use of self-reported carelessness checks, such as, 'In your honest opinion, should we use your data in our analyses in this study? (Do not worry, this will not affect your payment, you will receive the payment code either way.)' (Brühlmann et al. 2020). This text was included after the rest of the experiment, and all participants responding with 'no, please do not use my data' then excluded. Previous data have suggested that up to 11.7% of crowdsourced responses might be careless (Jones et al. 2022), although previous data with that exact item suggests a lower rate of 5.6% self-reported careless responses (Brühlmann et al. 2020). For the present research, we planned for a rate of 10% self-reported careless responses. Therefore, with these two data quality checks in mind, we planned to collect data from 1,151 participants per-condition in order to reach our planned sample size (of 1000 usable responses per-condition).

Measures

The first outcome measure (H1) was a response on a 7-item Likert scale to the following question, 'How does the above

message affect your perceived chances of winning?'. Seven response options allowed participant to rate their chances of coming away with more money than they started: 'My chances of winning are... Very high/High/Somewhat high/Neither high nor low/Somewhat low/Low/Very low chance of coming out ahead'. In a previous study, participants responded on average at the middle item of this scale ($M=4.1$, $SD=1.6$; 7 = 'very high', 1 = 'very low') when given the original house edge phrasing only (Newall, Walasek, and Ludvig 2020b). This suggested that this item should work well for the current research, as the alternative house edge phrasing could have resulted either in higher or lower perceived chances of winning.

The second outcome measure (H2) was a multiple-choice question, measuring participants' correct understanding of the information given to them, 'Which of the following best describes what the message means?' Correct response option, 'For every £100 bet on this game about £90 is paid out in prizes'. Following the first use of this measure by Collins et al. (2014), previous research has used a further three incorrect response options, '90% of people who play this game will win something/This game will give out a prize 9 times in 10/If you bet £1 on this game you are guaranteed to win 90p'. However, when given the original house edge phrasing most participants have tended to answer this question correctly (70.9%; Newall et al. 2023). It would therefore be beneficial to make this measure harder, so that accurate rates of responding were closer to 50%. Some previous research found that around 20% of participants responded with a 'don't know' response when this was added to a list of four similar responses (Behavioural Insights Team 2022), suggesting that this would be a good way to reduce accuracy rates *via* a reduction in successful guessing. Another incorrect response used in this previous research was: 'For every £100 bet you will lose no more than £10'. Therefore, with the addition of these two additional response options, this resulted in a six-alternative choice.

Statistical analysis

The first two hypotheses were tested using only data from participants in one of the two house edge conditions. H1 was tested *via* ordinary least squares regression, with house edge format as the independent variable (original, alternative), and participants' responses on the 7-point scale as the dependent variable. H2 was tested *via* logistic regression, with participants' responses as the dependent variable (correct/incorrect), and experimental condition as the independent variable (original, alternative). H3 was tested *via* two separate models corresponding to those used for H1 and H2, but where binary variables were used for each house edge condition, which were then compared against responses in the return-to-player condition.

The preregistered protocol (<https://osf.io/5npy9>) contained some power analyses to support our plan to collect 1000 usable responses per-condition. For H1 and H2, it was impossible to know what magnitude of change on the dependent measures would lead to meaningful differences in actual gambling environments. Therefore, we were required

to proceed heuristically, by powering our study for relatively small effects which were within our budget of resources to run this study. Given this uncertainty, we chose to explore a change on H1's outcome from 4.1 to either 3.8 or 4.4 ($SD = 1.6$, $d = 0.188$), with 95% power and an alpha of 0.05. This was calculated using the 'WebPower' package in R (Zhang et al. 2018). This identified a requirement of 1473 (rounded-up to the nearest integer), or 737 participants in each house edge condition (rounding-up). For H2, we chose to explore a change in accuracy of 6% (accuracy moving from 50% to 56% or 44%, $OR = 1.27$, $d = 0.133$), again with 95% power and an alpha of 0.05. Using the WebPower package, this identified a requirement of 933 (rounded-up to the nearest integer), or 467 participants in each house edge condition (rounding-up). We did not perform a power analysis for H3 here as that was a secondary aim of the present research. However, we do note that previous research found d s of 0.48 and 0.69 for the two outcomes when comparing the original house edge phrasing with the return-to-player (Newall et al. 2023), indicating that H3 should have been more than adequately powered.

