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When Losing Money and Time Feels Good: The Paradoxical Role of Flow in Gambling

Raymond V. Lavoie[1] & Kelley J. Main[2]

[1] Girard School of Business – Marketing, Merrimack College, North Andover, MA, USA
[2] Asper School of Business – Marketing, University of Manitoba, Winnipeg, MB, Canada

Abstract

Despite being well-known for its positive consequences, the psychological state of flow has raised some concerns. In this research, we advanced our understanding of the relationships that flow has in the context of online gambling. Across two studies, in which participants played blackjack and slots, we demonstrated that flow is associated with an increase in the amount of time spent gambling. Flow is also related to an increase in the amount of money spent. We demonstrated that the reason that flow increases the amount of playing time is that its inherently enjoyable nature makes it difficult to stop. We also tested the alternative hypothesis that this relationship occurs because in flow, people lose track of time. Although flow is related to losing track of time, that does not mediate the relationship with playing time. Lastly, we demonstrated that despite losing more money and spending more time while gambling, those who experienced flow had more enjoyable experiences overall, creating a counterintuitive and potentially dangerous situation for gamblers. A secondary goal of this research was to explore ways in which to protect consumers from this paradox. We used warning messages and on-screen interruptions to potentially thwart flow. However, both tactics were ineffective. We discuss the implications for future research and practice.

Keywords: flow, time, money, online gambling

Résumé

Bien qu'il soit connu pour ses conséquences positives, l'état de fonctionnement psychologique optimal (state of flow) suscite certaines inquiétudes. Dans cette recherche, nous approfondissons notre compréhension des relations propres à cet état qui s'établissent dans le contexte du jeu en ligne. Dans deux études dans lesquelles les participants ont joué au blackjack et à des machines à sous, nous avons

démontré que l'état optimal est associé à une augmentation du temps passé à jouer. Cet état psychologique est également lié à une augmentation des dépenses. Nous démontrons la raison pour laquelle l'état optimal augmente le temps de jeu, notamment sa nature intrinsèquement agréable qui rend un arrêt difficile. Nous avons également testé l'autre hypothèse selon laquelle cette relation est due au fait que, dans cet état optimal, les gens perdent le contrôle du temps. Bien que cet état soit lié à la perte de la notion du temps, cela ne modifie pas la relation avec le temps de jeu. Enfin, nous démontrons que malgré la perte d'argent et la perte de temps au jeu, ceux qui vivent une expérience optimale au jeu ont eu des expériences plus agréables dans l'ensemble, créant une situation contre-intuitive et potentiellement nocive pour les joueurs. Un objectif secondaire de cette recherche est d'explorer les moyens de protéger les consommateurs de ce paradoxe. Nous avons utilisé des messages d'avertissement et des interruptions à l'écran pour tenter d'entraver l'état optimal, en vain. Ces deux tactiques se révèlent inefficaces. Nous abordons les répercussions pour la recherche et la pratique futures.

General Introduction

Flow is a rewarding psychological state of deep but seemingly effortless involvement in an experience (Engeser & Rheinberg, 2008). In flow, people experience a loss of self-consciousness, a distorted perception of time, and a sense of control (Csikszentmihalyi, 2000). Flow has been shown to elicit high levels of both enjoyment and performance across a wide variety of contexts, including sports (Jackson, Martin, & Ecklund, 2008), video games (Jegers, 2007; Sweetser & Wyeth, 2005), and work (Debus, Sonnentag, Deutsch, & Nussbeck, 2014). Flow is best known for its positive consequences regarding happiness and its potential to contribute to overall well-being (Fredrickson, 2001).

Our research was concerned with the outcomes of flow in the context of online gambling. In gambling contexts, a number of critical factors are common in facilitating flow, including clear goals, immediate reinforcement, reduced distractions, and perceptions of control (Griffiths, 1999; Harrigan & Dixon, 2009). These factors make gambling, especially the experience of online gambling (Griffiths, 2003; Moreau, Chabrol, & Chauchard, 2016), a context that is highly conducive to flow (Schull, 2005). Multiline slot machines also foster flow, as they have a unique ability to elicit an outcome that is referred to as a loss disguised as a win (LDW; Dixon, Harrigan, Sandhu, Collins, & Fugelsang, 2010; 2014; Harrigan, Dixon, MacLaren, Collins, & Fugelsang, 2011). By reinforcing a player with the gain of credits on a spin, but fewer overall credits, LDWs allow for more frequent perceived gains. These outcomes also create a ''smoother'' experience for the player, which seems to promote the absorbing state of flow (Schull, 2012).

