

## Understanding the Slot Machine Zone

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**Running Head:** UNDERSTANDING THE SLOT MACHINE ZONE

### **Conflict of Interest Statement**

Luke Clark is the Director of the Centre for Gambling Research at UBC, which is supported by funding from the Province of British Columbia and the British Columbia Lottery Corporation (BCLC), a Canadian Crown Corporation. The Province of British Columbia, and BCLC had no involvement in the ideas expressed herein, and impose no constraints on publishing. Luke Clark has received speaker/travel honoraria from the National Association of Gambling Studies (Australia) and the National Center for Responsible Gaming (USA). He has received consulting fees from Gambling Research Exchange Ontario (Canada) and the National Center for Responsible Gaming (USA). He has not received any further direct or indirect payments from the gambling industry or groups substantially funded by gambling. He has received royalties from Cambridge Cognition Ltd. relating to neurocognitive testing. Spencer Murch completed his PhD at the Centre for Gambling Research at UBC. He has no further conflicts of interest to disclose.

### **Acknowledgements**

The authors would like to thank Magdalen Schluter for providing insightful input into the Gambling Immersion hypothesis presented in this paper.

**Abstract**

**Purpose of Review:** The *slot machine zone* describes a ‘trance-like’ state of diminished attention to time passing and gambling-irrelevant events during Electronic Gaming Machine (EGM) use. This article summarizes two prominent theoretical accounts of this state, and articulates a new account that seeks to integrate them.

**Recent findings:** *Zone* experiences are correlated with gambling problems, and may be amplified by specific features of EGMs and other modern gambling formats. Links with excitement, relaxation, and depression have been found, implicating both positive and negative reinforcement processes. Emerging evidence suggests gamblers in the zone are more focused on EGM use (‘zoned in’). Models rooted in either Flow Theory or dissociation do not fully account for these effects.

**Summary:** Integrating earlier models, we propose a continuum of gambling immersion as a function of problem gambling severity. Cognitive studies aimed at clarifying the psychological nature of immersion will help inform programs that treat and prevent gambling harm.

**Keywords:** Gambling, Slot machine zone, Flow, Dissociation, Immersion, Problem gambling

### Introduction

Approximately 0.5% of people experience significant impairment in everyday functioning as a result of their gambling, meeting clinical criteria for a diagnosis of *Gambling Disorder*, a non-substance related addictive disorder defined in the DSM-5 [1, 2]. A much larger portion of people who gamble experience some degree of gambling-related harms (e.g. poor credit rating or missed bill payments), without qualifying for a diagnosis of Gambling Disorder [3]. Indeed, the majority of gambling-related harm in society may actually occur in individuals without Gambling Disorder [4], underscoring a recent argument that there is no ‘safe’ level of gambling involvement [5]. This broader focus on gambling harm underpins the evolving public health approach to gambling. The public health framework also recognizes that the incidence of gambling harm depends on individual traits and vulnerabilities, in combination with the design of gambling products and the environments in which they are found [6]. Thus, the potential for harm may be multiplied when vulnerable individuals are exposed to high-risk gambling products and situations.

In characterizing the interplay between individual vulnerabilities and the impacts of gambling products, the gambling field is increasingly focusing on how the subjective experiences of gamblers are shaped by the structural characteristics of specific gambling activities. Structural characteristics encompass the design and gameplay features endemic to a given gambling format (e.g. pace, betting options, audiovisual feedback, etc.) [7]. Much of this focus has been devoted to slot machines, and other kinds of Electronic Gaming Machines (EGMs, a term that encompasses slot machines, video poker, video lottery terminals, and other standalone digital games). These products are increasingly recognized as a particularly harmful gambling format [8–11]. In our own work, we have investigated a uniquely absorptive cognitive

## UNDERSTANDING THE SLOT MACHINE ZONE

state that is often reported by people who gamble on EGMs [12]: the so-called *slot machine zone*. We and others have been inspired by qualitative work over the past four decades that depicts a highly-focused, trance-like state in which other goals and motivations become subordinate to the continuation of gambling [13, 14; see also 15]. In one account, an EGM gambler in treatment describes the zone as “like there’s nobody else there, just you and this machine and no one else matters...half the time you can’t even hear people or what’s going on because you’re just focused on this machine” [15]. Similar accounts were reported by Schüll [13, p. 2]: “It’s like being in the eye of a storm... Your vision is clear on the machine in front of you, but the whole world is spinning around you, and you can’t really hear anything. You aren’t really there – you’re with the machine, and that’s all you’re with”.

These qualitative descriptions typically characterize the zone as a focusing of attention on the gambling activity at the expense of other mental functions. However, people in the zone typically report more than just a strong focus on gambling (see Table 1). These individuals often feel as though they are ‘outside of themselves,’ like they ‘take on a different identity,’ and report completely losing track of time. Thus, it remains an empirical question whether this state differs qualitatively or quantitatively from engagement in other activities or hobbies, such as watching television or household chores.

## UNDERSTANDING THE SLOT MACHINE ZONE

Table 1. Two frequently used slot machine zone questionnaires.

### DQ

1. “(Did you feel / Have you ever felt) like you were in a trance while gambling?”
2. “(Did you / Have you ever) experienced a memory blackout for a period while gambling?”
3. “(Did you feel / Have you ever felt) like you were outside of yourself or watching yourself play while gambling?”
4. “(Did you feel / Have you ever felt) like you took on a different identity while gambling?”
5. “(Did you / Have you ever) lost all track of time while gambling?”

