**A Study of Adaptive Gambling Behavior of Casino Employees in Macau**

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**Abstract**

Two hypotheses have been advanced to explain gambling prevalence and addiction among various populations—the exposure hypothesis and the adaptation hypothesis. This study tests these hypotheses in the context of casino employees in Macau. In the etiology of gambling, casino employees have been considered a unique segment of the population. Employees working in casinos are probably more exposed to gambling stimuli than any other group. The findings suggest that indicators of heavy involvement in casino gambling among casino employees were no higher than among other residents of Macau. In terms of gambling frequency, casino employees actually gambled less often than the general adult population in Macau. These results are in contrast to results from studies of gaming venue employees in Australia and Canada. The differing findings are probably attributable to particularities of Macau discussed in the article.

Keywords: Casino employees, Macau, gambling duration, gambling frequency, adaptation hypothesis, exposure hypothesis.

**A Study of Adaptive Gambling Behavior of Casino Employees in Macau**

**Introduction**

Over the last three decades, many jurisdictions across the world have introduced casinos, sometimes in response to fiscal pressure, often with the stated aim of either providing a boost to their economies and to visitor numbers or repatriating residents’ spending from casinos in neighboring states; Japan is just one of the latest countries to plan for permitting the development of integrated resorts based around gaming. Wherever such a policy is debated, natural and legitimate concerns are raised about the possibility that increased accessibility to gaming will generate higher levels of problem gambling and gambling harm in local populations.

This possibility has received considerable attention in the gambling studies literature, with research focused around two hypotheses. The ‘exposure hypothesis’ proposes that populations with greater availability of opportunities to gamble will indeed experience an increase in the prevalence of problem gambling. The ‘adaptation hypothesis’ accepts this possibility but suggests that greater prevalence may be only transient as individuals and societies will adapt to the risks present in the new environment and eventually there will be a levelling-off or reversal of any initial impact. This adaptation might take only years, rather than decades (Abbott, 2006), though this of course is not to say that considerable harm might not have been generated in the interim. The two hypotheses could be regarded as rival; but one could also regard the adaptation hypothesis as a later modification of the exposure hypothesis, extending the analogy with biological threats where exposure to a new toxicity increases disease prevalence but, later, affected populations eventually develop some form of resistance, allowing disease levels to fall back, even to initial levels.

The two hypotheses will be examined in this paper in the setting of Macau, with particular focus on casino employees. Our choice of setting reflects that Macau offers a somewhat extreme example of a population having been exposed to a substantial expansion of gaming in the local environment and, of all its residents, those working in casinos will have had the greatest exposure and the greatest opportunity to gamble. If exposure and adaptation are relevant concepts, one might expect to see them evidenced in this jurisdiction, and in particular, among its casino labor force.

Macau has a long history, going back to Portuguese administration in the mid-nineteenth century, as an enclave for legal gaming in a region where generally there was prohibition. However, a step-change in the scale of the industry occurred from 2004 after the Government of the new Special Administrative Region had opened up its market to foreign competition. The number of casinos and the volume of gaming activity increased very rapidly indeed over the following years (Sheng and Gu, 2018), eventually allowing gross gaming revenue to reach six times that achieved by the Las Vegas Strip, and this in a jurisdiction with a population of only some 676,000 and an area of just 32.9 sq.km. Mega-casino resorts came physically to dominate the cityscape and, by 2018Q2 (when we collected our survey data), fully 21% of all employees were working in the gaming sector. For comparison, the corresponding figure for Las Vegas in 2019 was 15% (Nevada Department of Employment, Training and Rehabilitation, 2019, p.16). Thus, the whole population had been exposed to a new environment saturated with gambling opportunities and a very significant proportion of all adults spent their daily working hours actually inside casinos. The exposure hypothesis would predict that the community generally would experience elevated prevalence of problem gambling and those working in casinos would be especially vulnerable to increased risk of problem gambling over time. Proponents of the adaptation hypothesis would look for signs of stabilization of or a fall in prevalence at some point and might expect casino employees to be less prone to ‘irresponsible’ gambling as they became more familiar with their working environment.

We will first review the general literature around the two hypotheses and then the specialist literature on problem gambling and problem gambling among casino industry workers. Then, after reporting trends in participation in gambling and prevalence of problem gambling according to official statistics for the Macau population as a whole, we will present findings from our own survey of 230 casino employees and 169 non-casino employees in Macau, where they were asked to reveal differences in gambling behavior and motivation now compared with when they first started gambling in casinos. Our final section will review the extent to which the data are consistent with the two hypotheses.