Despite the many positive consequences of flow, its absorbing state while one is gambling has elicited concern. Research has suggested that experiencing flow while gambling is related to problem gambling status and depression (Dixon et al., 2014, 2017). Although different from dissociative states in several important ways, the absorbing aspect of flow has been compared to having the same attraction as dissociative states do (Wanner, Ladouceur, Auclair, & Vitaro, 2006), which gives gamblers the ability to escape the realities of their day-to-day lives (Abbot & Volberg, 1996; Cartmill, Slatter, & Wilkie, 2015; Getty, Watson, & Frisch, 2000). Multiline games appear to be especially dangerous for players with gambling-related pathology because of the allure of absorption (Dixon et al., 2014; Templeton, Dixon, Harrigan, & Fugelsang, 2015).

As a result of flow's association with negative outcomes, authors have used the term "dark flow" (Dixon et al., 2017, 2019) to refer to it in gambling contexts. This term is motivated by research that demonstrates that there can be a dark side to flow (Partington, Partington, & Olivier, 2009). We sought to extend these findings by providing empirical support for more dangerous consequences of flow in gambling. In particular, we explored the negative relationship between flow and the amount of money and time spent while gambling, as these relationships have yet to be demonstrated. We examined this relationship across two studies in the contexts of online slot machines and online blackjack.

Beyond exploring whether flow has negative consequences, a primary motivation of this research was to demonstrate why flow can be dangerous. The extant literature offers two potential mechanisms for its danger. Flow has two primary components: fluency and absorption (Engeser & Rheinberg, 2008). The fluency component is related to the inherent enjoyment and perceived ease of progress in an experience. Fluency is epitomized by the seemingly effortless progression towards a goal, which can be fostered by positive reinforcement. The absorption element is related to feeling "one" with the task and losing track of everything else around you. The latter component is the result of having a high degree of mental devotion (attentional resources) to a specific stimulus.

The two components of flow offer two potential explanations for its relationship with spending too much time while gambling. The fluency component of flow, which helps make it intrinsically rewarding (Webster, Trevino, & Ryan, 1993), could enhance the pull to continue, making it difficult to stop, despite how much money and time is being spent. The intrinsically rewarding nature of flow could make it dangerous in the gambling context because the consumer is enjoying the flow state, which downplays the concurrent loss of time and money. This possibility is consistent with work that has focused on the reinforcement pattern that drives the danger of LDWs. This danger is based on the continuous reinforcement and smooth experiences that are created as a result of playing multiple lines and being reinforced with sights, sounds, and money gains in small portions (Schull, 2005). The increased amount of smaller but more frequent reinforcement thus facilitates the fluency aspect of flow. We hypothesized that flow creates a pull to continue, which in turn increases the

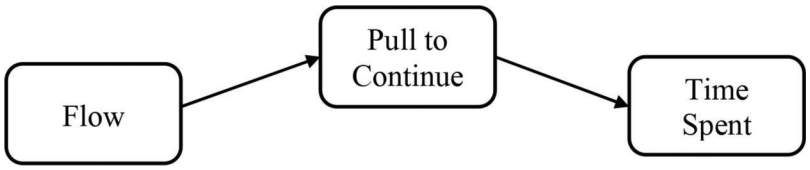

Figure 1. Flow mediation model.

amount of time spent gambling. We tested this relationship in both studies (see our model in Figure 1).

Hypothesis 1: Flow increases the pull to keep playing, which mediates an increase in the amount of time spent playing.

The alternative explanation is that the absorption element of flow distorts perceptions of time (Martin & Jackson, 2008), which can lead to spending more time gambling. Such distortion is dangerous while gambling because it allows time to pass beyond awareness, similar to the danger of dissociative states (Noseworthy & Findlay, 2009). Distorted perceptions of time can increase the amount of time spent gambling because an individual's ability to stop is compromised, while also potentially increasing the amount of money spent, beyond the awareness of the person playing (Schull, 2005). This aspect of flow in which there is a narrowing of attention is similar to the effects of dissociative states in which players lose track of everything else going on around them (Diskin & Hodgins, 1999). For a review of the similarities and differences between flow and dissociation, see Wanner et al. (2006).

Despite the potential for distorted time perceptions to increase the amount of time spent gambling, we do not suggest that it is the underlying reason that drives the relationship with flow. Flow distorts perceptions of time, as it is a defining characteristic of flow, but the role of time distortion as a mediator in the amount of time spent gambling is not compelling when compared with the positive aspects of flow and the desire it creates to keep playing. If flow makes gambling pleasantly enjoyable, it does not seem as reasonable that losing track of time is why people in flow keep playing for longer—it is because they want to. As a result, we did not formally hypothesize that time distortion is a mediator. However, given the relevance of time distortion, we tested for this alternative explanation in both studies.