### GEQf

1. “I lost connection with the outside world.”
2. “I forgot everything around me.”
3. “I was fully occupied with the game.”
4. “I was deeply concentrated in the game.”
5. “I lost track of time.”

*Note:* The Jacobs Dissociation Questionnaire (DQ) [16, 32] and flow subscale of the Game Experience Questionnaire (GEQf) [50], have been preferred in the gambling field, and include several similar items. Additional instruments may be needed to disambiguate the flow and dissociation accounts of the slot machine zone. Clauses in parentheses vary between studies depending on the authors’ hypotheses.

Early quantitative studies of this state emphasized depersonalization as a core feature, comparing the zone to a pathological dissociative state [14, 16, 17]. Subsequent research has examined the zone through the lens of Flow Theory from the field of positive psychology [18–20] (see Table 2). In our view, both of these models present a reasonable interpretation of the slot machine zone, and yet many people would consider dissociation and flow to be quite different psychological states.

## UNDERSTANDING THE SLOT MACHINE ZONE

In this review, we argue that neither account fully captures the range of slot machine zone experiences. On one hand, the flow account provides a clear explanation for the experiences of cognitive absorption and peripheral inattention during gambling, but does not clearly accommodate more dissociation-like symptoms such as depersonalization and derealization. On the other hand, dissociation theory provides a clear explanation for some of the more severe phenomena associated with the zone. However, it fails to account for recent findings in samples of people experiencing low-to-moderate gambling problems.

In this article, we describe the existing empirical literature relating to the slot machine zone. We then summarize the contributions of clinical dissociation and Flow Theory to our understanding of the zone. Integrating the available data from these approaches, we propose a novel *gambling immersion* framework adapted from the field of video game psychology. This immersion account reconciles the two existing models as different points along a dimension of problem gambling severity, such that the zone may appear more flow-like in people with less severe gambling problems, but may progress to a more dissociation-like construct among people experiencing severe gambling problems. Finally, we discuss a number of potential implications of this account for gambling regulators and policymakers.

[Insert Table 2 about here]

### **Why do Some People Experience a Slot Machine Zone?**

The severity of gambling problems that people experience is strongly related to their experience of the zone while gambling. This finding has been replicated more than a dozen times, and a recent meta-analysis showed a large overall correlation [21]. In that analysis, the

## UNDERSTANDING THE SLOT MACHINE ZONE

effect was not moderated by participant age or gender, or by the researchers' choice of zone and problem gambling questionnaires. In an earlier review of the topic, Schluter and Hodgins [22] noted that the relationship between zone experiences and gambling problems has been shown both immediately following a gambling session (i.e. a discrete 'zone state'), and as a frequency over the past 12 months (pointing to a more trait-like disposition towards absorptive experiences). These findings underscore the importance of understanding the zone, but do not clarify how it functions, or why it occurs. To approach these questions, we can look to recent research on individual traits, and structural characteristics of different gambling forms.

### **Individual traits that impact the zone**

The slot machine zone is not the same as simply having fun while gambling, spending a lot of time gambling, or finding gambling activities exciting. A large-scale study of high school students found that gambling involvement was associated with both greater excitement and greater relaxation during use [23], a result that could be viewed as paradoxical. A separate study concluded that flow experiences during online gambling increased users' desire to continue gambling, which in turn increased participants' gambling time [24]. Across three experiments in which we measured sympathetic nervous system activity (an indicator of excitement) using impedance cardiography during slot machine gambling, we found that undergraduate students who reported experiences consistent with the zone tended to show a greater change in cardiac sympathetic activity at the onset of gambling: increasing in two experiments, but decreasing in the third [20]. These findings suggest that the slot machine zone may be either exciting or relaxing, depending on specific aspects of the gambling scenario.

Several studies have shown significant correlations between slot machine zone experiences and positive affect [23, 24], indicating that zoning is subjectively pleasant. Other



## UNDERSTANDING THE SLOT MACHINE ZONE

work has shown positive relationships with depression symptomatology [19, 24; but see 25], including relationships between problem gambling, depression, the slot machine zone, and lower rates of mindful attention outside of gambling [24, 26, 27]. Consistent with the influential Pathways Model of problem gambling [28], these findings collectively suggest that positively reinforcing gambling events (i.e. winning) may be augmented by the negatively reinforcing effects of the slot machine zone to provide an escape from depressed mood, anxiety, past trauma, or other negative states such as stress [14, 29, 30]. In support of this view, a structural equation modelling study by McCormick and colleagues [31] found that depression, anxiety, and stress contributed to slot machine zone experiences, and the resulting ‘need to escape’ factor accounted for 46% of the total variability in gambling problems.

### **Structural characteristics that impact the zone**

The relative harmfulness of slot machines and other EGMs may be partially attributable to their ability to capture and hold users’ attention, facilitating zone experiences. Among 160 Australian survey respondents who indicated feeling as though they had been “in a trance” while gambling in the previous 12 months, the overwhelming majority (n = 126, 79%) indicated they had been using an EGM at the time [12]. Three studies have examined gamblers’ ability to respond to secondary tasks (e.g. in the visual periphery) while gambling on an EGM. In two of these, self-reported zone experiences were correlated with the severity of participants’ gambling problems, which was in turn correlated with poorer performance in responding to gambling-irrelevant peripheral shapes [23, 32; but see 33].