**Literature overview: The exposure and adaptation hypotheses**

The exposure hypothesis, applied to gambling, follows a public health paradigm. Opportunities to gamble are likened to threats such as a new source of air pollution or a new strain of influenza. In the exposed population, some individuals are more susceptible to harm than others and will contract the associated disease, which will then be observed to have increased in incidence and prevalence. Thus, for example, if electronic gaming machines (EGMs) are introduced into a region and then made highly accessible in all its population centers, as happened late in the last century in all Australian states except one, then it would be predicted that gambling problems would become more evident. A meta-analysis of 34 prevalence surveys in Australia and New Zealand between 1991 and 2008 confirmed a positive relationship between state-level problem gambling prevalence and the presence of EGMs and their density per unit of population (Storer, Abbott and Stubbs, 2009). In similar vein, but in a longitudinal study of individuals, Jacques and Ladouceur (2006) examined trends in gambling behavior in the city of Hull, Québec following the opening of its first casino, using a control sample from a non-casino city in Québec to purge any effects from wider changes in the gambling environment. One year after opening, a higher proportion of Hull residents were gamblers, there had been an increase in the ‘maximum daily loss experienced in gambling’ and there was now more frequent endorsement of items drawn from the South Oaks Gambling Screen (items intended to capture behaviors and attitudes correlated with problem gambling). As in Australasia, making a continuous form of gambling much more available was followed by an apparent increase in gambling problems in the host community. These two studies are just examples where the adaptation hypothesis in its simple form appears to be validated. They constitute relatively strong evidence to the extent that they are essentially based on natural experiments, comparing the same populations before and after a public policy intervention (namely permitting a new form of gaming or expanding the number of machine venues).

Evidence from another type of study, where participation and prevalence are related to geographical proximity to gaming opportunities, tends to point in the same direction, i.e. to support the exposure hypothesis. For example, Adams et al. (2007) found higher rates of (moderate) problem gambling among students at two Ontario campuses which had a casino nearby compared with among those attending two universities where the city had no casino. However, such studies offer relatively weak evidence because they lack a time dimension, making causation less clear. It might be, for example, that the pattern observed in Ontario was at least partially explained by students drawn strongly to gambling being disproportionately likely to choose a college town where there was a casino (reverse causation). On the other hand, more careful analysis can mitigate the problem. For example, Welte et al. (2004) analyzed data from a national telephone survey to show that, controlling for socio-economic status, ethnicity and neighborhood deprivation, Americans were about twice as likely to exhibit signs of pathological or problem gambling if they lived within ten miles of a casino. Their replication study (Welte et al, 2015), carried out more than a decade later, confirmed this result. Similarly, Philander (2019) analyzed data from more than 50,000 Canadians in four provinces and found that their probability of being classified as a problem gambler was positively related to the density of casinos in their health region of residence, even after controlling for information on each individual’s status with regard to other mental health disorders. The inclusion of control variables in each of these papers mitigates the risk that a positive association can be explained by, for example, casinos choosing to locate in areas where local populations already exhibit characteristics associated with elevated levels of problem gambling.

But evidence, even in the example before-and-after papers based on evidence from Australia and New Zealand and from Québec, is not unambiguous in its support for the (unmodified) exposure hypothesis. Reconsider first the meta-analysis presented by Storer, Abbott and Stubbs (2009). It indeed showed a positive association between problem gambling prevalence and machine density. But control variables included a trend term on which the coefficient estimate was negative and significant. This leads to the prediction that, once machine numbers are stabilized, prevalence-rates will fall over time. Reconsider next the study by Jacques and Ladouceur (2006). It is true that, one year after the opening of the casino in Hull, three indicators correlated with gambling problems had increased among members of the survey panel. But these increases were not maintained in follow-up surveys of the same panel two and four years after the casino opening. While there was considerable movement of individuals between levels of problem gambling across the time points, including incidence of relapse, the net effect of these movements left problem gambling prevalence no higher than before the casino opened. Thus, the increases observed at one year had proved transient.

The ‘additional’ findings in each of these papers are consistent with a need to supplement the exposure hypothesis with an addendum to the effect that, while increasing availability of gambling to a population may lead to increases in gambling problems, there may be sufficient adaptation to the new environment that these problems increase for only a limited time and prevalence may indeed turn down again. This is the adaptation hypothesis, introduced to the gambling literature by Shaffer, LaBrie and LaPlante (2004) (see also LaPlante and Shaffer, 2007). Their notion that individuals and communities may adapt to the presence of a potentially harmful gambling sector is supported by much formal and informal evidence generated since. For example, Black, McCormick and Losch (2012), albeit with a relatively small sample (n=356), found rates of pathological and problem gambling in Eastern Iowa in 2008-9 to be no higher than documented in an official prevalence survey in 1997-8 notwithstanding a considerable expansion in the state’s gambling offer including additional casinos and indeed the first land based (as opposed to riverboat) casinos. Comparing the results from two similar large-scale telephone surveys covering the whole of the United States, carried out in 1999 and 2013, Welte et al. (2015) reported no change in problem gambling prevalence (and a fall in participation) despite continuing expansion of gambling facilities in the form of such as new casinos and new off-track betting outlets (also see Black et al, 2012). Likewise, Abbott, Romild and Volberg (2014) found steeply lower participation in gambling in Sweden in 2008-9 than in 1997-8, and rates of problem gambling prevalence which were no higher, even though there had been substantial expansion of EGM availability, opening of the country’s first four casinos and the arrival of internet gaming including a state-owned poker website. Bondolfi et al. (2008) reported rates of pathological and problem gambling in Switzerland in 2005 which were unchanged since 1998 despite widespread openings of the country’s first casinos from 2002 (though it should be noted that convenience slot machines in non-casino locations had been removed as part of the gambling reforms). More generally, it is striking that, in countries with regular prevalence surveys, problem gambling prevalence-rates appear generally to have been stable or decreasing in the present century despite greater gambling availability almost everywhere, not least as a result of the emergence of an online gaming industry.

