

Examining the Relationship Between Metacognition and Anxiety with the Flow Experience

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Master of Arts in School Psychology*

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### Abstract

Flow is described as a state that occurs when an individual is fully engaged in an activity or task, where that person experiences intrinsic motivation to complete the activity because it is perceived as being rewarding in and of itself. The present study sought to examine how anxiety might be related to the flow experience, and if metacognition might moderate this relationship. Forty individuals were asked to play two games of Tetris: the first game was designed to create a mismatch between skills and task demands to increase feelings of anxiety in some participants, and the second game was designed to create a match between skills and task demands to help induce flow. Using this experimental paradigm, the present study was able to provide support for previous correlational research regarding the relationship between anxiety and the flow experience. However, no support was found for the role of metacognitive ability in moderating the relationship between either anxiety and experiences of flow, or anxiety and game performance. Implications and directions for future research are discussed.

### Acknowledgements

First and foremost, I would like to thank my supervisor, Dr. Michelle Eskritt-Keck, for instilling in me a love for the research process, and for her endless support and guidance throughout the development of my master's thesis. I would also like to thank our undergraduate research assistant, Bailey Thompson, for her time and effort spent recruiting and running participants for this project. Finally, I would like to thank my family and friends for their love and support throughout this process – I could not have done it without you.

## **Examining the Relationship Between Metacognition and Self-Regulation on Trait and State Anxiety and the Flow Experience**

Mihalyi Csikszentmihalyi (1990, 1996, 1997, 2000) described flow as a state that occurs when an individual is fully engaged in an activity or task, where that individual experiences intrinsic motivation to complete or continue that activity because the activity is perceived by the individual as being rewarding in and of itself. The perceived fit between an individual's skill level and task demands are at the core of the conceptualization of flow (Csikszentmihalyi, 2014; Keller & Bless, 2008; Shernoff, Csikszentmihalyi, Schneider & Shernoff, 2014). The state of flow is often experienced when an individual's perceived skill level and task demands are equally matched. For example, a ballerina who perceives a balance between her skills and the difficulty of the dance she is learning may find the activity more enjoyable, and dance for her own personal enjoyment. In this way, dancing is perceived by the ballerina as being rewarding regardless of extrinsic motivations (e.g., prestige, money, fame).

Most research to date in the field of flow has examined the relationship of task demands and skill level primarily through correlational, self-report data (e.g., Fullagar, Knight, & Sovern, 2013; Shernoff et al., 2014). One exception was by Keller and Bless (2008) who used an experimental paradigm to explore the causal impact of the compatibility between skill level and task demands on the flow experience. In their experimental paradigm, Keller and Bless (2008) adapted a version of the game *Tetris* in order to manipulate the compatibility between skill level and task demands by creating three versions of the game: adaptive (i.e., skill level is matched to task demands; automatic increase or decrease in game difficulty depending on the participant's skill level), boredom (i.e., skill level is greater than task demands), and overload (i.e., skill level is less than task demands). The researchers found that participants in the adaptive condition reported

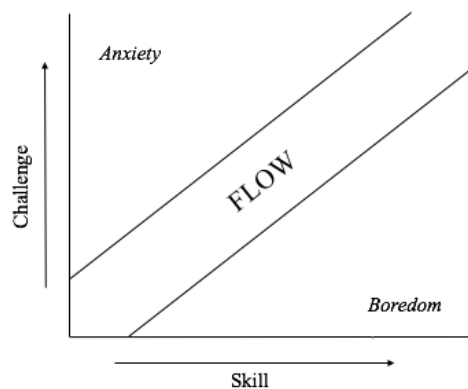
increases on several specific aspects of the flow experience, including: an accelerated passing of time, more involvement and enjoyment of the task, a higher level of perceived fit, and better scores on the game (Keller & Bless, 2008). These findings served to solidify the importance of the fit between skill level and task demands in the flow experience.

Csikszentmihalyi (1990, 1996, 1997) suggested that the state of flow is characterized by a number of other factors which have been supported by research, including: a complete focusing of attention (Pace, 2004), a feeling of total control (Shernoff et al., 2014), reduced awareness of distracting thoughts (Shernoff et al., 2014), a loss of self-consciousness (Pace, 2004), and a distorted sense of time (Keller & Bless, 2008). At the heart of the flow experience is the perceptual merging of action and awareness, which is thought to occur through the individual's centering of attention on a specific task (Csikszentmihalyi, 2014). It is important to note that although there is a merging of action and awareness while experiencing a state of flow, the relationship between an individual and the flow experience is not passive, and is instead built on an active interaction between the individual and their environment (Privette, 1983), where the individual feels in complete control of their actions and their environment (Csikszentmihalyi, 2000). However, the ability of an individual to enter a state of flow depends on other factors such as the context in which the activity is occurring (e.g., school or the home), individual differences (e.g., concentration, will to do the activity, involvement, happiness; Moneta & Csikszentmihalyi, 1996), personality characteristics [Nakamura & Csikszentmihalyi, 2002 (e.g., neuroticism (Csikszentmihalyi, 2014))] and perceptions and experiences of anxiety (Csikszentmihalyi, 2014; Kanfer, Ackerman, and Schmitt, 1989). In this way, a variety of factors may affect an individual's ability to get into flow by either directly (e.g., anxiety), or indirectly (e.g., individual factors

moderating the relationship between specific factors and the flow experience) affecting the flow experience.

