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The Appropriateness of Using Laboratories and Student Participants in Gambling Research

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Abstract

Increased recognition of the risks associated with gambling has resulted in a greater focus on empirical research to increase the understanding of gambling and design appropriate response strategies. Laboratory studies are a popular mode of research due to their relative ease and lower costs compared to field research; however such studies may be limited in the extent to which results can be generalized to real gambling scenarios. The current research investigated the validity of a laboratory research study using 127 university students (male=97, mean age=20.4) investigating the impact of harm-minimisation measures by replicating the study in gambling venues with 124 club patrons (male=89, mean age=44.1). The main results and effects of both studies were in the same direction, but fewer significant results were found in the venue study. Venue participants provided much less information in response to survey questions than student participants and were less likely to return follow-up questionnaires. It was concluded that both laboratory and field studies provide valuable contributions to the field, but caution should be taken in interpreting results, and where possible both methodologies should be used to verify conclusions.

Key words: research methodology, students, gambling, laboratory studies, field studies, young adults

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The Appropriateness of Using Laboratories and Student Participants in Gambling Research

Following increased acknowledgment of the risks associated with gambling and unsuccessful attempts to minimize harm, the importance of empirically-supported responsible gambling strategies has been widely accepted by governments, industry and the community. Gambling research in the field is complicated by difficulties in accessing gambling venues and patrons, cost and complications, ethics and regulatory approval required and problems in controlling extraneous variables. Consequently, the majority of empirical research is completed in laboratory settings with small convenience samples or university students, thus, limiting the external validity of the results and the extent to which findings can guide effective policies and strategies Since Campbell's (1957) distinction between internal and external validity, it has been acknowledged that laboratory studies have greater reliability, but that may not be able to be generalised to the real world. Given the importance of empirically sound gambling research, it is essential to investigate the extent to which results from laboratory studies using student subjects can be generalized to wider populations and settings and real-world behaviour.

Laboratory studies have been extensively and successfully applied in scientific research since physical laws and processes occurring in nature (e.g., gravity, mitosis, and electromagnetic radiation) can be replicated in laboratory settings.. Simulated gambling activities, ranging from coin-tossing exercises and theoretical decision tasks (such as the Iowa gambling task) to playing virtual games and quite authentic laboratory casinos, are regularly used in studies of gambling and associated physical, emotional and cognitive responses. However, that humans are the object of study in gambling research raises special questions about the ability to extrapolate experimental findings beyond the laboratory. Although the use of laboratories is frequently noted as a limitation, results from such studies are often generalised to real world gambling and in some cases form the basis of policies and development of treatment programs in the absence of empirical research conducted in gambling venues.

Although naturalistic studies are advantageous in providing a larger degree of scope and wealth of useful information, these advantages often come at the expense of precision and control (Meehl, 1954). Laboratory research investigates gambling by systematically manipulating factors thought to be influential, and examines the effect of these on the hypothesised outcomes. Such empirical research strives to elucidate the nature and parameters of psychological processes, thereby providing comprehensive explanations at different levels of analysis. However, as Dobbins et al. (1988) note, researchers should consider the purpose of laboratory research when making claims about cause and effect relationships between theoretical and real-life settings. Unlike research in the physical sciences, research in the field of humanities and social sciences investigating aspects of human behaviour, emotions and decision-making may be exposed to the influence of factors that operate differently in laboratories compared to other environmental settings. For example, Levitt and List (2007) examined research findings in psychology and experimental economics and concluded that behaviour is not just influenced by financial implications but by a host of factors including moral and ethical considerations, the

presence of observers, the context of decisions, advice from friends or experts, and individual characteristics. What is therefore required is careful consideration of the validity of extrapolating or generalizing laboratory findings to other settings, particularly in respect to gambling research.

There are many benefits to conducting gambling research in laboratories; they are easier to plan and complete, cheaper to run, extraneous variables (for example, alcohol and tobacco consumption) can be controlled to increase internal validity, and participants can be randomly allocated to experimental conditions allowing greater causal inferences to be drawn in investigating the relationship between variables. Additionally, laboratory experiments overcome some of the difficulties associated with in vivo gambling research including securing research participants, industry and venue cooperation, legislation involved with modification to gambling situations and ethical complications with participants gambling for money. It has also been reported by participants that despite laboratory settings, if appropriate factors are introduced, for example chances to win a major payout and/or lose money, the experience of playing is similar to being in a gambling venue (Leary & Dickerson, 1985).