A number of specific features of modern slot machines and EGMs have been proposed as contributors to the zone, including frequent reinforcement, rapid pace of play, and the presence

## UNDERSTANDING THE SLOT MACHINE ZONE

of near misses [13, 34]. That said, many of these elements have yet to be empirically tested (Table 2). From a methodological perspective, experienced gamblers may only enter the slot machine zone when using either real, or highly realistic gambling products, and although gambling research is increasingly turning to authentic products and field studies [26, 35], authentic gambling products do not readily allow researchers to modify specific structural characteristics for rigorously controlled designs.

Among the slot machine features that have been directly tested as contributors to the zone, *multi-line betting* appears to be one key ingredient. On a traditional slot machine, a win is awarded if the symbols match up in a straight line across the middle of the display. By contrast, modern slot machines typically allow gamblers to place many concurrent bets across different ‘paylines’ on the device’s screen (i.e. paylines may cross the top or bottom of the screen, as well as diagonally or in different zig-zag patterns). In two studies of casino gamblers and undergraduate students, betting on multiple paylines increased subsequent zone ratings [36, 37]. In our study [37], zone ratings were increased by upping the number of paylines, but not by simply increasing the overall bet size on a single payline. These effects may be driven by increases in reinforcement rate: multi-line slot machines allow for losses-disguised-as-wins, in which reinforcing audiovisuals occur despite a net loss of credit. Increasing the reinforcement rate by introducing smaller, more-frequent reinforcement also results in a ‘smoother’ decrement of credit, potentially explaining the link between multi-line gambling and the zone [13, 37]. Despite significant research investigating *near misses* in gambling games [38], we are not aware of any research linking this prominent game feature to experiencing the zone – indeed, the frustrating aspects of a near-miss could plausibly disrupt a state of immersion.

## UNDERSTANDING THE SLOT MACHINE ZONE

The absorptive effects of EGMs could also be shaped by environmental features of casino venues, such as in cases where the casino floor design is intended to produce a sense of envelopment [13, 39]. There are few papers examining the impacts of such venue-level factors on gambling, but one study of 160 adults found that individuals who lost track of time while playing slot machines reported greater zone experiences if they had not been exposed to ambient casino sounds and background music [40]. The authors further found that louder music with a slower tempo contributed to participants keeping track of time. Here, one pertinent point is that online and mobile gambling formats provide gamblers with more opportunity to shape their own gambling environments. Online EGMs, for example, can provide many of the same features as their land-based counterparts, but in the privacy of one's own home. This may encourage or prolong people's experience of the slot machine zone. A large, recent study of gamblers who play blackjack or slots online found elevated gambling duration and expenditure among gamblers who reported zone-like experiences [41].

### **Existing Theoretical Accounts of the Slot Machine Zone**

Thus far, we have used the term "slot machine zone," to describe absorptive gambling experiences. However, we note that this term is unduly specific. The slot machine zone is neither limited to slot machines, nor to gambling activities. These kinds of experiences have been reported in online poker [42], and in various non-gambling activities including video gaming [43] and smartphone use [44]. Indeed, we speculate that the neural mechanisms responsible for absorption in the slot machine zone may be the same ones responsible for the sense of absorption people experience in everyday activities like reading and studying. The gambling field implicitly recognizes the widespread occurrence of zone-like experiences, likening them to pre-existing

## UNDERSTANDING THE SLOT MACHINE ZONE

constructs established in other areas of psychology. In particular, *dissociation* from the realm of clinical psychology [16, 22], and *flow* from the realm of positive psychology [19, 45].

The dissociation account of the slot machine zone started in the 1980s with Jacobs' [14] position that the behavioural aspects of addiction represent a kind of *self-medication*; an attempt to alleviate a chronic state of hypo- or hyper- arousal that interferes with homeostatic balance. In his view, addictive substances and behaviours provide an escape from the unpleasantness of this aversive arousal state, as well as past psychological traumas. Examples of this dissociative response are shown in Table 1, and formalized in the Dissociation Questionnaire (DQ) which is still widely used as a subjective measure of this state. These experiences align with broader conceptions of clinically-relevant dissociation, emphasizing depersonalization and derealization as key symptoms [46, 47]. Certainly, this emphasis on a motivation to escape from negative cognitive states aligns well with the accumulated evidence linking zone experiences and gambling problems [22, 31].

Although *Flow Theory* has been a pillar of the field of Positive Psychology since the 1980s, research on gambling flow is still in its infancy. *Flow* is a shorthand term that describes “the holistic sensation when we act with total involvement” [18]. In his seminal works, Csikszentmihalyi describes the conditions and effects of flow as: i) active cognitive processes in the absence of metacognitive awareness, ii) a narrowing of attention on a specific space or thing, iii) a diminished sense of self-consciousness, iv) a confident sense of control over one's surroundings, v) a clear sense of the task and order of actions, and vi) intrinsic motivation towards performing the activity. Through a narrowing of the scope of attention, flow during gambling could accommodate a diminished awareness of time passing, and cognitive escape from low mood and stress. Although these experiences are central features of the dissociation

## UNDERSTANDING THE SLOT MACHINE ZONE

account, they appear to be more collateral in the flow model. On the other hand, Flow Theory provides plausible explanations for the higher rate of zone experiences associated with certain gambling formats [12]. For example, slot machines and other EGMs afford clear patterns of continuous behaviour (i.e. ‘when the reels stop spinning, you can press the Bet button again’), and do not impair users’ sense of situational control by including other actors in the gambling situation (that might be expected at a crowded table game).