### Flow and Anxiety

The relationship between the perceived fit between skill-level and task demands has been well documented as it relates to experiences of anxiety or apathy and the flow experience (Csikszentmihalyi, 2014; Jackson, Kimiecik, Ford & Marsh, 1998; Kanfer, Ackerman & Schmitt, 1989; Keller & Bless, 2008; Keller, Blomann, and Kleinböhl, 2011; Shernoff et al., 2014). To illustrate these relationships, Csikszentmihalyi (1975; see Figure 1) proposed a model of flow which states that when the task demands exceed the individual's perceived skill level, then that individual will experience anxiety. Conversely, when an individual's skills are higher than the task demands, boredom will occur, which may also be experienced as anxiety as the skill-level task demand ratio becomes larger. In this model, it is important to note that the compatibility between skills and task demands depends on the individual's perception of their skills and the task demands, rather than the actual skill level or task demands. In this way, a person's self-efficacy at the task at hand may affect whether they experience anxiety, boredom, or flow (Koehn, 2013; Nakamura & Csikszentmihalyi, 2002).



*Figure 1.* Csikszentmihalyi's (1975) proposed model of the relationships between skill-level and task demand and the flow experience.

The relationship between task demands, capabilities, and anxiety has been further explored in sports psychology as it relates to the “Inverted-U hypothesis” (Yerkes & Dodson, 1908), where moderate levels of arousal are typically associated with better performance of a given task, and high or low levels of arousal are typically associated with poorer performance (Gould & Krane, 1992; Spielberger, 1989). Recent research has complicated this proposed relationship, suggesting that additional factors such as self-confidence may moderate the anxiety-performance relationship (Craft, Magyar, Becker & Feltz, 2003). This same moderating relationship has also been noted between self-confidence and entering a state of flow (Jackson, 1995; Jackson et al., 1998; Stavrou & Zervas, 2004), where self-confidence is thought to moderate the debilitating effects of anxiety (Hardy, Jones & Gould, 1996). Thus, anxiety is thought to be a separate construct from confidence. An individual’s level of confidence in their skills (Jones & Swain, 1992) and their perceived ability to control themselves and the environment (Jones, 1995; Jones & Hanton, 1996) may lead them to perceive anxiety as either being debilitating or facilitative, with those who feel confident and in control perceiving anxiety as facilitative, and low-confidence individuals perceiving anxiety as debilitating (Cumming, Olphin & Law, 2007; Hanton, Mellalieu, & Hall, 2004; Jones & Hanton, 2001). In this way, an individual’s confidence in their skills to execute the task, and perceptions of task demands as they relate to experiences of anxiety will affect the ability of the individual to get into a state of flow (Nakamura & Csikszentmihalyi, 2002).

### **Self-Efficacy, Metacognition, and Emotion-Regulation**

Task-specific self-confidence as has been referred to as self-efficacy, which is said to be an individual's perceptions of confidence in their ability to successfully execute the specific behaviour or skill required to meet the task demands (Bandura, 1977). Individuals with strong self-efficacy typically focus their energy on the task at hand and will work tirelessly to overcome any

obstacles that they encounter because they believe that their success or failure at the task is in their control. Conversely, individuals with low levels of self-efficacy may doubt their ability to control the task outcomes, which may hinder the activation of problem-solving behaviour and task persistence (Coutinho, 2008). Bandura (1977) proposed four main sources of efficacy expectations: 1) performance accomplishments (i.e., repeated successes will raise expectations of success, repeated failures will lower them); 2) vicarious experience (i.e., self-persuasion that if others can do it, so can I); 3) verbal persuasion (i.e., external suggestion from others that they can cope successfully to perform the task at hand); and 4) physiological states (i.e., individuals are more likely to expect success when they are not experiencing high levels of physiological agitation).