Anderson et al. (1999) argue that generalising from one situation to another, or from one participant population to another, is as problematic for field research as it is for laboratory research; laboratory research frequently uses behavioural measures, field research often relies on more artificial self-report measures (Dipboye & Flanagan, 1979). For these reasons it is often advantageous to conduct and publish results of laboratory research using student participants to contribute to the field of knowledge in cases where field research may take much longer, be completed without a thorough methodological approach, thus limiting the reliability of findings, or not be conducted at all. There are instances where generalizability might not be of primary importance; for instance, when testing a general theory or testing methodological strategies (Levitt & List, 2007). In some cases, laboratory research may form a preliminary study that provides the basis for a larger field study that can verify the results.

Comparisons between laboratory and field studies in gambling research

In the domain of gambling research very few field studies in in-vivo gambling setting have been completed; .Dickerson and Adcock (1987, p.4) have argued that these emphasise the “irrelevance of much that has been done in the laboratory”, by failing to create the realistic conditions necessary to provoke the same reactions, thoughts and behaviours as gambling situations.

Comparisons between studies in gambling research have found both consistencies and contradiction between laboratory and field studies. Furthermore, the extent to which results from laboratory research can be generalised to real-life gambling scenarios (Dickerson, 1984; Leary & Dickerson, 1985) has been questioned. For example, the concept of illusion of control was based on results from a series of field studies (Langer 1975). A number of subsequent laboratory studies have concluded that this irrational belief, that an individual has some control over the outcome of a game determined by chance, plays a role in maintaining gambling behaviour (Dixon et al., 1998; Strickland et

al., 1966). However, several laboratory studies (Burger & Smith, 1985; Ladouceur & Mayrand, 1984; May et al., 2005) have failed to replicate Langer's (1975) findings that subjects have illusion of control beliefs when gambling on chance events and these lead to risky behaviours, raising questions over the validity of these original findings, including whether the field studies accurately measured illusions of control.

Another example of the discrepancy between laboratory and field research involves the long-standing hypothesis that it is the excitement and arousal associated with gambling that strongly motivates persistence even in the face of heavy financial loss (Custer, 1982; Goffman, 1969). Several studies of physiological reactions have found significant increases in regular gamblers' heart rates when gambling (on cards or electronic gaming machines) in laboratory (Ladouceur et al, 2003; Leary & Dickerson, 1985; Wulfert et al., 2008) or natural settings (Coulombe et al., 1992; Griffiths, 1993; Meyer et al., 2000). However, in a direct comparison, Anderson and Brown (1984) found significant differences in heart rate between laboratory and casino gambling situations in a group of experienced blackjack gamblers, with a significantly lower mean increase in heart rate (7bpm as compared to 23bpm) measured in the laboratory situation. In addition, the majority of players used different strategies in laboratory as opposed to venue settings. These results question the validity of using laboratory for studies of arousal during gambling. However, interpretation of results are limited by the dissimilarity in the samples used by Anderson and Brown (1984) as the laboratory study included 12 male undergraduate university students, none of whom gambled regularly or had played blackjack before and were not included in the casino session, and 12 regular male blackjack players, who also participated in the casino gambling sessions. Furthermore, the laboratory setting offered a smaller chance of winning a relatively small prize (£10), while the "natural" setting had a greater chance of winning larger prizes and did not represent a typical gaming session due to the presence of researchers and physiological measuring devices.

The inconsistencies between laboratory and field studies may be explained in several ways; firstly, there are methodological limitations to any empirical research, a point raised by Walker (1992) who questioned the ecological validity of many studies. Walker (1992) argued that the lack of significant effects found in laboratory studies could be due to the artificiality of the tasks, the use of low-frequency gamblers, and the reduced motivation of players in the laboratory. Biases may also be introduced if outcome feedback is provided during tasks, or participants are given too much information, which may encourage a performance bias as participants' suspect how their behaviour is being evaluated (Delfabbro, 2004; Matute, 1995).