Notably, both the flow and dissociation accounts agree on at least one core element: the disruption of normal attentional processes such that individuals have a hard time disengaging from the gambling activity or becoming cognizant of peripheral events. One study has been conducted with the specific goal of comparing flow to dissociation in gamblers. Wanner and colleagues [48] compared a modest sample of 14 people diagnosed with Pathological Gambling to a large sample of student athletes, administering both the DQ and Flow State Scale [49]. The gamblers reported significantly higher dissociation and lower flow with respect to their gambling than the athletes did with respect to their athletics, although the authors noted that each dimension of flow was clearly reported by the gamblers. These findings thus suggest that there may be considerable overlap between these competing constructs. This overlap is also evident in the two most frequently-used instruments in this field, the modified DQ [16, 32] and the flow subscale from the Game Experience Questionnaire (GEQf, Table 1) [50]. Indeed, in our experiments using the DQ alongside an earlier iteration of the GEQf, we found sufficient internal consistency across items to consider them as a single, larger scale [25, 36].

Whereas the dissociation account clearly emphasizes escape motivation, Flow Theory is ambiguous when it comes to motivational states: are gamblers experiencing flow driven *only* by the intrinsic motivation to continue gambling, or does the drive to experience flow work *in*

## UNDERSTANDING THE SLOT MACHINE ZONE

*tandem* with excitement, winning money, and other common motives? Our recent study [25] sought to disambiguate these possibilities. We recruited 53 past-year slot machine gamblers to use a real slot machine for 20 minutes while wearing mobile eye tracking glasses (figure 1A). Using several eye movement metrics, we examined whether gamblers who self-reported zone experiences while gambling were more, or less, interested in the ongoing act of gambling on a slot machine. Our primary, pre-registered analysis found that gamblers who reported zone experiences spent relatively more time looking at the device's credit display, and relatively less time looking at the spinning reels (figure 1B-C). Zone experiences were further associated with an increased number of visual saccades, suggesting that these participants were more motivated to visually examine the gambling imagery on screen. We concluded based on these results that the slot machine zone more likely represents an active state of increased attention to one's ongoing goals and performance within the gambling activity.

[Insert Figure 1 about here]

A potential limitation to the flow model concerns the fact that flow is often described as an unambiguously positive thing; an *optimal human experience* [18]. If it is true that flow leads to prolonged gambling, then the 'house edge' of gambling products guarantees that gamblers who experience flow will tend to lose more money and experience more harm. Recent research in online blackjack and slot machine gamblers supports this stance, showing prolonged use, greater expenditure, and higher enjoyment among higher-flow participants [41]. Thus, it is the structural properties of gambling products, rather than the cognitive basis of the state, that make immersion during gambling unique. Dixon proposes the term 'dark flow' to clarify that, although the flow experience itself may be viewed as pleasurable by users, the downstream consequences

## UNDERSTANDING THE SLOT MACHINE ZONE

of high gambling participation are likely harmful [19]. Somewhat to the contrary, emerging evidence suggests that some dimensions of gambling flow (namely control and concentration) may be protective against problem gambling, while others (intrinsic motivation and losing track of time) appear to aggravate problem gambling risk [45].

Interestingly, at least one contemporary model of dissociation explicitly incorporates Flow Theory. In Butler's model of Normative Dissociation [51], dissociation is understood as a range of experiences that are marked by a disintegration of cognitive processes that usually work *in tandem*. For example, if visual attention typically enables you to focus on work while occasionally checking the time so that you do not forget about an upcoming appointment, a 'normative' dissociative episode would involve becoming so engrossed in work that you forget about the appointment entirely. At the far end of the spectrum, examples of pathological dissociation include depersonalization and derealization, in which the senses of the self and one's surroundings can become distressingly disintegrated from one's normal cognitive experience. In Butler's model – which does not consider any application to gambling – dissociation exists on a continuum from benign (or even beneficial) everyday experiences to distressing and serious alterations in perception and experience. Thus, we recognize that: 1) there are many common elements in existing models of the slot machine zone, and 2) neither the flow nor the dissociation account completely captures the full range of experiences typically reported.

### **The Gambling Immersion Account**

Although the flow and dissociation models have received significant attention, the cognitive underpinnings of the slot machine zone have not been sufficiently investigated to arbitrate between them. Although some efforts have been undertaken to investigate the

## UNDERSTANDING THE SLOT MACHINE ZONE

experience using experimental methods, the overwhelming majority of large-sample research thus far has focused on identifying correlates of self-reported zone states (Table 2). We thus propose an integrative account using the more neutral label of *gambling immersion*, which aims to synthesize the elements of the flow and dissociation views that have been empirically established in the context of gambling. In the video gaming field, two distinct levels of immersion have been characterized in digital activities: one shallower, and one deeper [52]. Level one immersion is flow-like, involving absorption in the activity and consequent inattention to external stimuli, which may fog one's sense of self and the passage of time. This is consistent with empirical findings characterizing attentional effects among immersed gamblers [23, 25, 32, 53]. In contrast, level two immersion is closer to pathological dissociation, emphasizing a deeper state in which the individual's identity blurs with the world of the game. This is strikingly similar to Jacobs' original account of dissociation in gambling [14], and descriptions of derealization and depersonalization in the context of dissociative disorders. Importantly, the immersion account stipulates that level two immersion is dependent on reaching level one immersion, which is in turn dependent upon continuous engagement with the game.