Based on these proposed areas of efficacy expectations, individuals are likely to feel most confident at a specific task when they possess metacognitive knowledge about their capacity to do well at the task, and are able to appropriately regulate their emotions in order to control stress reactions (Bandura, 1977). Metacognition, according to John Flavell (1979), is how an individual monitors or thinks about their own cognition (i.e., thinking about thinking). Flavell (1979) suggested that metacognitive monitoring occurs through the actions and interactions between metacognitive knowledge (i.e., knowing which strategies work, how to use the strategies, and knowing when to use the strategies) and metacognitive regulation (i.e., planning, comprehension monitoring, evaluation of progress and goals). Metacognitive monitoring also plays an important part in emotion regulation. Emotion regulation can be defined as "the process by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions" (Gross, 1998, p. 275). Individuals engage in emotion regulation when they are motivated to influence their emotional trajectory (Gross, Sheppes & Urry, 2011) either to regulate

the emotion in and of itself (i.e., “I no longer want to feel angry”), or for external reasons (i.e., “I am motivated to look happy in a conversation with a superior at work so that I will get a promotion”; Gross, 2015, p. 5). In this way, an individual's metacognitions may serve to alter the way that they think about and respond to changes in emotions.

Wells and Matthews (1996) proposed a model called the self-regulatory executive function (S-REF) model based on metacognitive theory and Beck's (1967) schema theory to describe emotional disorders. This model states that an individual's metacognitive ability is central to emotion regulation and emotional responding, as metacognitive beliefs affect how people engage in self-regulation strategies, which becomes the basis for emotional disorders and emotion dysregulation (Wells & Cartwright-Hatton, 2004). Specifically, individuals form cognitive appraisals (e.g., “I must worry in order to be prepared; I cannot control my thoughts” Wells & Cartwright-Hatton, 2004, p. 386) as well as implicit procedural metacognitions that guide thinking and action (Wells & Cartwright-Hatton, 2004). In this way, individuals with maladaptive metacognitive monitoring processes may be less likely to be able to monitor and overcome their anxiety (i.e., state anxiety) in order to perform well on a given task. In some cases, these individuals may even provoke an anxious state in an otherwise benign situation, also causing poor performance on a given task.

### **The Present Study**

The present study sought to examine if metacognitive ability might moderate the relationship between anxiety and the flow experience. To induce flow, participants played the adaptive version of Tetris as used by Keller and Bless (2008). In order to manipulate the participants' feelings of anxiety, participants first practiced the game by playing either the boring, or overload condition of the game to affect their perception of their ability to succeed at the task

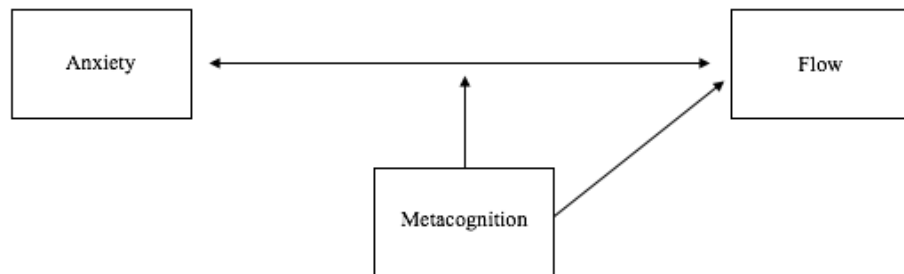
(i.e., their self-efficacy), subsequently increasing or decreasing their levels of anxiety. In the present study, systematic manipulation of anxiety provided us with a more direct, and in-depth explanation of its relationship with the flow experience. Further, assessment of metacognitive skills and flow experiences allowed us to examine the relationship of metacognitive skills in the relationship between anxiety and the flow experience. To our knowledge, there have been only a handful of studies published to date that used an experimental approach when testing flow theory (Keller & Bless, 2008; Keller & Blomann, 2008; Keller, Bless, Blomann, & Kleinböhl, 2011; Mannell & Bradley, 1986; Rheinberg & Vollmeyer, 2003), none of which have examined the relationships between anxiety and metacognition with the flow experience.

As discussed above, one of the hallmark features of flow theory is a perceived balance between the individual's skill level and task demands. Specifically, a perceived imbalance between skill level and task demands will lead to either anxiety (i.e., when the task demands are beyond perceived skill level), or boredom (i.e., when the task demands are much less than the perceived skill level). Based on this, as illustrated in Figure 2, we hypothesized that level of anxiety would predict ability to get into flow where low rates of anxiety would lead to higher reporting of flow, and higher rates of anxiety would lead to fewer reports of flow. Likewise, Figure 3 displays our hypothesis that level of anxiety would predict participant's Tetris game performance, where lower rates of anxiety would lead to higher game scores, and higher rates of anxiety would lead to lower game scores.