Although there is therefore much evidence favoring the adaptation version of the original exposure hypothesis, generalization is inherently difficult. Results across studies would be expected to differ because expansion of gambling activities will take a different form and scale in different places (for example, the introduction of lotteries would not necessarily produce the same effects as the introduction of EGMs), jurisdictions will vary in whether they accompany expansion of gambling with appropriate policies to mitigate gambling harm, and impact may be less if there is already a range of gambling activities available as opposed to a very restricted gambling sector. Further, if the adaptation hypothesis is generally valid, the time-series of indicators of harm should first turn up and then turn down after any expansion. Conclusions from research studies may then differ according to at which points in time the indicators of harm are measured. If indicators show an increase at the time of measurement, this supports at least some version of the exposure hypothesis but does not rule out subsequent adaptation. If indicators are the same or lower at the time of measurement, this is consistent with the adaptation hypothesis but does not rule out that there had already been some initial harm after gambling expansion was implemented. All these considerations are likely to account for heterogeneity in findings in the literature. LaPlante et al. (2018) examined 34 peer-reviewed papers which looked at gambling outcomes (variously defined, including measures of participation and problem gambling prevalence) before and after an expansion of gambling opportunities. In 22 studies, observed outcomes were unchanged or lower. In 12, observed outcomes were higher. Of the eight studies which tested statistically whether the problem gambling rate had changed, six reported that it had not.

We note that the academic debate considered here has been conducted entirely in the context of Western countries. Macau presents an opportunity in an Asian context to observe how gambling outcomes in the local population have responded in the face of a sustained and significant expansion of a casino industry.

**Literature overview: Problem gambling among casino workers**

In many sectors of the economy there is concern that workers in settings from where a potentially risky product is supplied may themselves be at elevated risk of harm. For example, pharmacists as a group appear to be at higher risk of recreational abuse of prescription drugs than the general population (Merlo, Cummings and Cottler, 2012); and the hospitality industry had the third-highest prevalence of (unhealthily) heavy drinking among the nineteen employment sectors covered by the US National Survey on Drug Use and Health (Bush and Lipari, 2015).

In the case of the casino sector, concern over the possibility that workers will be at high risk of gambling harm was reflected by Shaffer and Korn (2002) in their early review of problem gambling as a public health issue. They identified venue employees as one of the vulnerable groups which should be the focus of research. In general, the exposure hypothesis predicts that gambling industry employees will be at high risk because they are directly in contact with a gambling environment and culture, i.e. disproportionately exposed relative to the rest of the population (LaPlante and Shaffer, 2007). Hing and Gainsbury (2013) discussed the mechanisms through which this may work to increase risk, informed by an Australian survey of employees in casinos and in hotels and clubs offering EGM gaming venues. Important factors included an approving attitude towards gambling by managers and colleagues, the presence in the workplace of triggers to gamble, an enhanced knowledge about and familiarity with gambling, and constraints on other means of socializing associated with the pattern of shift work in the industry. On the other hand, some employees appeared to benefit from protective factors such as observing customers’ losses and hearing about the problems gaming has caused them and also from discouragement of gambling activity by some colleagues. Guttentag, Harrigan and Smith (2012) reported that 72% of more than 900 employees in five Ontario casinos agreed or strongly agreed that ‘as I have become more knowledgeable about the games, I have realized that I cannot overcome the house odds in most games’. Increasing knowledge as a result of occupational exposure was also demonstrated in Dangerfield’s (2004) survey of 123 staff at two Alberta casinos, where a significantly smaller proportion of respondents proved susceptible to ‘the gambler’s fallacy’ than had been estimated for the general provincial population. Boredom with the gambling environment is a further possible protective influence for casino staff as 70% of the Ontario sample in Guttentag, Harrigan and Smith (2012) endorsed that ‘after work I want to avoid spending even more time in a casino or involved with gambling’.

Potentially then, exposure through employment could in principle increase or decrease risk of problem gambling across the whole group of employees. However, most published studies estimate prevalence-rates far in excess of population norms. For example, the combined prevalence-rate of moderate-risk and problem gambling among the casino staff in Ontario surveyed by Guttentag, Harrigan and Smith (2012) was 12.1% compared with 3.4% in the general population of the province; and Hing and Nisbet (2009), from a survey of 532 gaming venue employees in Victoria, found a similarly-defined prevalence-rate of 19.3% compared to an estimate of 1.9% for the state made four years before (both these studies also revealed far above-average gambling participation among their gaming employees). An exception to these and findings in similar studies conducted in Western countries was in the only Asian study we identified. Lee et al. (2008) reported that only 3% of respondents to a survey of South Korean casino employees met the criteria for lifetime Level 3 gambling set by the South Oaks Gambling screen, which was no higher a prevalence-rate of problem gambling than in the national population.

Studies documenting elevated rates among casino workers carry a powerful message of the need for employers in the sector to provide responsible gambling programs for their staff. However, they cannot themselves yield decisive evidence relevant to the evaluation of the exposure and adaptation hypotheses. For example, high prevalence-rates may be associated with a tendency for those already most heavily engaged with gambling to seek jobs in casinos. Guttentag, Harrigan and Smith (2012) investigated reasons for joining the industry and reported that a significant proportion of their respondents agreed with the statement ‘I was a frequent gambler who thought I would enjoy the work’.