Another explanation for inconsistencies between studies is that the phenomenon being examined is very sensitive to the context of the situation. Anderson and Brown (1984) argued that there are hidden interactions which only occur in real-life situations that are ignored in laboratory settings. For example, Thompson, Armstrong, and Thomas (1998) contend that illusion of control will only occur in certain situations and will not occur if certain factors are not present, for example skill-related factors, emphasis on success or failure, need for the outcome, mood and the intrusion of reality. Furthermore, Delfabbro

(2004) points out that illusions of control may be produced not only by gambling, but by individual difference variables such as control motivation, gender, and locus of control, and therefore, pre-existing differences, not otherwise accounted for, may contaminate results.

Furthermore, the act of transferring variables from an in-vivo to laboratory setting may change their nature. For example, Ladouceur, Gaboury, Bujold, Lachance, and Tremblay (1991) found regular electronic gaming machine (EGM) players did not differ in the number of irrational vocalisations produced during gambling, the number of bets doubled, or reported motivation to gamble in laboratory compared to natural settings. Participants did wager more money in the laboratory than natural setting; however, in the laboratory the money wagered was provided by the researcher, as opposed to their own money wagered in the in situ setting. The authors concluded that "results showed that playing videopoker in a laboratory produces cognitive, behavioral, and motivational phenomena which are equivalent to those observed in a natural setting" (Ladouceur et al., 1991, p. 115). However, few significant behavioural differences were found between the conditions and as only 20 subjects were included (19 men and 1 woman) the study may have lacked sufficient power to detect other differences, suggesting the authors may be overstating the results.

In another study of EGM gamblers, investigators compared arousal during EGM gambling in natural and laboratory situations (Dishkin et al., 2003). The two physiological measures used (heart rate and skin conductance) performed differently in the two situations as did subjective ratings of arousal. Although change occurred in the same direction, arousal responses were higher in the venue setting. Though results differed between the situations, moderately strong correlations between laboratory and in vivo situations were obtained, supporting the validity of laboratory research. This research was limited due to the small sample (N=30), limiting the power to detect significant differences between groups. Furthermore, participants could only win up to a certain amount and play for a maximum of 20 minutes in the laboratory and all participants gambled first in the lounge before the laboratory task, which may have confounded results.

Gambling field research is difficult to conduct as random allocation and control of extraneous variables is not always possible, reducing the ability to draw causal implications about the factors measured. Although laboratory research permits methodologies that increase causal inferences, they may fail to illicit the same responses that occur in gambling scenarios, limiting the utility of results. Several studies have directly compared laboratory and in-vivo gambling research but results are limited by the small sample sizes and other methodological complications. It is essential that gambling research continue to increase knowledge of the factors involved in gambling behaviour and how gambling-related harm may be reduced. However, it is necessary that research attempts to address and overcome the limitations inherent in both laboratory and field research. Due to their high degree of experimental control, laboratory-based studies may be instrumental in isolating the processes that are involved in gambling behaviour, and,

using this information; researchers can effectively develop harm-minimisation strategies that can be evaluated in field research.

Use of appropriate samples

In addition to the complexity in using either laboratory or in situ settings, it is also essential that appropriate participants and recruitment methods are used to obtain suitable samples. Samples must be sufficiently large that they have power to detect significant differences between conditions, a limitation of many studies conducted in gambling research. Samples should also be randomly selected from a sufficiently large population to increase the extent that conclusions can be made about the greater population. However, in reality there are many obstacles to recruiting an ideal representative sample such as gaining access to a suitable population and finding enough participants willing to be involved. As a result, research studies often use a combination of methods including convenience sampling and accessing a limited range of populations including university students and a small number of participating venues. Although this may not necessarily reduce the value of the research, it is important to consider the most suitable population to sample in planning a study.

The propriety of using university students as participants in psychological research has been debated numerous times, reflecting the importance of considering the merits of this sampling approach. In a 1977 editorial for the Journal of Consumer Research, Robert Ferber argued against the use of convenience samples (usually university students) for two reasons; firstly, the participants may be inappropriate if they are not consumers of the product being investigated, and second, because the sample is not based on any formal plan that would allow the results to be generalised to a larger population. In contrast Oakes (1972) investigated the external validity of using university student subjects as compared to nonstudent subjects and concluded that while there were limitations to the external validity of using college students (the "science of sophomores" (Oakes, 1972, p. 962)), there were as many limitations to the external validity of using 'real people' and, therefore, research with college students as subjects is just as valid as research drawing on any other subject population. Furthermore, Oakes (1972) argued that any behavioural phenomenon found in a certain population, may not exist among members of another population, but this does not make it any less genuine, and it would be true no matter what population one sampled in the original research.