We also planned equivalence tests using the two one sided t -test (TOST) procedure. Whereas standard null hypothesis significance procedures test the hypothesis that the difference between groups, or the association between variables is significantly different from zero, equivalence testing allows effects below a given interval to be rejected as 'too small' to be of practical significance, which is referred to as the 'smallest effect size of interest' (Lakens 2017). Power analysis was conducted to test whether the proposed analyses were appropriately powered given the sample sizes proposed using the 'power_t_TOST' function in the TOSTER package (Lakens 2017) in R (R Core Team 2020). For this power analyses, the smallest of the two effect sizes from the previous power analysis was used as the smallest effect size of interest ($d = 0.133$), and this suggested a required sample size of 969 participants per-condition to achieve 80% power. This final power analysis supported our intention to collect 1000 usable responses per-condition.

Finally, we planned some exploratory analyses, investigating H1 and H2, which are the most novel aspects of the present research. These are marked as exploratory here. Two exploratory analyses see if there are any interaction effects between the phrasing of house edge information and PGSI, in order to detect whether the optimal phrasing of house-edge information might depend on gamblers' level of problem gambling severity. Two extra regression models added a main effect of PGSI and an interaction between PGSI and experimental condition. Since p -values on interaction terms in non-linear models are not always interpretable (McCabe et al. 2020), the model for hypothesis 2 used ordinary least squares, as this has been recommended as a way of counter-acting this issue (Ai and Norton 2003).

Results

Related to H1, we found that participants had a mean perceived chance of winning of 3.9 ($SD = 1.6$) in the original

house edge condition, and 3.2 ($SD = 1.5$) in the alternative house edge condition. Ordinary least squares regression suggested that this difference was statistically significant ($B = -0.71$, $t(2234) = -10.9$, $p < .001$, 95% CI $[-0.84, -0.58]$).

Table 3 shows patterns of responses to the second outcome measure of correct understanding. Related to H2, we found that 57.7% of participants provided the correct response in the original house edge condition, compared to 39.0% in the alternative house edge condition. A logistic regression suggested that this difference was statistically significant ($OR = 0.47$, $z = -8.8$, $p < .001$, 95% CI $[0.40, 0.55]$).

Equivalence tests were conducted as a sensitivity analysis to determine whether the significant differences observed in testing for H1 and H2 were practically different, i.e. larger than the smallest effect size of interest. The t -tests were statistically significant ($H1 - t(2222.04) = -10.9$, $p < .001$; $H2 - t(2231.72) = -9.0$, $p < .001$), confirming that the original and alternative house edge phrasings differed from each other on perceptions of winning and correct understanding. The equivalence tests were non-significant ($H1 - t(2222.04) = -7.8$, $p = 1$; $H2 - t(2231.72) = -5.9$, $p = 1$), indicating the effects between the two groups were not statistically equivalent. Although the t -values for the equivalence tests are high, these are non-significant because in both cases one of the two one-sided tests was non-significant (Figures 1 and 2). In both sets of tests, the observed effect was larger than the lower bound and fell outside of the equivalence bounds; i.e. the difference observed between the two house-edge conditions was greater than the smallest effect size of interest. Moreover, the 95% confidence intervals for the tests fell outside the lower bounds for both sets of equivalence bounds ($H1 - \text{raw difference} = -0.713$, 95% $C.I. = -0.820$ to -0.605 , $H2 - \text{raw difference} = -0.187$, 95% $C.I. = -0.221$ to -0.153). Therefore, we can conclude these differences are both statistically and practically different.

H3 compares the two house-edge conditions against the return-to-player condition on these two outcomes. Participants in the return-to-player condition had a mean perceived chances of winning of 4.8 ($SD = 1.7$), which according to an ordinary least squares regression was higher than both the original ($B = -0.95$, $t = -14.1$, $p < .001$, 95% CI $[-1.08, -0.82]$), and alternative ($B = -1.66$, $t = -24.6$, $p < .001$, 95% CI $[-1.80, -1.53]$) house edge conditions. This aspect of H3 was therefore supported. However, 37.5% of participants in the return-to-player condition provided the correct response to the measure of correct understanding, which was significantly lower than the original house edge phrasing (57.7%; $OR = 2.27$, $z = 9.5$, $p < .001$, 95% CI $[1.9, 2.7]$), but not the alternative house edge phrasing (39.0%; $OR = 1.07$, $z = 0.7$, $p = .471$, 95% CI $[0.90, 1.26]$). Despite these similar rates of providing the correct response across the return-to-player and alternative conditions, the patterns of incorrect responses were different across these two conditions. Two incorrect responses were given more often in the return-to-player condition: '90% of people who play this game will win something' (31.9% versus 4.5%), and 'This game will give out a prize 9 times in 10' (20.9% versus 5.8%). While the

Table 3. Responses to outcome measure of correct understanding.