Since the exposure and adaptation hypotheses are based on dynamic processes, the first-best approach to overcome the problem of reverse causation is to observe *changes* in casino employee behavior over time. Shaffer and Hall (2002) surveyed 6,067 American casino workers, with follow-ups one and two years later. However, there was a high attrition-rate and only 1,167 were surveyed at each of the three time points. Among this latter group, there was considerable heterogeneity in how their gambling status (according to the South Oaks Gambling Screen) varied between the three points in time but many more ‘improved’ than shifted to a ‘worse’ status and, as a result, prevalence of Level 3 gambling declined from 4.4% at baseline to 2.0% at one year and 1.8% at two years; the number experiencing the less severe Level 2 gambling also declined. These declines are consistent with the adaptation hypothesis. Of course, there are caveats. First, no comparison is made with a non-casino group to allow for a natural tendency towards recovery even in less exposed populations. Second, there was a very high attrition-rate, to be expected given the high turnover in this labor force, and this may have biased results, for example those who developed gambling problems may often have been encouraged to leave their job. Nevertheless, this is a study with a prospective longitudinal design which shows that deterioration in gambling status does not inevitably follow from workplace exposure to gambling and enough cases of improvement are observed to conclude that the adaptation hypothesis captures a real phenomenon. However, it should be remembered that the hypothesis is about aggregate outcomes. Individuals are heterogeneous and a significant number of respondents still progressed to a greater level of problems and, for some, these may have been aggravated by the environment in which they worked.

Longitudinal studies are rare in all fields because they are difficult and expensive to carry out. Other authors cited above have only been able to report results from cross-sectional studies of casino employees. However, some have attempted to capture dynamics by asking respondents about their gambling behavior in the past, typically at the point when they entered the industry. They will not have had a screen for problem gambling applied to them but information, albeit unavoidably subject to recall bias, can be obtained to allow evaluation of whether individuals have gambled more heavily or more frequently over time. For example, Guttentag, Harrigan and Smith (2012) found that the majority (59.4%) had not changed and, of the remainder, many more (28.4%) had decreased rather than increased (12.2%) their gambling. Little variation in these proportions was observed when respondents were divided into groups defined by their length of employment at gaming venues. Broadly similar findings were reported in Hing and Nisbet (2009). These results are again at least consistent with the adaptation hypothesis and suggest that escalation of gambling may not be the typical experience during casino employment.

In our Macau survey, we also inquired about individuals’ gambling behavior in the past in order to compare with present self-reported behavior. We incorporate an additional feature by extending the survey to cover also a sample of non-casino employees in the same city, to allow inference about whether changes in the gambling behavior of casino staff mirrored or not those in the wider population.

**Trends in participation and prevalence in Macau**

As background to our own research results, we consider now trends evident from prevalence surveys conducted in Macau by the University of Macau on behalf of the Social Welfare Bureau of Macao government. There have been six such surveys between 2003 and 2019, with sample sizes of around 2,000 and problem gambling status determined by either the DSM-IV or DSM-V diagnostic screen. In general, headline results are made available online but with no detailed reports published. Nevertheless, headline results collected from over the period are interesting because they are consistent with the adaptation hypothesis narrative that initially a population presented with an expanded accessible gambling offer will respond with greater participation in gambling and more individuals will experience problems. But, subsequently, interest will fade and participation and prevalence will then fall back again.

The first openings of new casinos after the liberalization of licensing regulations took place in 2004. During that year the number of casinos increased from 11 to 24 and by the end of 2007 there were 34. Over this period, the number of gaming tables increased from 424 to 1,092 and the number of slot machines from 814 to 13,267 (Statistics and Census Service of Government of Macao Special Administrative Region, 2019). Concentration of casinos in Macau, is perhaps a little away from the most densely populated housing areas; but Macau is a relatively small city and so the whole population may be said to have been exposed to a very much higher level of gambling availability than hitherto (the change being exogenous to the extent that the new investment in casinos was intended to draw in an international audience; increased accessibility for local residents was incidental). Those newly engaged to work in casinos were of course subject to exposure which could be regarded as particularly potent.

The first two prevalence surveys (2003 and 2007) presented data from before and after this period of rapid growth. The participation-rate in casino gambling duly rose, from 20.3% to 23.6%; mean expenditure increased five-fold; and there was a sharp increase in the estimate of prevalence of combined ‘probable pathological’ and ‘probable problem gambling’, from 4.3% to 6.4%. These changes were consistent with a strong exposure effect. However, participation and prevalence estimates fell more or less steadily across subsequent surveys to reach significantly lower levels even than in 2003 (pre-expansion). In the 2019 survey, participation in casino gambling was down to 9.4% and gambling participation overall (lottery and social gambling were the principal activities) had also fallen substantially. The prevalence estimate, defined now under DSM-V as ‘moderate’ or ‘severe’ gambling disorder, had fallen to 1.3%, which could be said to be low by international standards.