There are theoretical reasons to expect that college students will provide different data to nonstudents. According to Carlson (1971, p. 212), "students are 'unfinished' personalities" in a relatively early adult life stage. As such they may differ systematically from older individuals. These is some evidence to support the notion that personalities are not fully stabilised in young adults and rather, continue to develop throughout life, reaching a peak of consistency when individuals are in their 50s or 60s (Caspi & Roberts, 2001). Following a review of psychology literature, Sears (1986, p. 515) concluded that, compared with nonstudents (older adults) "college students are likely to have less-crystallized attitudes, less-formulated senses of self, stronger cognitive skills, stronger tendencies to comply with authority, and more unstable peer group relationships" resulting in biased research if this is the only population examined. This assertion may be

supported by brain-imaging studies that show that brain development is not complete until young people have reached their early to mid-20s (Giedd, 2004; Sowell et al., 1999). The frontal cortex that controls cognitive processing and other executive functions including judgment and caution is the last to mature. However, the exact relationship between the structural changes and development of the brain and behavioural changes has not been established. It has also been argued that students differ from nonstudents as they are more homogeneous (Calder et al., 1981; Greenberg, 1987; Kraus, 1995). This may result in stronger effect sizes of hypothesis tests than if nonstudents were involved, as there are fewer extraneous variables to be controlled. These findings suggest that although there are no precise limitations on the types of studies that young adult university samples can be used for, care should be taken when interpreting the results of studies based on young-adult samples and student populations, particularly in the extent to which these can be generalised to other populations. This may be particularly important when interpreting results of studies that examine cognitive processes and executive functions.

To assess the implications of using university student subjects in social science research, Peterson (2001) conducted a second-order meta-analysis of previous literature to provide comparative data for university student subjects and nonstudent (adult) subjects (cumulative $N > 650{,}000$). In general, responses of college student subjects were found to be slightly more homogenous than those of nonstudent subjects, which may be expected due to the greater similarity of the sample. Although this reduces the extraneous variables that may affect outcomes, it may also minimise relationships that do exist among variables. Furthermore, effect sizes derived from college student subjects frequently differed from those derived from nonstudent subjects both directionally and in magnitude; however, no systematic pattern to these differences was observed. In a meta-analysis of 32 studies in industrial/organizational psychology and organizational behavior, Gordon, Slade, and Schmitt (1986) found that although there were many similarities in results from students and nonstudents, the majority of studies (73%) reported one or more important between-group differences. However, the authors noted that there is less discrepancy when both subject groups appear to be equally familiar with the experimental task. Gordon et al. (1986) concluded that external validity may be improved by using student subjects with demographic and interest profiles similar to the nonstudents to whom researchers wish to generalize.

In contrast to these findings, in a direct comparison between students and the general population, a survey of lottery use was administered to a sample of 1,009 from the general population and 299 marketing students from a state university (Browne & Brown, 1993). Supporting the validity of samples of students, student's attitudes, game preferences, and reasons for play were similar to those of the general population. Similarly, Locke (1986) had experts review work behaviour research in various areas (e.g., personnel, motivation and attitudes) and all of the reviews concluded that the principles derived in laboratory research utilising college students tend to generalize to actual employees in field settings. These mixed results imply that researchers must be cautious when using university student subjects and be cognisant of the implications of doing so, including the possible constraints on conclusions and chance of misinformation.

Convenience samples are often used for cost and logistical considerations and efforts may be taken to implement sampling plans that involve sample of the independent variables being investigated. Although the conclusions may still be limited, such research may still provide useful information. Peterson (2001) argued in favour of replicating research based on college student subjects with nonstudent subjects before attempting any generalisations. It is also essential that any research reports fully on the characteristics of their samples so that independent, informed judgments can be made as to the possible implications.

All experimental results are subject to the influence of demand characteristics, that is, the participants' perception of the purpose of the study and their willingness to respond in a manner that will support the hypotheses being tested (Orne, 1959). Orne (1962) noted that college students tend to hope and expect that their participation in the study will contribute to science and human welfare, which may exaggerate their performance and responses on some tasks.