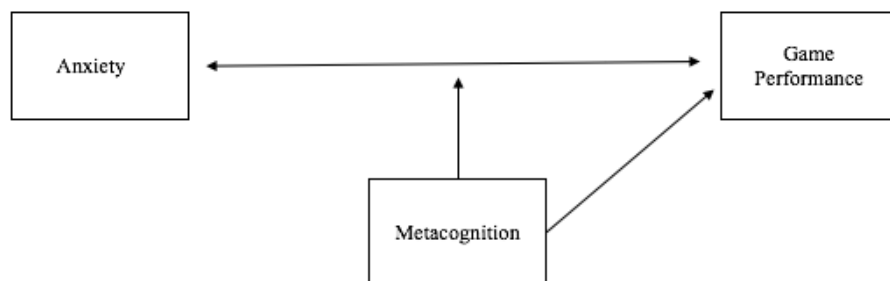
Next, metacognitive processes have been shown to affect both knowledge, and regulation of actions, with individuals with strong metacognitive skills typically performing better on tasks than their low metacognitive skill counterparts. Therefore, we predicted that metacognition would be directly related to both scores on the Tetris game and reports of flow. Specifically, that those

with strong metacognitive skills would report higher rates of higher scores on the Tetris game and higher rates of flow; and those with weak metacognitive skills would report lower scores on the Tetris game, and lower rates of flow (see Figures 2 and 3).

Due to the fact that metacognitive processes have also been shown to affect the regulation of thoughts and emotions, we hypothesized that metacognitive skills would moderate the relationship between anxiety and flow, and anxiety and Tetris scores. Specifically, we predicted that strong metacognitive skills would lead to lower reports of anxiety and higher reports of flow, and weak metacognitive skills would lead to higher reports of anxiety and lower reports of flow (see Figure 2). Similarly, we also predicted that strong metacognitive skills would lead to lower reports of anxiety and higher scores on the Tetris game, and weak metacognitive skills would lead to higher reports of anxiety and lower scores on the Tetris game (see Figure 3).



*Figure 2.* Hypothesized relationships between anxiety and metacognition with participant reports of flow.



*Figure 3.* Hypothesized relationships between anxiety and metacognition with scores on the Tetris game.

## Method

### Participants

Sample size for this study was estimated using Cohen's (1992) sample size estimation tables. Assuming a large effect ( $R^2/1 - R^2 = 0.35$ ) and two predictors on one continuous outcome variable (or partial correlations across three continuous variables) with  $\alpha = 0.05$  and power = 0.80, 30 people were estimated to be an appropriate sample size. Given that we were testing two models with two predictors each, we also looked up sample size for four predictors at the same effect size,  $\alpha$ , and power. The estimated sample size for four predictors was 38 participants. To get significance in the same two scenarios at moderate effects (0.15), we would have needed 67 or 83 participants, respectively. Due to the amount of time required to run each participant, and the time constraints for completion of this study, we decided to go with the estimated sample size for four predictors and a large effect size (i.e., 38 participants).

Forty individuals 19 years and older ( $M_{age} = 27.4$ ,  $SD = 11.27$ , range = 19-61) were recruited from psychology classes and recruitment posters that were placed around Mount Saint Vincent University in Halifax, Nova Scotia, Canada. Individuals were also recruited through social media advertising (i.e., Instagram and Facebook) in Winnipeg, Manitoba, Canada. Of those participants, seven were male (17.5%) and 33 were female (82.5%). All participants were required to have normal, or corrected-to-normal vision to participate. An equal number of individuals participated in each manipulation condition (i.e., 20 participants completed the boring version of the Tetris game, and 20 participants completed the overload version).

Participants were entered to win a \$20 *Tim Horton's* gift card. Additionally, participants recruited from their psychology classes had the opportunity to receive partial course credit at the discretion of their instructor.

## Materials

**Tetris computer game.** Participants played a modified version of the computer game *Tetromino* (a *Tetris* clone; Sweigart, 2010), modelled after the Tetris task that was used by Keller and Bless (2008) to manipulate the skills-demands compatibility. Tetris is played on a matrix where participants are required to rotate seven different shapes by 90 degrees in order to make full lines. The players earn points once they make these lines, which also causes the completed line to disappear. The shapes that are left over will then be used to create new lines until the shapes reach the top of the matrix and the game ends.

In our modified version of Tetris, there were three versions of the game: boring, adaptive, and overload. In the boring condition, shapes fell at a slow rate, and players did not have the option to speed up the rate at which the shapes fell. In the overload condition, the shapes began to fall at a very fast rate; if the player was still successful in the overload condition, the speed at which the shapes fell continued to increase. Participants did not have the option to slow down the rate at which the shapes fell, but did have the option to speed up the rate at which a particular shape fell.