These very strong downward trends occurred even though there was further expansion in casino provision and despite significant inward migration of individuals from regions where they had not previously been exposed to an intense gambling environment. Some sort of ‘adaptation’ therefore seems to have taken place and on a sizeable scale. It might be the case that this adaptation was able to occur even in the face of continued expansion of gaming facilities because, particularly given that the new casinos were spatially concentrated, additional tables and slots did not increase accessibility for locals: their environment was already saturated. Shaffer, LaBrie and LaPlante (2004) proposed that any link between gambling problems and availability was likely non-linear, implying diminishing marginal effects from each unit increase in level of provision.

Against this background, we undertook a survey of Macau residents, including both casino employees and non-casino employees in the sample. Our aim was to evaluate how casino gambling behavior had changed over time and whether the pattern of changes was or was not similar between casino employees and non-casino employees. The past point in time against which we evaluated change was the first twelve months after the respondent had first started gambling in casinos. Other papers cited above used the year when the employee started work in casinos but we wished to compare changes between casino staff and other Macau residents, hence a different reference point was needed. We also investigated respondents’ susceptibility to the gambler’s fallacy (similar to Dangerfield, 2004).

**The survey**

Our survey was completed, in Chinese, by samples of casino employees and non-casino employees between May 21 and July 20, 2018, either online or in face-to-face interviews in public places in Macau. The online survey was conducted through SurveyMonkey, links having been sent to mobile phones of the trainees of the Macau Gaming Teaching and Research Center, WeChat groups of casino junket operators, members of a casino trade union, and bachelor degree students studying at the Casino Career Center while working in casinos.

The total number of responses from Macau residents (i.e. we excluded interviewees who were external tourists, typically from Mainland China) was 619. When carrying out the analysis, we did not include questionnaires which had not been finished, respondents who had never gambled in a casino (established by the first question in the survey- no casino employees fell into this group) or those who did not reveal whether or not they had a job in a casino. Finally, we worked with completed questionnaires from 230 casino employees and 169 non-casino employees. Their profiles by demography and self-reported date of first casino gambling are displayed in Table 1.

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Insert Table 1 About Here

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From each respondent, we collected standard background data including age and gender. We also asked about their current casino gambling behavior (defined over the preceding twelve months). Measures of behavior included the frequency of playing and the duration of a typical session. Each of these captures a dimension of the individual’s level of engagement with casino gaming; but they are also well-established correlates of problem gambling. For example, Currie et al. (2006), from analysis of more than 19,000 respondents to the Canadian Community Health Survey, determined that the risk of gambling harm increased very substantially once gambling frequency reached monthly or more often, regardless of whether controls for demographics were included in the model. And Leonard and Williams (2016), in a large-scale longitudinal study, also in Canada, found that frequency was highly correlated with problem gambling status in repeated cross-sections and a strong prospective predictor of whether an individual would move into the problem gambler category at the next wave of the survey. The relevance of duration as well as of frequency was illustrated by Schellinck and Schrans (2004). Using data from Nova Scotia, they reported that duration of a session was the strongest predictor of the problem gambling status of a player from a comprehensive list of behavioral, physiological and emotional indicators observable in the gaming venue. Working with Australian data, Delfabbro, Thomas and Armstrong (2016) found that 90% of problem gamblers reported individual sessions of three hours or more (though many non-problem gamblers also engaged in lengthy play). Duration may therefore be regarded to some extent as a proxy for problem gambling and indeed may be the direct source of harm if quality of decision taking suffers when play is prolonged.

To indicate frequency, those who had casino gambled at all in the past year were asked in our survey to choose between four options, namely daily, weekly or more often, monthly or more often, and less than monthly. For duration, they were just asked to state the amount of time. As this yielded large numbers of probably rounded answers, we grouped responses into categories: less than one hour, between one and two hours, between two and three hours, between three and four hours and more than four hours. Each grouping was defined to include its lower boundary (for example, an answer of ‘3 hours’ was allocated to the 3-4 hours band rather than the 2-3 hours band). We also collected an additional indicator of current gambling behavior, the respondent’s maximum size of bet (in Macau patacas) in the preceding twelve months.

Finally, we assessed respondents’ adherence to ‘the gambler’s fallacy’ by asking them to evaluate the statement ‘After losing many times in a row while gambling, I am more likely to win’. There were five possible responses, from strongly disagree to strongly agree. The gambler’s fallacy is an example of an erroneous belief which might lead to gambling harm, for example because a player who has had a losing session is encouraged to spend yet more money because he or she thinks that a change in luck is overdue. Although the need for a short survey restricted us to addressing only ‘the gambler’s fallacy’, it may be fairly argued that this erroneous belief is highly correlated with, and indeed drives, many others included in more detailed inquiries into cognitive distortions in gambling (Ejova, Delfabbro and Navarro, 2015). Leonard and Williams (2016) found that false beliefs about gambling products constituted a statistically strong predictor of problem gambler status (though the effect size was relatively small).

The second strand in the project was to compare respondents’ gambling behavior over the immediately preceding twelve months with their behavior in the year when they first gambled in a casino. Questions on that initial year relating to frequency and duration were similarly framed as those covering the last year before they completed our questionnaire. We examined movements in frequency and duration of play between the two points in time and display these in transition matrices for both casino and non-casino employees (Tables 2 and 3). The number of subjects captured in each table is typically slightly below the total size of the sample because a very small number of respondents had failed to answer one of the questions on the basis of which the particular table was compiled.