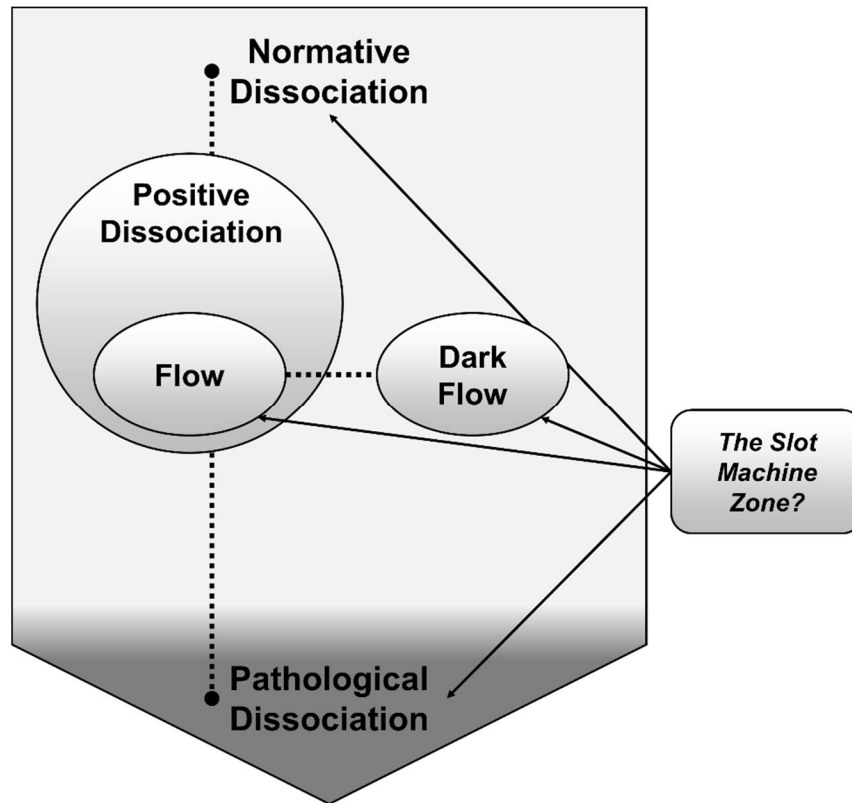
In other words, *gambling immersion* is hypothesized as an absorptive experience during repetitive gambling activities that interferes with other goals and activities. Milder cases may involve attending to gambling to the extent one fails to notice time passing or changes in their surroundings, while more severe cases may also involve disruptions in one's sense of self and their identity. In a version of Butler's model that we adapted for gambling and the slot machine zone (Figure 2), we have laid out several constructs that have been applied to gambling and other potentially-addictive technologies. Whereas Butler and Csikszentmihalyi interpret flow experiences as 'positive' instances of dissociation [18, 51], concepts of gambling dissociation



## UNDERSTANDING THE SLOT MACHINE ZONE

that permeated the field of psychology during the 1980s and '90s tended to be much more aligned with a more traditional view of dissociation that emphasizes depersonalization and derealization [14, 17].

Figure 2. Model of dissociative experiences, adapted and expanded from Butler [51].



*Note:* The two dominant constructs for understanding the slot machine zone (Csikszentmihalyi's Flow Theory, and dissociation from Jacobs' General Theory of Addictions), appear at odds with respect to whether the experience is positive, benign, harmful, or pathological. Dark flow is a variant on flow theory that refers specifically to negative consequences that incidentally occur during prolonged gambling in a flow state [19, 24, 26, 68].

## UNDERSTANDING THE SLOT MACHINE ZONE

Adopting an immersion account has several key advantages in the gambling field. First, it helps explain why fast-paced, continuous gambling formats seem to be associated with immersive experiences [12, 13]: immersion at any level depends on continuous engagement. Second, it suggests a mechanism underlying the strong correlation between immersive experiences and problem gambling [21]: if problematic gambling includes loss-chasing and other behaviours that prolong the gambling activity, these individuals may more-easily access level two immersion. Since the DQ and GEQf questionnaires do not distinguish between immersion levels, this may simply appear as larger overall scores. Notably, this also suggests that level two immersion could be a distinct phenomenon in samples with more severe gambling problems, and that the full host of immersive experiences may not be observed in samples that include only recreational gamblers [25, 36]. This means that experimental samples may show different efficacies for immersion-reducing treatments and countermeasures, depending on their range of severity scores. Third, it provides a fuller accounting of the spectrum of experiences reported in qualitative studies of the slot machine zone [15], and avoids omitting experiences that do not fit with the theory (e.g. taking on a different identity). We acknowledge that this is also a limitation: by incorporating elements of both the flow and dissociation accounts, the model may be underspecified. Future research will aim to refine the theoretical account of gambling immersion, assessing a broader range of experiences including depersonalization and derealization from Dissociation Theory, and self-consciousness, meta-cognitive awareness, and volitional control from Flow Theory.