Lastly, in the adaptive condition, the speed at which the shapes fell adjusted depending on how well the player was doing (i.e., the difficulty will match player skill level). If the player filled five lines, the speed at which the shapes fell would be slightly increased; however, if the player filled three or fewer lines, the speed at which the shapes fell was decreased. As in the overload condition, participants were able to make a particular shape fall faster if they wanted. Participant performance was assessed by the total number of lines that they completed during the game.

**Flow State Scale** (FFS; Jackson & Marsh, 1996). The FFS is a well-established scale designed to measure an individual's thoughts and feelings after participating in a particular task or event (Jackson & Marsh, 1996). The FFS is a 36-item scale that is designed to measure nine of the

main dimensions of flow (i.e., clear goals, meaningful feedback, a balance between skills and challenge, sense of control, perception of time, merging of action and awareness, concentration, and loss of self-consciousness), with each dimension being measured by four items on the scale. Each individual item was rated on a 5-point Likert-scale (1= Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Strongly agree; 5 = Strongly disagree; Jackson & Marsh, 1996). Flow state was calculated for each participant by totalling the responses to all 36 items on the scale for a possible low score of 36 and a possible high score of 180, where higher scores indicated higher reports of flow.

**Spielberger State-Trait Anxiety Inventory 6-item** (STAI: Y-6 item; Marteau & Bekker, 1992). The STAI: Y-6 item is a six-item short form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, 1983). This self-report measure consists of six statements that are designed to assess how individuals feel "right now, at this moment" (Marteau & Bekker, 1992, p. 306). Individuals rated themselves in relation to each item on a 4-point Likert scale (1 = Not at all; 2 = Somewhat; 3 = Moderately; 4 = Very much). Individual participant scores on this measure were calculated by totalling their responses to each question on the scale for a possible low score of six and a possible high score of 24, with higher scores indicating higher levels of state anxiety.

**The Metacognitions Questionnaire-30** (MCQ-30; Wells & Cartwright-Hatton, 2004). The MCQ-30 is a 30-item shortened version of the Metacognitions Questionnaire (MCQ) that was developed by Cartwright-Hatton and Wells (1997) in order to assess metacognitive beliefs in adults. It is based on the S-REF model proposed by Wells and Mathews (1996), and aims to measure specific dimensions of metacognition that are thought to be associated with many emotional psychopathologies (e.g., depression, generalized anxiety disorder, and panic disorder).

The questionnaire is comprised of five factors that reflect positive and negative metacognitive monitoring, and judgements of cognitive confidence: 1) positive beliefs about worry; 2) negative beliefs about thoughts concerning uncontrollability and danger; 3) cognitive confidence (i.e., assessing confidence in attention and memory); 4) negative beliefs concerning the consequences of not controlling thoughts; and 5) cognitive self-consciousness (the tendency to focus attention on thought processes). On this questionnaire, individuals rated themselves with respect to each item on a 4-point Likert scale (1 = Do not agree; 2 = Agree slightly; 3 = Agree moderately; 4 = Agree very much). Total scores for each participant were calculated by totalling all responses, with a possible low score of 30 and a possible high score of 120. Additionally, subscale scores were computed for each of the five subscales, with a possible low score of 6 and a possible high score of 24. For both total and subscale scores, higher scores indicate higher levels of unhelpful metacognitions.

### **Procedure**

Data collection occurred in a quiet space free of distractions (e.g., in a lab, or in another quiet room). Data collection primarily occurred individually; however, also occurred in small groups in a lab setting. The procedure for this study consisted of five phases (see Figure 4).

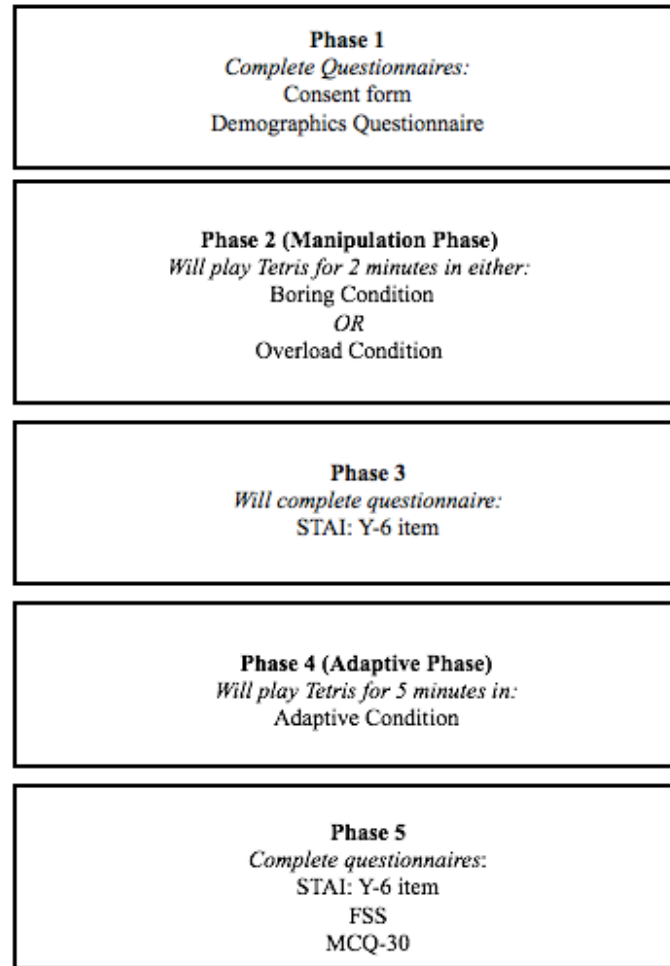
In phase one, once prospective participants provided informed consent to participate in the study, they filled out a preliminary demographics questionnaire. The demographic questionnaire was designed to elicit personal information (e.g., gender, age), exclusionary criteria (e.g., vision deficits, previous participation in a Tetris study experiment), history of Tetris game use, and skill level (see Appendix A).