Response	Original house edge (N = 1118)	Alternative house edge (N = 1116)	Return-to-player (N = 1099)
90% of people who play this game will win something	10.4%	4.5%	31.9%
This game will give out a prize 9 times in 10	8.4%	5.8%	20.9%
If you bet £1 on this game you are guaranteed to win 90p	2.5%	4.4%	2.2%
For every £100 bet on this game about £90 is paid out in prizes	57.7%	39.0%	37.5%
For every £100 bet you will lose no more than £10	10.2%	31.8%	3.2%
Don't know	10.8%	14.5%	4.4%

Correct answer displayed in bold.

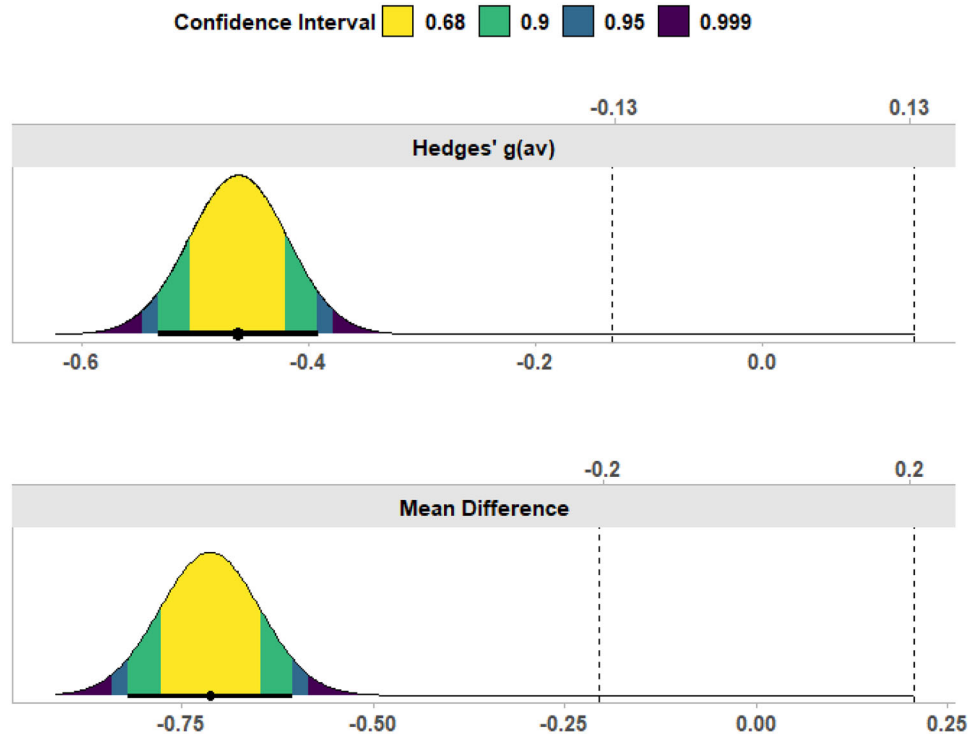


Figure 1. Plot of the difference between the original and alternative house edge conditions on their perceived chances of winning. The dashed lines are the smallest effect sizes of interest for the equivalence test. Negative values suggest lower perceived chances of winning in the alternative phrasing condition.

incorrect response ‘For every £100 bet you will lose no more than £10’ was given more often in the alternative house edge condition (31.8% versus 3.2%).

Results of the exploratory regression analyses extending H1 and H2 by adding a main effect of PGSI and an interaction term between house edge condition and PGSI are shown in Table 4. In both regression models, PGSI levels did not influence either outcome measure (p 's $\geq .078$), either as a main effect or *via* an interaction. The closest effect to the pre-registered level of significance was the interaction effect between PGSI and house edge condition for the perceived chances of winning measure. If further replications find that this effect exceeds the preregistered significance threshold, then this suggests that the difference between the two house edge phrasings might be lessened among gamblers suffering from higher levels of problem gambling severity. This exploratory analysis suggests that the results from H1 and H2 were robust across all levels of problem gambling severity.