Despite the high number of studies in the field of gambling research that use university student subjects, there is a deficit in research directly examining the impact of this method. One study compared the results of a survey of lottery use administered to a sample of 1,009 from the general population with a survey of 288 marketing students at a state university (Browne & Brown, 1993). Results revealed that the student's attitudes, game preferences, and reasons for play were similar to those of the general population, supporting the validity of student samples. Similarly, Lichtenstein and Slovic (1973) found the same irrational and non-systematic preference patterns among Las Vegas casino patrons that had been observed in prior studies with students. In a random telephone survey of 2,274 U.S. residents aged 14-21, nonstudents were significantly more likely to have gambled frequently and were more likely to be classified as an at-risk or problem gambler as compared to students (Welte et al., 2008); however the study did not compare risk of gambling problems when gambling frequency was controlled for so conclusions cannot be made on the distinction between student and nonstudent regular gamblers.

University students are commonly included as research participants in a purposeful attempt to understand gambling behaviour in young adults. Youth and students have been repeatedly identified as being a vulnerable population at high risk of developing gambling related problems (Delfabbro, 2008; Jacobs, 2004; Shaffer et al., 1997). As such, it is important to include this group in gambling research. However, as demonstrated above, care must be taken in the interpretation of findings, and replication of studies in a sample of nonstudents is recommended before generalising results to wider populations.

Aims and hypotheses

Given the quantity of laboratory studies that have shaped the theoretical understanding, treatment options and policy formulation in regards to gambling it is essential to investigate the validity of laboratory research in direct comparison to field studies with an adequate sample size and minimal extraneous variables, particularly avoiding

methodological differences between conditions. This study aimed to determine the extent to which the findings derived from a laboratory-based experiment using university students can be replicated in a more ecologically-valid gambling venue using gambling patrons.

Despite previous discordant findings between field and laboratory studies, by utilising sufficiently large samples and the exact replication of methodology, it was expected that the results from a laboratory study would be similar to those obtained from an experimental study conducted in a gambling venue. Although the extent to which university undergraduate students are representative of the general population has been disputed (e.g., Carlson, 1971; Ferber, 1977) there is some evidence that results found in student populations can be generalised to other settings and samples (Browne & Brown, 1993; Locke, 1986). Furthermore, based on the findings of Gordon et al. (1986) that results from student samples may be generalised to samples with similar experiences and interests, a sample of regular gamblers recruited from a university should produce similar results to a sample of regular gamblers recruited from a gambling venue. Therefore, it was hypothesised that the results of a laboratory study conducted with regular student gamblers would be comparable to the results from an identical study conducted in a gambling venue with a sample of regular gamblers.

The potentially greater homogeneity of the student sample (Calder et al., 1981; Greenberg, 1987; Kraus, 1995; Peterson, 2001), familiarity with completing experiments and questionnaires, and desire to confirm the research hypotheses (Orne, 1962) was expected to lead to more significant results and greater observed effect sizes for students as compared to nonstudents. Furthermore, students' familiarity with completing surveys and elaborating on written responses, and hope to contribute towards science was expected to result in a greater level of detail in written responses than non students participating in gambling venues. This effect may also be heightened by the uninterrupted laboratory session and setting in which the students completed their task, as compared to a gambling venue characterised by much external stimuli and greater salience of other activities that participants could be engaged in.

In summary, the specific hypotheses for this study were that:

1. The results obtained from a laboratory study using a university sample would be comparable and in the same direction as those found in a sample of gamblers participating at a venue.
2. There would be a greater impact and more significant results for students than for venue gamblers.
3. Students would provide more detailed and/or extensive information than venue gamblers

Method

Two studies were conducted using identical methodology but varying in the sample utilised (student gamblers and nonstudent gamblers) and experimental settings (laboratory and gambling venue) enabling the findings to be compared in the present

research. The studies using student and gambling venue patrons had approval from the University of Sydney Human Research Ethics Committee (HREC).