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Insert Table 2 About Here

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Insert Table 3 About Here

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**Past-year casino gambling**

*Frequency*

In field work, the survey had been terminated if a subject had never gambled in a casino. Thus, all those we studied had experience of casino gaming. However, a significant proportion were no longer participating. 35.2% of casino employees and 38.8 % of non-casino employees had not done so in the preceding twelve months (this indicates higher participation than estimated in official prevalence studies but our sample is restricted to those with at least some lifetime participation). Of the remainder, by far the most common response to the question on frequency was ‘less than monthly’. So, a large majority of respondents played only occasionally or not at all. However, there were ‘regular gamblers’ (defined by the top three bands, i.e. by playing at least monthly) in each group, 7.5% of all casino employees and 12.0 % of non-casino employees. According to research cited above, this level of engagement with gambling is associated with sharply elevated risk of problem gambling.

Using difference in proportions tests applied with Stata software, we found no significant difference between the proportions of the two sub-groups who were non-gamblers in the past year (p=.464). The proportion of ‘regular gamblers’ was higher in the non-casino employee group but sample sizes were too limited for the difference to be significant at conventional levels (p=.131). This latter finding appears to be inconsistent with a simple version of the exposure hypothesis because the group of casino employees has been exposed to a gambling environment more directly and for more time each week than other Macau residents and yet their propensity to be regular gamblers is no higher and may indeed be lower.

*Duration*

Here we analyzed typical session length among those who had played at all in the preceding year. In each sub-sample, median duration of past-year casino gamblers was between one and two hours. But there were significant numbers of respondents who played for three to four hours (and 28 altogether whose typical length of play exceeded four hours). It is believed that session duration of greater than three hours is associated with sharply elevated risk of problem gambling (Delfabbro, Thomas and Armstrong, 2016).

Of the 105 casino employee who had played in the past year, 23 (15.9%) reported duration of three hours or more. Of the 101 non-casino employees who had participated in gaming in the past year, 24 (23.8%) were high duration players. Though the difference in proportions is again not significant (p=.121), it is of note that not only is there a higher proportion of regular players in the non-casino sample but also a higher proportion who play for long periods of time. These findings are inconsistent with a simple version of the exposure hypothesis and its prediction that gaming venue employees will tend to be more (not less) engaged in gambling and more (not less) prone to behavior correlated with problem gambling.

*Maximum size of bet*

From experiments, increased stake size has been argued to be correlated with a deterioration in quality of decision-taking, potentially leading to greater risk of harm (Parke et al., 2016), and indeed placing a regulatory limit on size of bet has been part of responsible gambling strategy in jurisdictions such as Great Britain. We asked those who had gambled in a casino in the past year what their maximum bet size had been in Macau patacas. We grouped the answers into five categories, from below MOP500 (USD63) to MOP5,000 (USD626) or higher. We compared the distributions of answers for casino employees and non-casino employees.

The proportion of respondents reporting a maximum stake size in excess of MOP5,000 was smaller in the casino (10.9%) than in the non-casino (17.1%) employment group but the result was reversed when the lower threshold of MOP2,000 (USD250) was considered (32.0% versus 25.6%). But in neither case was the difference statistically significant (p-values of .282 and .151) and so there was no evidence of different patterns of behavior in respect of stake size.

*The gambler’s fallacy*

The relevant survey question was answered by all 230 casino employees in the sample and by 166 of the 169 non-casino employees. They were asked to give a Likert scale response describing their agreement or disagreement with the proposition that “After losing money many times in a row while gambling, I am more likely to win”. The proportion who ‘agreed’ or ‘strongly agreed’ was small but non-trivial and it could be argued that those exhibiting this cognitive misunderstanding were at elevated risk of gambling harm through, for example, feeling justified in chasing losses. Particularly given Dangerfield’s (2004 findings for casino staff in Alberta, we expected casino employees in Macau to be less prone than other residents to the gambler’s fallacy because of greater knowledge of games played in their venues, where almost all games are games of pure chance. However, the distributions of answers for the casino and non-casino employment groups were very similar. For example, 11.3% of employees and 10.0% of non-employees endorsed the gambler’s fallacy by indicating agreement or strong agreement (the difference decisively non-significant, p=.673). If greater understanding of games acquired on the job is speculated to be a protective factor mitigating exposure effects, there is no support for the proposition in our data.

**Change in casino gambling over time**

The previous analysis has offered results which are inconsistent with the unmodified version of the exposure hypothesis given that it shows broadly similar recent behavior patterns between casino and non-casino employees. Indeed, any differences evident were in the direction of illustrating lesser rather than greater engagement with gambling among those exposed to gambling culture through their workplace. However, consideration of the ‘adaptation amendment’ requires some measure of change in gambling engagement over time. We therefore asked respondents to recall their typical frequency and duration of play in the twelve months following their first participation in casino gambling. By design all those who completed the survey had gambled in casinos at some point. We provide summaries of how frequency and duration changed for individuals in the transition matrices displayed as Tables 2 and 3.