Discussion

The optimal communication of risk information can act as an input to a public health approach to reducing gambling-

related harm (Eggert 2004; Livingstone et al. 2019; Newall et al. 2023). Compared to the return-to-player information that is currently given on some gambling products in certain jurisdictions, house edge information has been proposed as an equivalent and yet superior method of communication, particularly since it can result in reduced rates of gambling persistence (Newall, Byrne, et al. 2022). However, past empirical research has only used one way of phrasing house edge information (‘original’ format, e.g. ‘this game keeps 10% of all money bet on average’; Newall, Walasek, and Ludvig 2020a), while at least one other phrasing has been proposed (‘alternative’ format, e.g. ‘on average this game is programmed to cost you [10]% of your stake on each bet’; Livingstone et al. 2019; p.3). The present research was the first to empirically compare these two formats, and found that the original format had the highest rate of correct understanding, while the alternative format resulted in the lowest perceived chances of winning. Both of these differences exceeded the smallest effect size of interest. When compared to return-to-player information, the original phrasing had both lower perceived chances of winning and higher rates of correct understanding, while the alternative phrasing

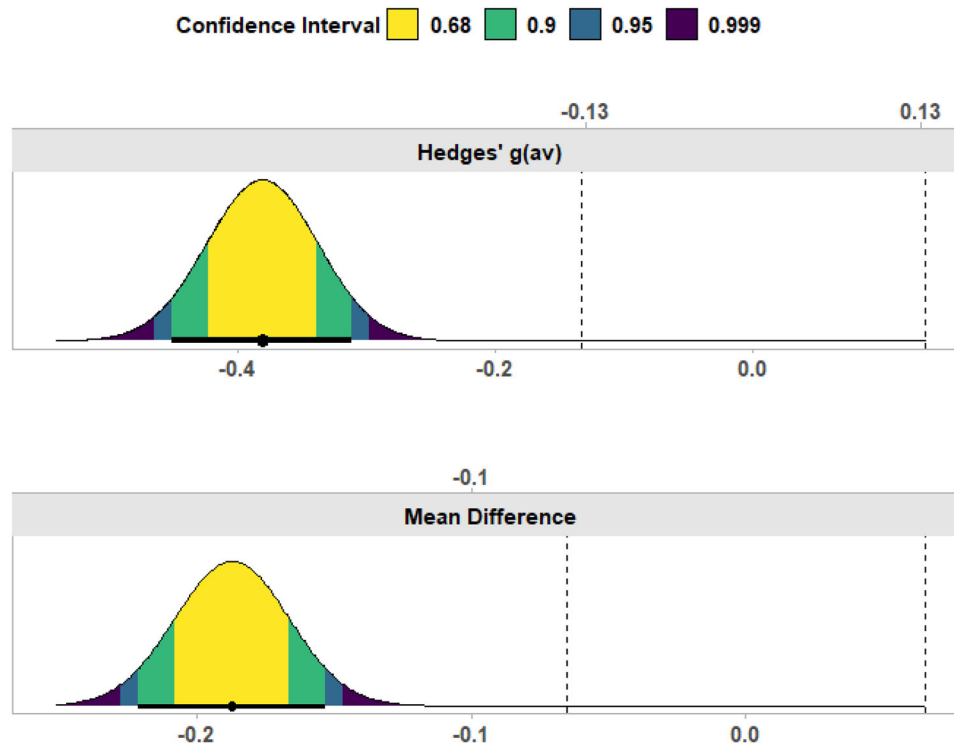


Figure 2. Plot of the difference between the house edge conditions in their correct understanding of the information given to them. The dashed lines are the smallest effect sizes of interest for the equivalence test. Negative values suggest lower rates of accurate understanding in the alternative phrasing condition.

Table 4. Regression model results comparing the two house-edge conditions, while adding a main effect of PGSI and an interaction term.

	Co-efficient [and 95% confidence interval]	t-statistic (p-value in parentheses)
Perceived chances of winning		
Alternative house edge	-0.79 [-0.94, -0.64]	-10.1 (< .001)
PGSI	-0.00 [-0.03, 0.02]	-0.1 (.900)
Interaction	0.03 [-0.00, 0.07]	1.76 (.078)
Correct understanding		
Alternative house edge	-0.17 [-0.22, -0.13]	-7.0 (< .001)
PGSI	0.00 [-0.01, 0.01]	0.3 (.766)
Interaction	-0.01 [-0.02, 0.01]	-0.9 (.347)

had only lower perceived chances of winning. In line with Newall et al. (2023), this supports the use of the original phrasing instead of return-to-player information. The alternative phrasing still deserves further consideration, as its resulting low perceived chances of winning is an attractive property. However, it is currently limited by its lower rate of correct understanding compared to the original phrasing.