Laboratory Study using Student Gamblers

In the laboratory study, 127 regular (defined as playing at least once every two weeks) EGM players (76% male, aged 17-29, M=20.4, SD=2.5) were recruited from an undergraduate university population using an online experimental signup system and were given course credit in recognition of their participation. Participants came to a laboratory and played a computer simulated EGM that included a warning sign that varied between participants by mode of presentation (pop-up or static) and message contents (information about the game, encouraging self-awareness of current behaviour, or a control/blank message). Although no money was used due to ethical constraints, participants were encouraged to play as if using a real EGM, and simulated machines were preloaded with sufficient credit to allow continual play. Participants were instructed to play until they wished to stop, or were stopped by the experimenter after ten minutes of play. The majority of participants (85.8%) continued play. Participants completed a post-test questionnaire, designed specifically for this study, to determine the impact of the sign on within-session thoughts and behaviours and two-weeks following play were emailed a follow-up questionnaire to determine the impact of the sign on gambling following the session. The follow-up questionnaire was to be printed, completed, and returned to the researcher's office.

Venue Study using Regular Gamblers

In the venue study, 124 regular EGM players (72% male, aged 18-65, M=44.1, SD=20.8) were recruited from participating gambling venues in Sydney. Venue patrons who were not currently gambling were approached by the lead author and asked if they would like to participate in the study in return for two movie vouchers. Following recruitment, the procedure was identical to the laboratory study although the setting was different. Participants were taken to a table just off the gaming floor and were instructed to play a laptop simulated EGM with the same conditions as the lab study. The majority of participants (68.5%) stopped play of their own accord. Participants then completed a post-test questionnaire and two-weeks later were mailed a follow-up questionnaire, which included a stamped, self-addressed envelope to return the completed questionnaire to the researcher.

Results

Overall, the results of both studies were in concordance, supporting hypothesis one. In both studies, participants were statistically significantly more likely to accurately recall pop-up messages than static messages immediately at post-test and at the two-week follow-up. These results are displayed in Table 1.

Table 1: Percentage of participants in each mode of presentation that answered affirmatively to each item and associated chi-square analysis

Study 1 (N=127)				**Study 2 (N=124)**			
Post-test	Static	Pop-up	Chi-	Post-test	Static	Pop-up	Chi-

			square analysis				square analysis
Recall (yes) seeing sign	68.8%	88.9%	$X^2(1, N = 127) = 7.69, p < .005$**	*Recall (yes) seeing sign*	44.3%	87.3%	$X^2(1, N = 124) = 25.63, p < .0001$**
Recall (yes) message content	44.4%	79.4%	$X^2(1, N = 127) = 6.10, p < .047$*	*Recall (yes) message content*	24.6%	63.5%	$X^2(1, N = 124) = 19.00, p < .0001$**
Accurate free recall of message	39.1%	70.0%	$X^2(2, N = 127) = 13.65, p < .001$**	*Accurate free recall of message*	22.2%	49.1%	$X^2(2, N = 124) = 22.72, p < .0001$**
Reported impact on within-session thoughts	29.7%	54.0%	$X^2(1, N = 127) = 7.68, p < .005$**	*Reported impact on within-session thoughts*	4.9%	27.0%	$X^2(1, N = 124) = 11.16, p < .001$**
Reported impact on within-session behavior	18.8%	44.4%	$X^2(1, N = 127) = 9.72, p < .002$**	*Reported impact on within-session behavior*	3.3%	14.4%	$X^2(1, N = 124) = 4.65, p < .031$*
Follow-up				Follow-up			
Recall (yes) seeing sign	63.2%	86.0%	$X^2(1, N = 114) = 7.82, p < .005$**	*Recall (yes) seeing sign*	50.0%	78.00%	$X^2(1, N = 77) = 6.62, p < .010$**
Very accurate free recall of message	34.5%	44.1%	$X^2(2, N = 113) = 7.92, p < .019$*	*Accurate free recall of message*	1.6%	15.9%	$X^2(1, N = 77) = 7.90, p < .019$*

** Indicates statistical significance at $p < .01$
* Indicates statistical significance at $p < .05$

Furthermore, hypothesis two was also supported as although differences between conditions were significant in both studies, reported impacts were smaller in the venue study than in the university study; and fewer significant results were found. While pop-up messages were recalled more frequently and more accurately in both studies and had a

greater reported impact on thoughts and behaviours than static signs, the reported effects were significantly smaller in the venue study. For example, as seen in Figure 1, although pop-up signs are accurately recalled at post-test and follow-up by university (70.0% and 44.1%) and venue (49.1% and 15.9%) participants significantly more than static signs, recall is greater for university than venue participants.