### **Conclusions**

Butler's normative dissociation model underscores a key concern in the gambling field: from the commonly used questionnaire items in Table 1, the extent of 'pathological' versus

## UNDERSTANDING THE SLOT MACHINE ZONE

‘positive’ dissociative phenomena during gambling remains unclear. The Dissociative Experiences Scale (DES), which includes a greater number of items specific to depersonalization and derealization, and queries dissociative experiences in all areas of participants’ lives [54], has been positively associated with Gamblers’ DQ ratings [17, 55]. Further, general dissociation ratings on the DES may be linked to the severity of gambling problems [56, 57; but see 58, 59]. However, the DES is not specific to gambling-related dissociation, and the DQ was not designed with the intent to provide deep insight into the different expressions of these ‘pathological’ dissociative symptoms. At this time, we cannot say whether the slot machine zone is an example of positive dissociation (i.e. flow) or pathological dissociation. At this stage, settling on either the dissociation or flow view is likely to inadvertently omit important symptoms and implications, as noted above.

A fuller understanding of the psychological nature of the slot machine zone has key implications for gambling policy and the development of responsible gambling measures. Adopting a *gambling immersion* model, and conceptualizing it as lying on a continuum with other recreational activities, may improve public awareness of the dangers of immersion in gambling, and also help to reduce stigma associated with problematic use of slot machines. At the same time, gambling regulation has been widely predicated upon informed consent and personal responsibility [60]. These principles are challenged by evidence that gambling products can induce a state of diminished self-awareness and peripheral attention, which is further correlated with problematic gambling. Many gamblers experience difficulty in tracking gambling expenditures [61], and this may be at least partly caused by an “unthinking” zone state in which normal attention is impaired [13, 62, 63]. Some research raises the attractive possibility of disrupting the zone using *embedded disruptions* like informational pop-up messages, breaks in

## UNDERSTANDING THE SLOT MACHINE ZONE

play, alarm clocks, or other measures that actively interfere with the typical continuity of gambling [53, 64, 65]. Many of these interventions have been extensively tested in the world of video games, where our model of *immersion* also originates. We strongly encourage further research in this area to ascertain the utility of these and other consumer protection measures [66].

From an industry perspective, technological innovations in EGM designs often aim to provide a more immersive experience [67]. With advances in both eye tracking and wearable technologies in consumer markets, it is likely that EGMs will become more sophisticated in eliciting (and perhaps detecting) the immersion state. A recent patent on integrating eye movement tracking into slot machines indicates that EGM manufacturers have begun to incorporate these innovations, including larger video displays and 3-dimensional game elements, with the explicit intent of providing “a more immersive and attractive gambling experience” [67]. Given the apparent link between immersive experiences and gambling problems, this approach could be viewed as questionable. Further research should be undertaken to establish whether gambling immersion causes gambling problems, or appears as a result of gambling problems. Until this question is resolved, gambling regulators may consider limiting immersive technologies that might increase gambling harm.

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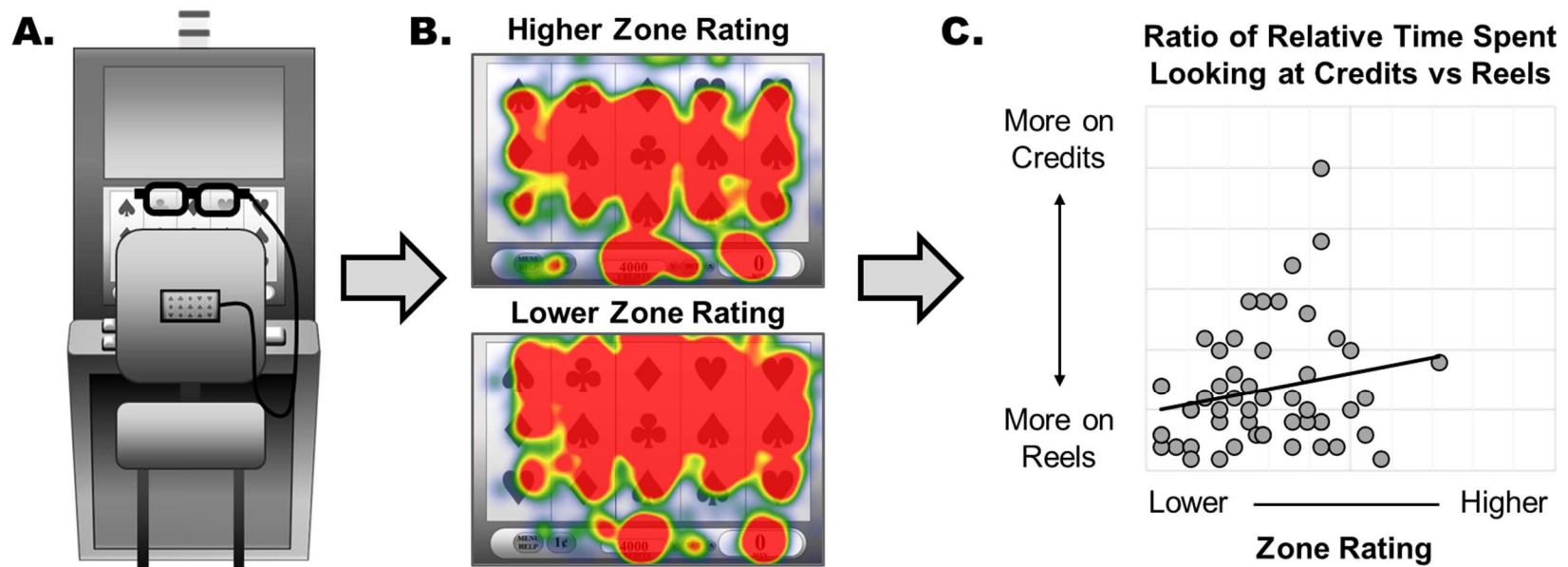
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Figure 1. Procedure and results from Murch et al. [25].