The purpose of phase two was to manipulate participant self-efficacy and subsequent anxiety at the Tetris task. Participants were randomly assigned to play a practice game of Tetris

for two minutes in either the boring or overload condition. Once completed, in phase three, the participants completed the STAI: Y-6 item to measure if the practice game did manipulate feelings of anxiety.

Phase four was considered the “test phase,” which served the purpose of creating a skills-demands compatibility for all participants. In this phase, all participants played Tetris for five minutes under the adaptive condition. Participant performance was assessed by the total number of lines that they completed during the five-minute timespan.

Lastly, in phase five, participants were asked to complete three questionnaires. They were asked to fill out the FSS to measure flow experience during the Tetris game, and the MCQ-30 questionnaire to measure metacognitive ability. Participants were again asked to complete the STAI: Y-6 item questionnaire in order to assess their degree of state anxiety. The entire procedure took approximately 25 minutes to complete.



*Figure 4.* Five phase procedure for the Tetris task experiment.

## Results

Table 1 displays the means, ranges, and standard deviations of computer game performance (i.e., for the manipulation and adaptive games), FSS scores, STAI: Y-6 item scores, and MCQ-30 scores.

### Manipulation of Anxiety

The Spielberger State-Trait Anxiety Inventory 6-item (STAI: Y-6 item; Marteau & Bekker, 1992) consisted of six items. Cronbach's alpha ratings were computed for STAI: Y-6 item scores following the manipulation game ( $\alpha = .83$ ), and following the adaptive game ( $\alpha = .87$ ) and were at an acceptable level. Participant scores on the STAI: Y-6 item following both games yielded a full

range of anxiety scores across participants (see Table 1), and were normally distributed (see Figure 5). Independent samples t-tests were computed in order to examine if being in either the boring or overload condition was related to state anxiety levels. Although not significant, following the manipulation phase, those in the overload condition ( $M = 2.45$ ,  $SD = 2.30$ ) reported higher levels of state anxiety compared to those in the boring condition ( $M = 1.30$ ,  $SD = 0.98$ ;  $t(38) = 1.077$ ,  $p = .288$ ).

### **Predicting the Experience of Flow**

The Flow State Scale (FFS; Jackson & Marsh, 1996) consisted of 36 items ( $\alpha = .91$ ). Correlational analyses showed that participant scores on the FFS and adaptive game performance were significantly correlated ( $p < .01$ ; see Table 2); however, this relationship was not observed between total FFS scores and game performance in the manipulation phase ( $p = .496$ ). Further, analyses revealed that participant scores on the FFS and reported skill level at Tetris were also significantly correlated ( $p < .01$ ; see Table 2). That is, individuals who reported having a higher skill level at Tetris reported higher rates of entering into flow. Further, participants who experienced more success on the adaptive game also reported higher rates of getting into flow.

The two variables used to predict flow were anxiety and metacognition. Additional analyses that examined FFS scores as they relate to participant scores on the STAI: Y-6 item taken both after the manipulation ( $p < .01$ ), and adaptive ( $p < .01$ ) game phases were significantly negatively correlated (Table 2). That is, individuals who reported lower rates of state anxiety also reported higher rates of getting into flow, and vice versa. This relationship between flow ratings and state anxiety was true for anxiety ratings taken after both the manipulation and adaptive Tetris games.