Regarding the amount of money spent, we did not consider a process-related hypothesis because the potential mediators (i.e., the pull to continue and losing track of time) may not have direct relationships with money spent. The pull to continue should increase the amount of time spent, but this is not necessarily related to the amount of money lost. Losing track of time is not the same as losing track of money spent. Unlike time, flow is unlikely to lead to a loss of focus on how much money has been won or lost. In fact, flow may encourage greater awareness of wins and losses because they are direct features of how one is performing. Being engaged in the gambling experience means that one is in tune with reinforcements such as the amount of money won or lost. We hypothesized that flow is a direct contributing

factor to someone losing money because of the inherent enjoyment in flow, which could make people more likely to keep playing after small losses. We tested this direct relationship in both studies.

Hypothesis 2: Flow has a positive relationship with the amount of money lost.

The Present Studies

Across two studies, we explored flow's relationship with the amount of time and money spent gambling. We explored these relationships within the contexts of online slot machines and online blackjack. Beyond exploring the potentially dangerous consequences of flow, we also sought to mitigate them. If flow is related to spending more time and money, that would create an unfair situation for consumers, whose decision making would be compromised by flow. The well-being of gambling consumers is part of the gambling providers' responsibilities and should be managed (Carroll, 1979). We explored ways that organizations can work to mitigate the negative effects of flow, without eliminating flow completely (Suchman, 1995).

Study 1: Flow and Online Slots

The primary goal of Study 1 was to provide preliminary support for Hypothesis 1, that experiencing flow while gambling will increase the pull to keep playing, which will increase the amount of time spent. To provide additional support for this mediator and its positive nature, we wanted to examine how flow is related to positive affect in this context. We suggest that those in flow are enjoying the experience, and so despite spending more time and money, they should have stronger positive affect, which is a dangerous paradox for consumers. We also sought to evaluate the alternative mechanism that those in flow lose track of time, which does not allow them to properly manage when to stop playing. The secondary goal was to provide support for Hypothesis 2 that flow will have a positive relationship with the amount of money spent.

An additional goal of this study was to determine ways to thwart flow and mitigate its dangers for consumers. To do so, we used warning messages and information that is currently used by a number of organizations to protect consumers. Warning messages and information can be given before or during gameplay. For example, in Massachusetts, the GameSense program has been created to educate gamblers about possible misconceptions or irrational beliefs. On their website, the program gives gamblers tips such as "Take breaks, and set a time limit when you gamble. Clear your mind!" (Massachusetts Gaming Commission, 2018). The Ontario Lottery and Gaming Corporation (OLG) has used an awareness campaign with the tag line "know your limit, play within it" to encourage responsible gaming (OLG, 2010). Warning messages are also used during gameplay, with warnings given in pamphlets or on screen. For example, facts about the independence of spins are also often put on slot machines so that the information is available during play. We tested the effectiveness of warnings in thwarting flow's negative consequences.

Method

Participants and procedure. Participants (N= 229 CrowdFlower workers, M_{age}= 32.89 years, 47.6% male) were asked to play an online slot machine game for as much time as they wanted. They gambled for 318.35 s (5 min and 18 s) on average. CrowdFlower is an online crowdsourcing site that has emerged as a data collection alternative to Amazon's Mechanical Turk. Founded in 2007, CrowdFlower boasts a large customer base (including eBay, Microsoft, etc.). It sources its workforce from a number of different channel partners (such as ClixSense, InstaGC), who perform tasks such as transcription, sentiment analysis, content moderation, and more. Participants were told that they would be playing slots for an additional payment and that their final ledger balance would be used to determine whether they won. To control for the amount of money spent, we instructed participants to play the auto-bet of 200 on each spin, which also controlled how many lines they played on each spin. Playing the auto-bet of 200 allowed the slot machine game to provide LDWs. An illustration of the gameplay screen can be found at http://casinogamesonnet.com/?game=fruit-bonanza&id=809.

To determine the degree to which flow could be managed by messaging, we presented participants with one of three messages on their computer screen before they started playing, or with a no-message control. One of the messages was a warning about flow, what it is, and its potential danger. The other two messages sought to draw attention to the ledger balance as a means to pull participants out of flow. One message asked participants to focus on the gains that they were making, while the other message asked them to focus on the losses they were incurring (see the Appendix for the messages).