*Note:* **A)** The study apparatus consisting of a multi-line slot machine, and a pair of mobile eye tracking glasses. **B)** Heatmaps of overt visual attention to the slot machine display for two representative participants: one who provided a higher zone rating for the gambling session, and one lower. **C)** Scatterplot depicting the sample correlation between zone ratings and the ratio of time spent looking at the device's ongoing credit display versus its reels.

Table 2. Studies investigating the slot machine zone.

Study	Year	Zone Model	Sample Type (N)	Setting	Experimental Treatment	Purpose
Jacobs [16]	1988	Dissociation	n <sub>1</sub> = 407 people with PG or Substance Use Disorders n <sub>2</sub> = 1011 controls	Inpatient treatment centers	Correlational design	Examines the prevalence of dissociation-like experiences in people diagnosed with addictive disorders
Kuley & Jacobs [69]	1988	Dissociation	n <sub>1</sub> = 30 people with PG n <sub>2</sub> = 30 non-problem gamblers	Community	Correlational design	Relates dissociative experiences to sensation seeking and gambling behaviour
Bergh & Köhlhorn [70]	1994	Altered state of consciousness	N = 105 people with PG	Hospitals	Qualitative analysis	Investigates the development of PG in Sweden
Kofoed et al. [71]	1997	Dissociation	n <sub>1</sub> = 59 people with PG n <sub>2</sub> = 25 people with Alcohol Dependence	Inpatient treatment centers	Correlational design	Examines the relationship between dissociation and PG in VLT gamblers
Gupta & Derevensky [17]	1998	Dissociation	N = 817 high school students	School	Correlational design	Tests Jacobs' [16] theory as an explanation for adolescent gambling risk
Diskin & Hodgins [32]	1999	Dissociation	n <sub>1</sub> = 12 VLT users with PG n <sub>2</sub> = 11 VLT users without PG	Laboratory	Irrelevant external light during VLT use	Looks at peripheral attention and dissociation during VLT use
Diskin & Hodgins [33]	2001	Dissociation	n <sub>1</sub> = 20 Video VLT users with PG n <sub>2</sub> = 21 VLT users without PG	Laboratory	Irrelevant external light during VLT use	Examines peripheral attention and dissociation both during VLT use and more generally
Wood et al. [72]	2004	Dissociation	N = 966 high school students	School	Correlational design	Investigates factors potentially common to PG and excessive video game use



UNDERSTANDING THE SLOT MACHINE ZONE

Gee et al. [30]	2005	Dissociation	N = 17 people who gamble more than once weekly	Laboratory, Telephone	Correlational design	Tests a telephone-based system for tracking mood state and gambling
Wanner et al. [48]	2005	Flow, Dissociation	n <sub>1</sub> = 14 people with PG n <sub>2</sub> = 21 recreational gamblers n <sub>3</sub> = 476 university student athletes	Common areas at 8 colleges	Correlational design	Examines the extent to which flow and dissociation are reported across PG and collegiate sports
Ledgerwood & Petry [55]	2006	Dissociation	N = 149 people seeking treatment for PG	Treatment Centers	Correlational design	Aims to identify subtypes of PG
South Australian Department for Families and Communities [12]	2006	Dissociation	N = 160 people who reported feeling “in a trance” at least some of the time while gambling in the past year	Community	Qualitative analysis	Assesses gambling prevalence in South Australia
Farrelly et al. [58]	2007	Dissociation	n <sub>1</sub> = 21 people experiencing problem gambling n <sub>2</sub> = 44 control	Community	Correlational design	Examines reported coping strategies among people with PG
Noseworthy & Finlay [40]	2009	Dissociation	N = 160 adults	Laboratory	Tempo and volume of ambient casino sounds and music	Examines the impact of casino environment on dissociative experiences while gambling using slot machines
Hopley & Nicki [42]	2010	Dissociation	N = 179 online poker players	Online	Correlational design	Aims to determine whether predictors of PG apply to online Texas Hold ‘Em
Carlbring et al. [73]	2012	Dissociation	N = 284 people with PG	Online	Internet-based cognitive behavioural therapy	Investigates internet-based CBT as an alternative treatment for PG