The Metacognitions Questionnaire-30 (MCQ-30; Wells & Cartwright-Hatton, 2004) consisted of 30 items ( $\alpha = .89$ ). Participant scores on the MCQ-30 are reported in Table 1, with higher scores indicating higher levels of unhelpful metacognitions. Correlational analyses showed that total participant scores on the MCQ-30 and state anxiety following the manipulation phase were significantly correlated ( $p < .05$ ; Table 2); however, the same correlation was not seen following the adaptive game phase ( $p = .483$ ; Table 2). That is, higher levels of unhelpful metacognitions were associated with higher levels of state anxiety following the manipulation game of Tetris; however, this relationship was not observed between state anxiety ratings taken following the adaptive phase.

A hierarchical multiple regression was conducted to address the hypothesis that reports of anxiety would be related to reports of flow, and more specifically, that metacognition would moderate the relationship between anxiety and flow. The analysis was completed in two steps. In the first step of the analysis (i.e., Model 1), the relationship of both metacognition and state anxiety were analyzed as they relate to flow. In the second step of the analysis (i.e., Model 2), an interaction variable (i.e., total score on the MCQ-30 multiplied by total score on the STAI: Y-6 item taken from the manipulation phase of the game) was computed and added to the analysis in order to examine if metacognition would moderate the relationship between anxiety and flow.

The overall model was significant both for both Model 1 ( $R^2 = .137$ ,  $F(2, 37) = 4.106$ ,  $p = .025$ ; Table 3) and Model 2 ( $R^2 = .156$ ,  $F(3, 36) = 3.407$ ,  $p = .028$ ; Table 3). However, it is important to note that although the overall model was significant, state anxiety was the only significant predictor of flow in both Model 1 [ $\beta = -.453$ ,  $t(37) = -2.397$ ,  $p = .008$ ], and Model 2 [ $\beta = -.1.278$ ,  $t(36) = -2.026$ ,  $p = .050$ ]. That is, although state anxiety was related to participants' reports of getting into flow, no direct relationship between metacognition and flow, or of

metacognition as a moderator of the state anxiety and flow relationship was found ( $p = .185$ ; see Table 3).

### **Predicting Tetris Game Performance**

During the manipulation phase Tetris game, participants were randomly assigned to play either the boring, or overload version of the Tetris game. Means, ranges, and standard deviations for participant scores were calculated for both the manipulation and adaptive Tetris games (see Table 1). Although descriptive statistics for each condition across both game phases of the study are provided, they should not be interpreted in a comparative manner due to differences in the speed that the game pieces were falling between the boring and overload conditions. Thus, participants in the overload condition were provided with an opportunity to potentially create more lines in the two minutes they were allotted to play the game in the manipulation phase, compared to participants in the boring condition of the game.

A second hierarchical multiple regression was conducted to address the hypothesis that anxiety would be related to Tetris game performance, and more specifically, that metacognition would moderate the relationship between anxiety and flow. The second analysis was completed in the same manner as the first, with anxiety and metacognition scores being entered into the equation first, followed by the interaction term. In this case, however, neither model was significant (see Table 4). That is, neither state anxiety or metacognition predicted game performance, and metacognition did not moderate the relationship between state anxiety and game performance.

### **Discussion**

The purpose of the present study was to examine if metacognitive ability might moderate the relationship between anxiety and flow, and anxiety and game performance. Critical to

addressing this purpose was for participants to experience a range of different levels of anxiety, and to ensure that the Tetris game was capable of inducing flow in at least some of the participants.

### **Manipulating Anxiety and Inducing a State of Flow**

The purpose of the two-minute Tetris game (i.e., the manipulation game) was to manipulate participants' state anxiety. Although not significant, analyses on data from the manipulation phase showed that individuals who participated in the overload condition (i.e., pieces falling at a quick pace) reported higher levels of anxiety compared to those who participated in the boring condition (i.e., pieces falling at a slow pace; could not speed up the rate at which the pieces are falling). Further, the manipulation Tetris game did indeed serve the intended purpose of manipulating levels of state anxiety, as exhibited by the wide range of anxiety scores (see Figure 5).

The purpose of the five-minute Tetris game (i.e., the adaptive game) was to create a skill level and task demand compatibility where individuals would be able to begin to enter a state of flow. At least a portion of the participants started to enter a state of flow. Keller and Bless (2008) examined the compatibility between skill level and tasks demands on the flow experience and found that the fit between skill level and task demands are crucial in the flow experience. The present study was able to replicate these findings, where individuals who reported a higher perceived skill level at Tetris also reported higher rates of flow. Further, in support of the importance of the fit between skill level and task demands in the flow experience, the present study found that FSS scores were related to participant performance on the adaptive Tetris game only. This relationship was not noted between FSS scores and participant performance on the manipulation games. This suggests that flow is related to performance when an individual experiences a match between skill level and task demands, which was achieved in our adaptive condition.