The differences between the two house edge phrasings with respect to rates of correct understanding may well have been revealed by the present research's use of a six-alternative choice question, compared to some previous research which used a four-alternative subset (Newall, Walasek, and Ludvig 2020a, 2020b). Looking at Table 3's pattern of responses, it is clear that alternative house edge format participants were much more likely to provide one of the two added incorrect responses ('For every £100 bet you will lose no more than £10'; 31.8%), in comparison to original house edge format participants (10.2%), or return-to-player participants (3.2%). As this incorrect response is quite similar to the correct response, these participants may well have given the correct response were the four-alternative subset to be given. If this had indeed happened, then the two house-edge

format conditions would have appeared similar on this measure (original: 67.9%; alternative: 70.8%). This more sensitive six-alternative question can reveal differences that may not have been apparent with the original four-alternative question, but more research should be done to explore the meaning of different incorrect responses on the item as it was used here.

The alternative phrasing may have been particularly susceptible to that incorrect response due to its use of the words 'is programmed to cost you', which implies a deterministic rate of loss which is fairly consistent with that incorrect response ('you will lose no more than £10'). On the other hand, this specific wording may have resulted in that phrasing's low perceived chances of winning, as it emphasizes the likelihood with which gamblers will lose over time in electronic gambling formats. The alternative phrasing's low perceived chances of winning suggest it could be an effective information format if it can be amended to reduce the incidence of this incorrect response. One potential amendment would be the addition of a 32-word 'volatility warning':

'It takes millions of plays for a gambling game to tend toward its average return. A gambling game will not return

a minimum value of prizes in any given period of gambling.’ (Newall, Walasek, and Ludvig 2020b).

Previous research has shown that this wording decreases perceived chances of winning, but has no consistent effect on rates of correct understanding when appended to the original house edge phrasing or return-to-player information (Newall, Walasek, and Ludvig 2020b). However, it may conceivably work to reduce the incidence of that novel correct understanding incorrect response, and a combination of the alternative phrasing and a volatility warning is worth considering in future research. The divergence across the two outcome measures between the two house-edge phrasings reveals a potential ethical issue for policymakers (Lades and Delaney 2022). It would be optimal to provide information that consumers understand and which induces desired patterns of behavior (less gambling). However, if the alternative phrasing’s low perceived chances of winning result in lower rates of gambling than the original phrasing, then policymakers would need to tradeoff between giving information that is widely understood, versus giving information that induces desired patterns of behavior. This would involve a value judgment lying outside the scope of current enquiry. Overall, this also shows why it would be beneficial to keep testing for combinations of gambling information which are both well understood and result in low perceived chances of winning, as well as investigate the behavioral consequences of different sets of information.

Limitations

This study is subject to various limitations that should be considered while evaluating its results. Participants were collected from a crowdsourcing platform, and so therefore took part in the study in return for payment. Although this data collection methodology introduces limitations (Pickering and Blaszczynski 2021), it does have some strengths too, such as the ability to cost-effectively oversample from gamblers of high levels of problem gambling severity (Russell et al. 2022). The study yielded self-report measures in response to a hypothetical scenario, which limits the external validity of the findings. However, previous studies have found converging evidence across self-report (Newall, Walasek, and Ludvig 2020b) and behavioral tasks (Newall, Byrne, et al. 2022) with respect to the related comparison of house edge and return-to-player information, which suggests that the present methodology may be a cost-effective way of investigating novel phrasings of gambling information. Furthermore, there are many other alternative ways of improving information delivery to gamblers, such as the use of graphical decision aides (Walker et al. 2019), which the study did not test. Finally, future studies may want to use other methodologies to measure gamblers’ understanding of relevant information, for example by asking them to explain their interpretation *via* an open-ended text box, rather than by providing a list of potential answers *via* a multiple-choice question.

Conclusions

This study supported previous findings on the superiority of the original house-edge phrasing in comparison to

equivalent return-to-player information (Newall, Walasek, and Ludvig 2020a, 2020b; Newall, Byrne, et al. 2022). Furthermore, the study found even lower perceived chances of winning with the alternative phrasing, and this may open up further potential improvements in the communication of house edge information in future research.

Disclosure statement

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ORCID

Philip W. S. Newall  <http://orcid.org/0000-0002-1660-9254>
Olivia M. Maynard  <http://orcid.org/0000-0002-9048-6627>

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