In both the casino and non-casino employees groups, roughly half of respondents reported the same level of frequency as at the beginning of their gambling career. Of the remainder, many more had shifted towards lower frequency (which sometimes meant abstention) rather than higher frequency. These stylized facts about the data are similar to those reported by Guttentag, Harrigan and Smith (2012) and Hing and Nisbet (2009) though their studies had start of casino employment rather than casino gambling initiation as their first time point (and offered no comparison with non-casino employees).

We focus again on regular (monthly-or-more-often) gamblers because they are the most engaged and also the most likely to experience problems from gambling. In the casino employee group, 51 were regular gamblers in their first year of gambling. Thirteen (25.5%) of these reported still being regular gamblers in the most recent twelve months. In the non-casino group, 25 were regular gamblers in their first year of gambling and ten (40.0%) were also in the regular gambler category at the time of the survey. This difference was, however, non-significant (p=.196).

It is also relevant to consider progression from occasional (less-than-monthly) to regular (monthly-or-more-often) gambling status. In the casino group, of 176 occasional gamblers at the first time point, four (2.3%) were regular gamblers at the time of the survey. In the non-casino group, there were 142 occasional gamblers at the first time point and eleven (7.7%) of these moved to being regular gamblers at the time of the survey. The difference between the two groups in terms of change to regular gambling participation was statistically significant (p=.022). This is suggestive that the risk of becoming more closely engaged with gambling is lower for casino staff, inconsistent with the simple exposure hypothesis and not inconsistent with the adaptation hypothesis. It cannot be put more strongly than that because we do not observe the time path of level of engagement between the two time points.

Our other key indicator of engagement is typical duration of play. In each sub-group, almost exactly half moved to either a lower duration or abstention between the two points, similar to findings for frequency. However, of the remainder, there were more cases of increased than of lower engagement in the non-casino group (and about the same number shifting to higher as to lower engagement among casino employees).

Retaining our threshold of three hours to distinguish long duration gamblers, we identified 41 current casino employees who reported long duration play at the beginning of their gambling careers. Of these, 17 (41.5%) were also long duration in the twelve months preceding the survey. In the non-casino employee group, there were 27 long duration players at their first time point and 13 (48.1%) of these again appear as long duration at the second time point. There was no significant difference (p=.587) in persistence of long play between the two groups.

In their first year of gambling, 176 current casino employees had been short duration players according to their recall. Of these, 6 (3.4%) were long duration players at the second time point. Among non-casino employees, 134 had been short duration players in the first year after initiation and eleven (8.2%) of these fell into the long duration category for the twelve months preceding the survey. ‘Progression’ from short to long duration play seems therefore to have been more common among the non-employees though the difference was only borderline significant (p=.066). Again, this finding would not have been predicted by the original exposure hypothesis and suggests that casino employment does not typically result in higher risk of personal heavy engagement with casino gambling.

**Discussion**

Our study of course has limitations. The sampling was not random and had a strong element of self-selection. No instrument for assessing problem gambling status was included in the survey (though we were able to examine established correlates of problem gambling). No information was collected on the job role of casino employees in their casino or about participation in alternative gambling activities. Measurement of change in behavior over time depended on respondents’ recall of the sometimes distant past. Cognitive biases were assessed only by respondents’ susceptibility to ‘the gambler’s fallacy’. But, notwithstanding these limitations, it is still possible to draw some tentative conclusions given that the evidence presented by the data tended always to point in the same direction.

First, we found that indicators of heavy involvement in casino gambling among casino employees were no higher (and in respect of frequency actually lower) than among other residents of Macau, at least those who have ever gambled in a casino. This illustrates that it is by no means inevitable that intense exposure to a gambling culture leads to greater consumption of gambling services, with its attendant risk of harm. This result is in contrast to results from studies of gaming venue employees in Australia and Canada but is somewhat similar to a finding from South Korea. It is tempting to conjecture that there is something different about Asian settings; but we find it more plausible to focus on particularities of Macau. In Macau, the economy is dominated by the casino sector, which accounts for more than one-fifth of all employment and offers median earnings about one-quarter higher than in the aggregated labor market (Statistical Information Service of Macao, 2019). This makes casino employment a very mainstream career choice in Macau (in contrast to Australia and Canada) and the sheer number of entrants to the sector will dilute any effect from a tendency of heavy gamblers to seek jobs in gambling (thereby boosting the measured prevalence of risky gambling among casino staff). Again, any adverse exposure effects may have been modified by protective measures. A wide range of population-wide responsible gambling measures were introduced by the Macau government in 2009 and have been particularly intensively targeted at casino employees. Perhaps as a result, awareness of responsible gambling provision is reported to be much higher in the casino sector than in the general population (Institute for the Study of Commercial Gaming, University of Macau, 2017), which may account for higher rates of help seeking among casino employees. At the employer level, the Macau Government has encouraged operators to adopt provisions in the ‘Responsible Gambling Business Code of Conduct’ designed to protect workers and in fact all six casino ownership groups in Macau have responsible gambling programs in place for their employees; frontline staff also receive training in identifying customers who may have problems. This latter provision may encourage self-reflection by those serving customers face-to-face. It has been argued, by, for example, Abbott (2006), that the impact of exposure and the speed of adaptation in the general population will depend partially on the presence and scale of safer gambling programs, such that differences in provision will cause heterogeneity in the effects of gambling expansion in different settings, and this point seems equally relevant to specialist populations of casino workers.