UNDERSTANDING THE SLOT MACHINE ZONE

McCormick et al. [31]	2012	Dissociation	N = 190 regular EGM gamblers	Community	Correlational design	Tests Jacobs' [16] dissociation theory in the context of EGMs
Oakes et al. [63]	2012	Altered state of consciousness	n <sub>1</sub> = 10 people experiencing problem gambling n <sub>2</sub> = 5 significant others n <sub>3</sub> = 15 CBT therapists and counsellors	Focus group	Qualitative analysis	Identifies factors that increase relapse among people abstaining from gambling
Stewart & Wohl [53]	2012	Dissociation	N = 59 undergraduate students	Laboratory	Presence of pop-up messages during gambling	Investigates the utility of a monetary pop-up reminder during EGM use
Dixon et al. [37]	2014	Flow	N = 102 gamblers	Casino	Number of paylines on an EGM	Examines preference for multi-line EGMs
Wohl et al. [74]	2014	Dissociation	N = 73 EGM users without PG	Focus group, laboratory	Limit setting tools embedded in EGM play	Investigates pop-up messages for monetary limit setting during EGM use
Cartmill et al. [75]	2015	Dissociation	N = 142 experienced gamblers	Online	Correlational design	Explores potential predictors of 'escape style' gambling among Australian youth
Craparo et al. [56]	2015	Dissociation	N = 45 people seeking treatment for PG	Treatment centers	Correlational design	Examines treatment outcomes among a group of people with PG
Imperatori et al. [29]	2015	Dissociation	N = 171 casino gamblers	Casino	Correlational design	Explores the potential role of dissociation in mediating the relationship between childhood trauma and PG
Templeton et al. [76]	2015	Flow	N = 83 EGM gamblers	Laboratory	EGMs with varying bet settings	Examines EGM users' preference for different bet strategies

## UNDERSTANDING THE SLOT MACHINE ZONE

Gori et al. [57]	2016	Dissociation	n <sub>1</sub> = 154 people with PG seeking treatment n <sub>2</sub> = 50 control	Treatment centers	Correlational design	Examines rates of several trait experiences among people with PG
Tricker et al. [77]	2016	Altered state of consciousness	N = 37 EGM gamblers	Online	Visual cues of gambling activities	Explores relationships between gambling urges, altered states of consciousness, and PG severity
McKeith et al. [27]	2017	Altered state of awareness	N = 38 EGM gamblers	Online	Visual cues of gambling activities	Investigates the effects of gambling cues on cravings and altered states of awareness
Murch et al. [23]	2017	Immersion	n <sub>1</sub> = 59 undergraduate students n <sub>2</sub> = 30 community members	Laboratory	Irrelevant peripheral shapes during EGM use	Examines people's responses to task-irrelevant stimuli during EGM use
Trivedi & Teichert [45]	2017	Flow	N = 500 online gamblers	Online	Correlational design	Explores potential sub-dimensions of flow, and their impacts on PG
Caretti et al. [59]	2018	Dissociation	n <sub>1</sub> = 516 people diagnosed with Substance Use Disorder or Gambling Disorder n <sub>2</sub> = 183 control	Community	Correlational design	Seeks to validate the psychometric properties of the Addictive Behavior Questionnaire
Chu et al. [78]	2018	Flow	n <sub>1</sub> = 30 undergraduate students n <sub>2</sub> = 31 past-year EGM users	Laboratory	Correlational Design	Investigates the use of 'stopper' features in modern EGMs
Dixon et al. [19]	2018	Flow	N = 136 casino patrons	Casino	EGM outcome type	Explores the potential relationship between flow and depression in the context of EGM use
Oakes et al. [15]	2018	Altered state of awareness	N = 29 people seeking treatment for gambling problems	Focus group	Qualitative analysis	Analyzes zone experiences reported by people with PG
Rémond & Romo [79]	2018	Immersion	N = 432 undergraduate students	Online	Correlational design	Explores the relationships between digital gambling, video gaming, internet, and mobile phone use

## UNDERSTANDING THE SLOT MACHINE ZONE

Dixon et al. [24]	2019	Flow	N = 129 casino patrons	Casino	Thought probes during EGM use	Explores potential relationship between EGM flow and deficits in mindful attention
Murch & Clark [36]	2019	Immersion	N = 76 undergraduate students	Laboratory	Bet settings on an EGM	Investigates immersion levels during EGM use with differing bet strategies
Dixon et al. [68]	2019	Flow	N = 129 casino patrons	Casino	Correlational design	Tests potential behavioural markers of flow, PG, and depression during EGM use
Lavoie & Main [41]	2019	Flow	n <sub>1</sub> = 229 adults n <sub>2</sub> = 62 undergraduate students	Online	Correlational design	Explores the relationships between flow, time, and expenditure during online blackjack and EGM use
Murch et al. [20]	2020	Flow	N = 312 undergraduate students	Laboratory	Correlational design	Tests a potential physiological marker of flow during EGM use
Murch et al. [25]	2020	Immersion	n <sub>1</sub> = 53 past-year EGM users n <sub>2</sub> = 27 adults	Laboratory	Correlational design	Tests whether immersion in EGM gambling is a 'zoned-in' or 'zoned-out' state
Kruger et al. [26]	2020	Flow	N = 111 casino patrons	Casino	Thought probes during EGM use	Examines flow and deliberate mind wandering during EGM use and more generally

*Note:* PG = Pathological Gambling. EGM = Electronic Gaming Machine. VLT = Video Lottery Terminal (a kind of EGM). This table presents a summary of research known to the authors, not a systematic review. See [21] and [22] for current systematic reviews and meta-analyses on the topic.