Measures. Flow, our independent variable, was measured after the gambling experience with the flow questionnaire, which provides a dichotomous (yes/no) assessment (Csikszentmihalyi & Csikszentmihalyi, 1988). The flow questionnaire provides three quotes that capture what it feels like to be in the flow state and asks if the person experienced what the quotes describe, creating two quasi-experimental conditions of flow (yes/no). For example, one of the three quotes is "I am so involved in what I am doing. I don't see myself as separate from what I am doing" (see the Appendix for all three quotes). To assess the first potential mediator (i.e., difficulty stopping), we used two items that we created, which asked participants, "How strong was the pull to keep playing?" and "How difficult was it to stop playing?" $r(228) = .548$, $p < .001$, on Likert scales from 1 (*not strong/difficult at all*) to 7 (*very strong/difficult*). To assess the second potential mediator that losing track of time increased the amount of time spent playing, we asked participants, "To what degree did you experience the following while gambling: 'I lost track of time'?" on a 7-point Likert scale from 1 (*not at all*) to 7 (*very much so*).

Following the gambling experience, participants were asked to report their final ledger balance as a measure of how much money they spent. Participants all started with $10,000 virtual dollars, and the final ledger was subtracted from that to see how

much they had won or lost. To assess the amount of time they spent, we used an embedded timer on the screen to see how long it took them to come back after following the link to the study (in seconds). We used the positive items from the Positive and Negative Affect Schedule scale (Watson, Clark, & Tellegen, 1988) to measure positive affect (10 items, $\alpha = .935$). Items were scored on 5-point Likert scales ranging from 1 (*not at all*) to 5 (*extremely*), which asked participants how they felt "right now" and included the following: inspired, determined, excited, interested, enthusiastic, proud, alert, attentive, strong, active. Lastly, we assessed participants' recall of the warning messages that they were given by asking if they were told to focus on anything while gambling and if they were warned about flow. If they said yes, we asked them to explain what the message said. There were other measures collected for exploratory purposes in this study and Study 2 that are not reported here.

Results and Discussion

The quasi-experimental conditions of flow were analysed independent of the message conditions to determine their relationship with the dependent measures. First, we wanted to examine the relationship between flow and the amount of time spent while testing the two proposed mediators. To do so, we tested the models by running PROCESS Model 4 (Hayes, 2013) with 10,000 bootstrap samples, using percentile confidence intervals (CIs) for both. First, we tested the model that flow would increase participants' difficulty in stopping play, which would mediate an increase in the amount of time spent gambling. The indirect model from flow to time spent through desire to keep playing was significant, $\beta = 81.31$, SE = 33.18, 95% CI [22.7940, 151.9978]. The significance of the indirect path, along with the positive beta values representing the strength of the relationships between flow and the desire to keep playing ($\beta = 1.54$, SE = .1927) and between that desire and the amount of time spent gambling ($\beta = 52.79$, SE = 16.52), supports mediation and the positive relationship between all of the variables in the model. That is, flow increased the desire to keep playing, which mediated an increase in the amount of time spent playing.

Using the same procedure, we ran a model to test the alternative explanation that those in flow would lose track of time, which is why they spend more time playing and are thus at risk of spending more money. Notably, although we did not predict or demonstrate a main effect of flow on time spent, it is acceptable to theorize and establish only an indirect effect through a mediator (Zhao, Lynch, & Chen, 2010). The indirect model from flow to the amount of time playing with losing track of time as the mediator was not significant, $\beta = 40.85$, SE = 37.75, 95% CI [-24.2898, 123.2950]. Flow had a positive relationship with losing track of time, $\beta = 2.08$, SE = .23, 95% CI [1.6239, 2.5385]. However, losing track of time did not mediate the relationship. This is because losing track of time had a positive relationship with the amount of time spent, but it did not reach significance, $\beta = 19.6305$, SE = 13.96, 95% CI [-7.8778, 47.1388].

We also wanted to determine whether people spent more money if they experienced flow. The results of independent sample *t* tests revealed that those who experienced flow spent more virtual money, M_{flow}= \$3,273.45, $M_{\text{no-flow}}$ = \$1,283.47, $t(194) = 1.99$,

$p = .048$, than those who did not, but despite losing more money, they also felt more positive after their gambling experience ($M_{flow} = 3.46$) than did those who did not experience flow, $M_{no\text{-}flow} = 2.61$, $t(227) = -7.16$, $p < .001$.