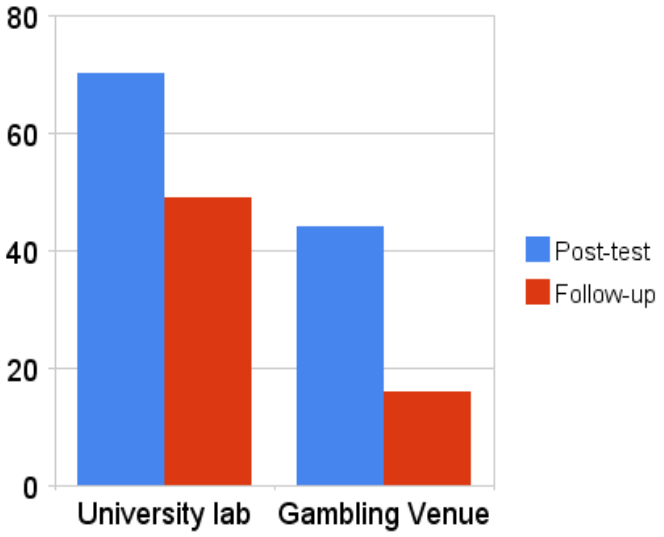

Figure 1. Percentage of participants completely accurate in free recall of pop-up messages post-test and at 2 week follow-up

Similarly, university student gamblers reported that the self-appraisal message had a statistically significant greater impact than the other messages on multiple thoughts and behaviours within the experimental session and in subsequent EGM session, including awareness of time, session length, and likelihood of taking a break. However, although results for venue gamblers showed that self-appraisal messages appeared to be more effective than other messages, following play there were no statistically significant differences based on message content. At follow-up venue gamblers reported that self-appraisal messages had a statistically significant impacted on thoughts regarding the awareness of time during sessions in the two-weeks following play and significantly more participants stated that viewing self-appraisal messages had influenced their awareness of time during subsequent EGM sessions than participants in informative and control conditions.

Confirming hypothesis three, less information was gathered from venue gamblers than from university students. Venue gamblers were much less likely to write responses in questionnaires compared to university students who almost all wrote elaborate responses to all questions. Whereas 91.0% (n=115) of university gamblers returned follow-up questionnaires, only 62.1% (n=77) of venue-recruited gamblers returned follow-ups, which were again completed to a lower degree of detail.

Discussion

All hypotheses were supported; results were in the same direction in both studies, more statistically significant results and stronger impacts were found in the laboratory study, and student participants were more reliable research participants and provided more details than venue participants in their responses.

There are several possible explanations for these findings. Firstly, although both groups were given the same introduction and were provided with little external incentives (course credit or movie vouchers), students may have been more willing subjects and motivated to assist the researcher by supplying the answers they presume to support the perceived hypotheses. Students are accustomed to completing questionnaires and understand their role as research participants. As such, they may be more willing to provide complete answers, consider responses with more care, and attempt to assist researchers with their study. In comparison, while the venue participants were involved in the study out of interest or to assist the researcher, they may not be used to completing forms and lose interest throughout the procedure giving less thought to their responses and the focus of the study.

Additionally, the effectiveness and impact of pop-up signs and self-appraisal messages may have been overestimated by students, who were hoping to assist the researcher by providing their interpretation of 'correct' responses (demand characteristics). As students appeared to be more willing and reliable research subjects, they may have overstated the impact of pop-up and self-appraisal messages resulting in inflated results. Alternatively, venue participants may not have paid as much attention to the signage and played for a shorter period of time, resulting in reduced exposure to pop-up messages. This may have resulted in an underestimation of the impact of pop-up self-appraisal messages on their thoughts and behaviours during gambling sessions, or, perhaps resulted in more accurate responses as gamblers may not attend to these messages if they were implemented on real EGMs. Furthermore, the lower quantity and quality of responses gathered from the venue participants reduced the information available for analysis which may have contributed to the fewer significant results and lower impact of significant differences found in the venue study compared to the laboratory investigation.