Second, we found that, relative to their behavior early in their gambling careers, those who were employed in casinos tend—if anything—to be less likely either to persist in heavy play or to move from light to heavy engagement compared with non-casino employees. In Macau, casino employment per se does not therefore appear to change the risk of movement towards heavy play. A footnote to this finding is that the risk may be further modified in future because an amendment to the Gaming Participation Law, effective from December 27, 2019, prohibits casino employees from entering gaming areas of casinos when not working (except at Chinese New Year).

Results of population prevalence surveys in Macau indicate that the major expansion of gaming facilities from 2003 was followed by increased participation and increased prevalence of problem gambling, just as the exposure hypothesis would have predicted. Subsequent steady decline in both metrics indicates that adaptation, including through enhanced responsible gambling provision, was sufficient to reverse initial exposure effects. The overall experience of Macau is therefore consistent with the adaptation hypothesis. Our study adds to the evidence by focusing on casino employees, for whom exposure is particularly intense. That it was hard to discern any tendency for casino employees to display greater involvement in gambling at a point in time or in terms of changes over time than others in Macau who had ever gambled in a casino is further suggestive that the exposure hypothesis alone is too simple and that adaptation is a real phenomenon.

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| **Table 1: Profile of the Respondents (*N*=399)** | | | | |  |  |
|  | **Casino (*N*=230)** | | **Non-casino (*N*=169)** | | **Total Sample** | |
|  | **Count** | **Percent** | **Count** | **Percent** | **Count** | **Percent** |
| *Age* | | | | | | |
| 21-30 | 47 | 20.4 | 48 | 28.4 | 95 | 23.8 |
| 31-40 | 129 | 56.1 | 72 | 42.6 | 201 | 50.4 |
| 41-50 | 41 | 17.8 | 23 | 13.6 | 64 | 16.0 |
| 51-60 | 12 | 5.2 | 16 | 9.5 | 28 | 7.0 |
| >60 | 1 | 4 | 10 | 5.9 | 11 | 2.8 |
| *Gender* | | | | | | |
| Male | 124 | 53.9 | 81 | 47.9 | 205 | 51.4 |
| Female | 106 | 46.1 | 88 | 52.1 | 194 | 48.6 |

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| **Table 2 Transition Matrices for Casino Employees** | | | | | |  |
| **2-1 Gambling Frequency in first year gambling and last 12 months** | | | | | | |
| Past 12 mo.  First Year. | No gambling in past yr. | Less than Monthly | Monthly or more | Weekly or more | Daily |  |
| Less than Monthly | 65 | 107 | 4 | 0 | 0 |  |
| Monthly or more | 11 | 15 | 2 | 0 | 0 |  |
| Weekly or more | 2 | 5 | 2 | 4 | 0 |  |
| Daily | 2 | 3 | 1 | 2 | 2 |  |
| Total | 80 | 130 | 9 | 6 | 2 |  |
| **2-2 Gambling Duration in First Year Gambling and Last 12 Months** | | | | | | |
| Past 12 mo.  First Year. | No gambling in past year. | Less than 1 hour | Between 1 & 2 hours | Between 2 & 3 hours | Between 3 & 4 hours | ≥4 Hours |
| Less than 1 hour | 20 | 11 | 3 | 2 | 0 | 0 |
| Between1 & 2 hours | 27 | 3 | 46 | 18 | 2 | 3 |
| between2 & 3 hours | 14 | 1 | 15 | 10 | 0 | 1 |
| between 3 & 4 hours | 8 | 0 | 4 | 2 | 5 | 3 |
| ≥4 hours | 3 | 0 | 3 | 4 | 1 | 8 |
| Total | 72 | 15 | 71 | 36 | 8 | 15 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Table 3 Transition Matrices for Non-Casino Respondents** | | | | | |  |
| **3-1 Gambling Frequency in First Year Gambling and Last 12 Months** | | | | | | |
| Past 12 mo. First  Year | No Gambling in Past Year. | Less than Monthly | Monthly or More | Weekly or More | Daily |  |
| Less than Monthly | 59 | 73 | 6 | 4 | 1 |  |
| Monthly or More | 2 | 3 | 4 | 0 | 0 |  |
| Weekly or More | 2 | 7 | 0 | 3 | 0 |  |
| Daily | 1 | 0 | 0 | 0 | 2 |  |
| Total | 64 | 83 | 10 | 7 | 3 |  |
| **3-2 Gambling Duration in First Year Gambling and Last 12 Months** | | | | | | |
| Past 12 mo.  First Year | No gambling in past yr. | less than 1 hour | between 1 & 2 | between 2 & 3 | between 3 & 4 | ≥4 |
| Less than 1 hour | 20 | 9 | 6 | 3 | 0 | 0 |
| Between1 & 2 Hours | 26 | 4 | 28 | 8 | 0 | 5 |
| Between 2 & 3 Hours | 8 | 0 | 4 | 7 | 5 | 1 |
| Between 3 & 4 Hours | 5 | 0 | 4 | 2 | 4 | 0 |
| ≥4 Hours | 1 | 1 | 0 | 1 | 2 | 7 |
| Total | 60 | 14 | 42 | 21 | 11 | 13 |