Lastly, we attempted to modify the flow experience with messages before playing. Because the warning messages were included as a means to potentially thwart flow, for the sake of analysis, we focused on their influence on the likelihood of entering flow. Participants were equally likely to enter flow, whether they received a warning about flow, a message to focus on the gains, or a message to focus on the losses, compared with the control condition of no message, $\chi^2(3) = 3.03$, $p = .39$. This suggests that the messages were not sufficient to limit people from entering flow. We also performed additional analyses to ensure that the warning messages did not influence the other dependent measures. The results of one-way analyses of variance of message condition on the amount of money spent, time spent, difficulty stopping, and positive affect were all non-significant. Regarding recall, 37.5% of people in the gains condition correctly recalled that they were asked to focus on gains, 45.3% in the loss condition correctly recalled that they were asked to focus on losses, and 78.18% who were given information about flow successfully recalled that this was the content of their warning message.[1]

In Study 1, we demonstrated that those who experienced flow perceived it to be more difficult to stop playing, which mediated an increase in the amount of time they spent gambling. Although we suggest that difficulty in stopping is positive in nature, related to the desire to keep playing, it is possible to conceive that the difficulty in stopping could be driven by something else, such as chasing losses. Although we did not measure enjoyment during the experience per se, the underlying desire to keep playing is likely driven by enjoyment of the experience because of its positive relationship with flow, which is inherently enjoyable (Csikszentmihalyi, 1975). Moreover, this alternative explanation does not fit with these findings, as chasing losses would be inherently negative and should not be related to flow. We sought to provide further support for this by examining the correlation between the pull to continue and positive affect. The results demonstrate that the pull to continue had a significant positive correlation with positive affect, $r(229) = .325$, $p < .001$, which is consistent with our explanation, but less so with the explanation that it is driven by chasing losses.

Those who experienced flow also spent more money than those who did not. Counterintuitively, despite spending more virtual money, those who experienced flow also felt more positive after the gambling experience. We also failed to thwart flow with three different messages before the gambling experience. A key finding from Study 1 is that flow also led people to lose track of time, and, although it had a positive relationship with the amount of time spent, losing track of time did not

[1]This may in part be because the questions were last among the set. The results reported include every participant, but they revealed the same conclusions when we selected only those who successfully recalled the specific message given.

mediate the relationship between flow and the amount of time spent playing. Our measure of losing track of time was asking people whether they "lost track of time," which may be problematic if people do not have a good sense of when they lose track of time. To address this, we performed a post hoc test with a more direct measure of distorted time perception.

In addition to measuring losing track of time in the main study, in the post hoc test, we assessed it by measuring how long participants gambled by using an embedded timer and asking them to "provide us with your best guess of how long you were gambling for." We asked them to provide their guess in minutes and seconds. After converting their guesses into seconds, we subtracted them from how much time they actually took for our measure of distorted time perception.

In addition to showing that the new measure does not mediate the relationship between flow and time spent gambling, we also sought to demonstrate that the subjective measure that we used in the main study reliably captures perceived time distortion. To do so, we performed a post hoc test from the same population of participants as in Study 1 (N = 115 CrowdFlower panellists, M_{age} = 40.17, 52.2% male). We used the same stimuli as in the main study, which asked participants to gamble with an online slot machine for as long as they wanted for a chance to win additional payment. Following the gambling experience, we measured subjective distortion of time in the same way as in the main study, using the question "I lost track of time" on a 7-point Likert scale from 1 (*not at all*) to 7 (*very much so*). We also included the new measure of time perception distortion as explained above with the discrepancy between perceived and actual time spent gambling (in seconds) as our measure. We assessed flow in the same way as in the main study, using the flow questionnaire, which provides a yes/no answer as to whether individuals experience flow or not (Csikszentmihayli and Csikszentmihayli, 1988).

The results of the independent samples t tests regarding losing track of time between those who experienced flow (N = 48) and those who did not (N = 67) were statistically significant with both measures. Those who experienced flow felt as though they had lost track of time relative to those who did not experience flow when we used the measure from the main study, M_{flow} = 4.83, M_{noflow} = 2.66, $t(113)$= 7.84, $p < .001$. Their guesses of how much time had transpired were also further off from the actual amount of time that had transpired, M_{flow} = 162.21 s, M_{noflow} = 34.88 s, $t(113)$= 3.41, p = .001. Notably, the two measures were significantly and positively correlated, $r(115)$ = .251, p = .007.

The results of mediation analysis with PROCESS Model 4, with flow leading to the new measure of time distortion for how much time participants spent gambling, revealed that the measure of time distortion did not mediate the amount of time they spent gambling, B= 4.23, SE = 15.26, 95% CI [-20.97, 38.82]. Together, these findings support the use of our subjective measure of time distortion in the main study, while also providing additional support that distorted time perceptions do not mediate the relationship between flow and the amount of time people spend gambling.