The laboratory study with student participants purposefully restricted extraneous variables (including alcohol and tobacco use, age, and level of education). This allowed the focus on theoretically interesting independent variables (mode of presentation and message content), thus increasing the estimated effect size of the experimentally manipulated independent variables while decreasing the effects of individual difference variables. In comparison, the venue study with regular gamblers did not control for such extraneous variables, as reflected in the wider variability of the sample, thereby introducing errors that may have reduced measured effects. For example, the level of education of the student gamblers may play a role in the relationship between mode of display and message contents and recall and impact of signs. Gamblers who have entered tertiary education may be more used to noticing and obeying signs and warnings and be familiar with pop-up style messages that are used on computer interfaces and Internet sites. This may have resulted in increased attention, recall and effect of signs observed in self-reported measures. Similarly, the younger age of gamblers may have played a role in

the greater recall and impact of signs reported in the laboratory study. Most likely, the reason for the disparity in results is a combination of some or all of these factors. However, despite the differences between the samples in terms of age, education and compensation received and differences in experimental settings, the overall results were comparable. This suggests that properly designed experimental studies using students in laboratories may be reliable and valid and if interpreted correctly, results may be generalizable to other settings and populations.

The findings of the current research are consistent with the conclusions of Levitt and List (2007) on experimental economics that because laboratories differ systematically from real-world environments, results may not be readily generalizable. However, the same concerns exist regarding data derived from naturally-occurring environments and both methodologies are useful in creating appropriate models to describe how data from experimental or natural settings can be related to other contexts (Levitt & List, 2007). Combining research analysis with a model of research behaviour expands the potential role of experiments. For example, the current study suggest that the effect sizes of results from university students obtained in laboratory settings should be reduced slightly, while significant results from venue-based studies may suggest a greater impact than that found when generalized to real-world populations. Furthermore, having some number from an experimental study is better than no quantitative concept especially when a theoretical model can be used to make appropriate inferences (Levitt & List, 2007). Therefore, the current research is important in providing a theoretical basis for making predictions and generalisations from future laboratory and field research.

When interpreting the results it is important to be mindful of the methodological limitations of this study. The HREC did not allow the use of performance-based on random rewards to simulate the monetary aspects of gambling in the experimental session. This may have modified participant's thoughts and behaviours from those experienced when gambling for money and may reduce the significance of thr results in terms of the extent to which this research replicates a gambling scenario. However, the simulated EGM did display credits won and lost and participant responses during the session indicated that they were aware of these and were making efforts to maximise the number of credits as in real settings. Furthermore, the inclusion of follow-up measures enabled thoughts and behaviours in actual gambling sessions to be examined.

Nevertheless, the current research has several strengths. The research methods were identical for each study, an improvement on previous research (e.g. Anderson & Brown, 1994; Ladouceur et al., 1991), which enables the results to be directly comparable. A sufficiently large sample was included in each study and participant's had similar experience with EGMs and interest in EGM play, again enabling comparison based on student status and experimental setting possible while reducing extraneous variables. The study provides useful insights enabling a direct comparison of results based on recruitment method and experimental setting that has important implications for gambling-related and broader social science research.

Conclusions

When comparing the utility of laboratory versus gambling settings and students versus gamblers, the context is crucial in all considerations. For example, if the research is attempting to investigate whether a particular harm-minimisation strategy is effective for youth, university students provide a useful sample. If successful, further studies can investigate the same strategy using different populations and settings to extrapolate findings. It is difficult, if not impossible to find any single research methodology that provides good internal and external validity, which suggests that a combination of research techniques and populations should be used and meta-analyses conducted to compare results between studies.

This replication study has important implications for a field still in its infancy, with many public health strategies extrapolated from other domains. Due to a lack of a large evidence base, conclusions are often drawn from a small number of studies, some of which are conducted in laboratories. Therefore, it is critical to understand the extent to which results from laboratory studies can be applied to a greater gambling population. Although laboratory studies are useful as they enable greater control over extraneous variables, increase information obtained and are easier to conduct, results should be interpreted with caution as they may be inflated as compared to venue-based gambling settings. Additionally, venue studies tend to provide greater ecological validity, but may result in an underestimation of results due to the inattention of venue research participants during an experimental session and reduced cooperation as research subjects. The current study provides a theoretical model for analysing experimental results conducted in various settings using different populations to make real-world interpretations. Laboratory findings can provide crucial insight and suggest underlying mechanisms that may be masked by extraneous variables in field studies, while field studies can demonstrate how naturally-occurring factors influence behaviour. Recognising the shortcomings that exist in both lab-generated data and results from natural settings, where possible, laboratory studies should be replicated in venues to determine if responsible gambling strategies effective in a controlled setting are similarly effective in a gambling environment.

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