Study 2: Flow and Online Blackjack

Study 2 had two primary goals: (a) to replicate the mediation results of Study 1 in a different gaming context (online blackjack) and (b) to test a new strategy to manage flow. We also sought to demonstrate the negative influence of flow on the amount of money spent as a result. Participants (N = 62 undergraduate students, M_{age} = 20 years, 70.5% male) were asked to play blackjack online for as long as they wanted.

Method

Participants and Procedure. Participants gambled for 592.64 s (9 min and 32 s) on average. They were paid $10, $5 of which was guaranteed payment and an additional $5 was to be used gambling. The $5 given to participants was converted to $20,000 in virtual currency.[2] As in Study 1, flow was measured after the gambling experience, creating two additional quasi-experimental conditions.

Given the inability of the messages to thwart flow in Study 1 prior to play, we sought to increase the strength of the interruption in the gambling experience in Study 2. To do so, we used pop-up messages during play as opposed to the messages given before playing (Auer, Malischnig, & Griffiths, 2014). Participants either had a message pop-up on the screen every minute stating, "you have been playing for another minute, it is currently X o'clock," or they played as normal without interruption. The pop-up message would disappear on its own after 6 s or if the player hit a button on the keyboard. Online blackjack screen can be viewed here: https://www.online-casinos.co.uk/best-blackjack-software-providers/.

Measures

All variables, including flow, positive affect (Watson et al., 1988; 10 items, α = .906), and the mediators of difficulty stopping, $r(62) = .617$, $p < .001$), and losing track of time, were measured the same way as in Study 1. Each participant started with $200,000, and their final ledger was subtracted from this to determine money spent. We assessed the interruption manipulation by asking participants whether a pop-up message came up on the screen (yes/no); if they answered yes, we asked them to report what it said.

Results and Discussion. To test mediation, we started with the model that flow increased the desire to keep playing, which increased the amount of time spent gambling. We ran PROCESS Model 4 with 10,000 bootstrap samples by using

[2]All variables, including flow, positive affect (Watson et al. 1988; 10 items, α = .906), and the mediators of difficulty stopping, $r(62) = .617$, $p < .001$, and losing track of time were measured the same way as in Study 1. Each participant started with $200,000 and their final ledger was subtracted from this to determine money spent. We assessed the interruption manipulation by asking participants whether a pop-up message came up on the screen (yes/no); if they answered yes, we asked them to report what it said.

percentile CIs (Hayes, 2013). The indirect model from flow to time spent through the desire to keep playing was significant, β = 84.57, SE = 40.35, 95% CI [28.7320, 195.9576]. This result, along with the positive valence of the relationships between flow and the desire to keep playing (β = 1.38, SE = .37) and between that desire and the amount of time spent playing (β = 61.09, SE = 22.49), shows that flow increased the desire to keep playing, which mediated an increase in the amount of time spent playing.

In the same way as in Study 1, we sought to provide further support of the positive nature of the mediator and against the alternative that it is driven by chasing losses. As in Study 1, the pull to continue had a significant positive correlation with positive affect, r (62) = .309, p = .015, which is consistent with our explanation of it being driven by the pleasant experience of flow and not from chasing losses.

We then tested the alternative model, that flow made people lose track of time, which mediated an increase in the amount of time spent gambling. The indirect model from flow to time spent through the desire to keep playing was not significant, β = -6.67, SE = 15.66, 95% CI [-61.34, 9.32]. Flow had a positive relationship with losing track of time but it was not significant, β = .68, SE = .63, 95% CI [-.58, 1.94]. Losing track of time had a non-significant relationship with the amount of time spent playing, β = -9.80, SE = 14.08, 95% CI [-37.98, 18.38].

As in Study 1, those who experienced flow also spent more money (M_{flow} = \$54,970.59) than did those who did not experience flow, $M_{\text{no-flow}}$ = \$5,205.36, t(60) = .70, p = .49, although the association was not significant. This is in part due to the large amount of variance in the final ledgers (SD_{flow} = \$291,414, $SD_{\text{no-flow}}$ = \$266,722) that resulted from participants being allowed to bet whatever they wanted, creating a wider range of values. As in Study 1, an independent samples t test on positive affect revealed that despite spending more money, those who experienced flow felt more positive following the gambling experience (M_{flow} = 3.29) than those who did not, $M_{\text{no-flow}}$ = 2.85, t(60) = -2.13, p = .037.

Independent samples t tests between those who had warning messages interrupt their play and those who did not on each of the key dependent measures were all non-significant, suggesting that the pop-up interruptions were ineffective. Eighty percent of people in the interruption condition were able to identify that there was a pop-up message and correctly recall the content of the warning message (i.e., identified that it was about the amount of time played). We used a chi-square test of independence to determine whether the likelihood of entering flow was related to whether participants had the pop-up message and it was not significant, $\chi^2(1) = 1.04$, p = .31. This finding suggests that the flow state is impervious to small pop-ups and would require a significant interruption to thwart it.

General Discussion

In this research, we explored the psychological state of flow and its negative consequences for consumers in the contexts of online slot machines and online

blackjack, respectively. We provide support for the relationship between flow and increased time spent gambling. We demonstrate that flow increased the pull to continue, which increased the amount of time spent gambling, and provide evidence that the pull to continue is positive in nature, which we suggest is driven by the enjoyable nature of flow. We also provide evidence that flow led people to lose track of time, but that this did not mediate the amount of time they spent gambling, despite the positive relationship.

These findings build on the existing literature by showing a dangerous new negative outcome of flow. By providing empirical support for the mechanism underlying this relationship, our research also offers a foundation for future research to build on in an effort to mitigate its dangers. Our data suggest that it is not the lack of ability to keep track of time, but rather the enjoyable nature of the flow experience that mediates the amount of time spent gambling. In fact, we demonstrate that despite spending more time and money, those in flow had a more positive experience overall. This finding, along with the supported mechanism of the desire to keep playing, contributes to the literature's discussion of the dangers of flow in gambling, as it demonstrates that the positive benefits (i.e., enjoyment) are inherently linked to its negative outcomes (i.e., spending more time).

Our study also showed mixed support for the relationship between flow and the amount of money spent. In Study 1, participants who were in flow spent more money gambling on the online slot machines. However, in Study 2, despite participants' spending more money playing online blackjack, the difference was not significant. This can likely be attributed to the highly variable nature of the game and the bets that can be made.

Our findings related to consumers' inability to regulate the amount of time and money they spend while in flow contributes to the literature by extending knowledge about the various dangers of flow in the gambling context. In particular, our findings extend concerns about flow to slot machines, where the danger of flow has been largely depicted to result from LDWs (e.g., Dixon et al., 2017). Our data show that online blackjack provides enough reinforcement to facilitate flow. Our findings, which are based on two different groups of participants, demonstrate potentially unfair and dangerous circumstances for all gamblers. These findings extend consideration for situations in which gamblers could be considered to be in danger (Blaszczynski et al., 2011; LaPlante, Gray, LaBrie, Kleschinsky, & Shaffer, 2012).

We also attempted to thwart the negative outcomes of flow by using warning messages (Study 1) and pop-up interruptions (Study 2). In Study 1, we provided messages before play related to focusing on the money lost, the amount of money won, and the dangers of flow. Interestingly, none of the messages were able to thwart flow. In Study 2, we sought to thwart flow by having a message pop up on the screen to remind players of how much time they had spent to help interrupt the experience. However, this also failed to significantly reduce flow experienced while gambling.

The findings related to the inability to mitigate flow with these tactics contribute to the discussion related to the shortcomings of current practices of corporate social responsibility in the gambling industry (Hing, 2001). Warning messages are often used to mitigate negative consequences in gambling, such as "Know your limit, play within it," which is the tag line used by the Ontario Lotto and Gaming Corporation (OLG, 2010), and "Play it safe: play with limits," which is used by an online gambling service (Royal Panda, 2018). In our studies, we warned participants of flow immediately before the experience, without effect. This suggests that tag lines used in advertisements about being careful about how much a person spends are likely to be rendered ineffective, as flow takes over while gambling, despite awareness.

Interestingly, despite spending more time and money, participants who experienced flow in our studies had a stronger positive affect than those who did not. These findings have both practical and theoretical implications (Dixon et al., 2019). It is a mandate of lottery and gaming organizations around the world to provide fair and high-quality gaming experiences (e.g., https://massgaming.com/). Our findings demonstrate the value of flow in this context, which gaming organizations can use to better understand their value proposition to consumers. That is, organizations can have a better understanding of how they create a positive perception in the minds of their stakeholders through flow. As we imply, this value can be used in strategic legitimation processes (Suchman, 1995), allowing organizations to reframe issues (Fiol, 1994) by highlighting the positive and socially desirable aspects of their service offerings.

Our findings open the door and call for future research related to the effects of flow in gambling and how to manage them. The lack of ability to shut off flow in this context is something future research should examine, as it will become dangerous when people are betting large amounts and when they are gambling for extended periods of time. Some ideas beyond the online context should also be explored. For example, in poker, which is an important context to explore, as it is associated with pathological gambling and overspending (Mihaylova, Kairouz, & Nadeau, 2012), perhaps increasing the amount of time that a dealer is switched out or how often a break must be taken can limit the dangers of flow, while allowing players to still experience flow during the game, but for less time. Social presence would also be an interesting line of inquiry in order to examine how it influences flow in the gambling context relative to other consumption (Pfund et al., 2018). Perhaps social presence can facilitate flow while winning, but thwart flow while losing, as participants would feel shame in losing money in front of others.

From a practical perspective, another method to control the negative outcomes of flow would be to have predetermined betting levels (Hing, 2001). Some examples of this have started to emerge in the market. For example, in Massachusetts, gamblers can use a tool called PlayMyWay, which allows players to set daily, weekly, or monthly budgets for themselves at the Plainridge Park Casino. This method would allow participants to enjoy the task and experience flow while also minimizing the potential negative consequences of how much money they lose.

The other aspect of this research that opens an interesting line of inquiry is the positive aspects of flow. In our studies, consumers had a more positive experience despite spending more time and money, but there is likely a moderator of this relationship and a boundary condition where spending money is no longer associated with more fun. In our studies, participants gambled a relatively small amount of money, which is a boundary condition of the findings. We expect that after a certain amount of money is lost, the relationship with positive affect would be thwarted. However, we also suggest that after a certain amount of losses, it would not be a flow experience, as gamblers would be worried rather than engaged with the task. Future research should explore this relationship with greater amounts of money and individual factors that influence the degree to which positive affect and flow can be sustained despite losing money. Relatedly, future research should also theorize and explore whether flow has an overall negative or positive impact on gamblers and gambling providers on the basis of the nuanced role that has been established in this research.

There are limitations to our subjective recall measures of flow, which may seem linked to the inability of our participants to recall the warning manipulations. Although self-report is an established way to measure flow, research should further explore the physiological aspects of flow to provide new measures that may be more reliable (Keller, Ringelhan & Blomann, 2011). However, people appear to have a good idea as to whether or not they are in flow, as the scales to measure it capture what it feels like to be in it. Our participants showed a limited ability to remember the warning manipulations, which is interesting because the increased attention and resources devoted to the gambling experience seem to limit the ability to process anything else. Future research should explore this relationship between flow and the memory of information provided beforehand, given the high demands on resources within flow. We suggest that because of the level of attention paid towards the flow experience itself, memory in flow may not be limited, but may in fact be enhanced. This is also a fruitful area for future research.

One of our studies was from a crowdsourced sample. There are potential limitations to using these samples, including those related to attention and diversity (Peer, Brandimarte, Samat, & Acquisti, 2017). Although we balanced these potential sample limitations with a study of undergraduate students, future research should endeavour to explore these relationships with regular gamblers and problem gamblers to examine whether there are nuances across different groups. We showed consistent results across both samples related to how flow influences the amount of time spent gambling, but the influence of flow on money may differ, depending on prior experience with gambling and income levels.

The paradox of positive and negative consequences of flow in gambling is perhaps most notable in the context of virtual reality gambling. This type of gambling has been predicted to grow drastically in the coming years, along with many other virtual reality applications (Kharpal, 2016). Virtual reality is a controlled context that is highly conducive to experiencing flow, which could exacerbate its negative outcomes,

especially given the removal from the real world, which attracts problem gamblers. However, researchers have also suggested that virtual reality has positive uses for responsible gambling, as it can be used in the treatment of problem gambling (Bouchard et al., 2017). We suggest that researchers focus on the virtual reality context so that consumers are fully aware of the dangers and are protected from them before they play.

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For correspondence: Raymond Lavoie, PhD, CETL Research Fellow, Girard School of Business, Merrimack College, 319 Crowe Building, 315 Turnpike Street, North Andover, MA, United States, 01845. E-mail: lavoier@merrimack.edu

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Appendix

Flow Questionnaire

Please read the following quotes. The questions that follow are based on them.

> "My mind isn't wandering. I am not thinking of something else. I am totally involved in what I am doing. My body feels good. I don't seem to hear anything else. The world seems to be cut off from me. I am less aware of myself and my problems."
>
> "My concentration is like breathing: I never think of it. When I start, I really do shut out the world. I am really quite oblivious to my surroundings after I really get going. I think that the phone could ring and the doorbell could ring or the house burn down or something like that. When I start, I really do shut out the world. Once I stop, I can let it back in again."
>
> "I am so involved in what I am doing. I don't see myself as separate from what I am doing."

Study 1 Warning Messages

The gains message asked participants to "focus on the winning spins you have and think about how much money you can make." The losses message said to "focus on the losing spins you have and how much money you are giving away."

The flow warning message said, "Flow is a state of being totally immersed in an activity to the degree that you forget about everything else around you and time seems to fly by. Flow can be dangerous when gambling because you can become immersed for too long and not realize how much time and money you have spent on that activity."