### **The Role of Metacognition in Game Performance and the Flow Experience**

As previously mentioned, the main purpose of the present study was to add to the existing literature on the relationship of anxiety and flow, and anxiety and performance by looking at the potential moderation effects of metacognition on the relationship between anxiety and flow, and anxiety and game performance. Previous research conducted by individuals such as Wells and Matthews (1996) suggests that metacognitive monitoring may be related to an individual's regulation of anxiety by altering the way that a person thinks about and responds to changes in emotions. Therefore, we predicted that metacognition would moderate the relationship between anxiety and flow, and anxiety and game performance; specifically, by helping participants to achieve lower rates of state anxiety through metacognitive monitoring in order to perform better at the task at hand and achieve higher rates of flow.

The previously mentioned model of perceived skill level and performance in the flow experience has been examined as it relates to experiences of anxiety in the flow experience; specifically, where a mismatch between an individual's perceived skill level and task demands may result in an anxious state, and lower reporting of flow (Csikszentmihalyi, 1975; Figure 1). In support of Csikszentmihalyi's (1975) proposed model of flow, and our hypothesis that level of anxiety would predict ability to get into a state of flow, individuals who experienced higher levels of state anxiety on the practice game reported lower scores on the FSS, indicating that higher rates of state anxiety are related to lower reporting of flow. Interestingly enough, and refuting Yerkes and Dodson's "Inverted-U Hypothesis," the hypothesized relationship between state anxiety and game performance was not found, where participants' reported level of anxiety was unrelated to their performance on either the manipulation or adaptive Tetris games.

A possible reason that the results of the present study do not reflect previous research may be related to the context of the Tetris task activity. Specifically, individuals might not have experienced sustained levels of elevated anxiety in relation to their potential game performance on the adaptive game of Tetris, due to knowledge that their game results and responses would remain anonymous. This would, in effect, remove the possibility of public evaluation of their performance (Spielberger et al., 1970), therefore decreasing the level of state anxiety that would be directed towards their upcoming game performance. Previous research in the area of sports psychology supports this rationale; one of the main characteristics of high-level sport is based on athletes performing at optimal levels in high-pressure situations (Jones, 1995). In sport, high-pressure situations are often characterized by pressures such as the presence of audiences, video-recordings of performances, and performance-contingent rewards (Wang, Marchant, Morris, & Gibbs, 2004). Due to the absence of the previously mentioned factors, the Tetris task was likely not interpreted as a high-pressure situation by the majority of participants.

Another explanation may be due to the nature of the dependent variables; specifically, that the basis of a state of flow is intrinsic motivation (Csikszentmihalyi, 1990, 1996, 1997, 2000), and desire to perform well on a game or task (i.e., obtain a high score) may be more extrinsically motivated by comparison. In this way, the intrinsic nature of both state anxiety and a state of flow may be one explanation of why these two variables were related when game performance was not. Further, when examining this rationale in relation to sports, athletes engaging in high-level sporting events often have a particular level of will and motivation, regardless of the source of motivation, to excel at the task at hand (Madigan, Stoeber, & Passfield, 2016); a level of motivation that was likely not achieved by participants in the present study. These explanations may explain

why the present study did not find the same relationship between anxiety and performance as has previously been found by other researchers.

Although previous correlational research exists regarding the relationship between anxiety and flow, and anxiety and game performance, to our knowledge, no previous research has examined the direct relationship between anxiety and flow, or the moderating effect of metacognition on the relationship between anxiety and flow using an experimental paradigm. The results of the present study show that although higher rates of reported unhelpful metacognitions were initially associated with higher rates of state anxiety following the manipulation game of Tetris, this relationship was not sustained following the adaptive game. This indicates that although metacognition may have initially been related to state anxiety, it did not appear to play a role in the regulation of state anxiety as it relates to the flow experience. Further, a null effect of metacognition on the relationship between state anxiety and game performance was also noted. In this way, metacognition did not appear to affect the relationship between either state anxiety and achieving a state of flow, or state anxiety and game performance.

When examining the non-significant relationship found between metacognition and flow, it is possible that the very nature of flow itself may be a cause for this absent relationship. One of the central aspects of the theory of flow is a perceptual merging of action and awareness that occurs through an individual's centering of attention on the task at hand (Csikszentmihalyi, 2014). Specifically, although there is an interaction between the individual and their environment, entering a state of flow might lead to the participant centering their attention on the task at hand, therefore leaving minimal resources to employ metacognitive strategies.

Next, when looking at the null relationship between metacognition and game performance, there are two main reasons why this might be the case. First, it is possible that the particular task

used in this study was insufficient in producing increased rates of emotional responding (i.e., state anxiety). However, it should be noted that this possibility is unlikely, given the range of anxiety scores reported by participants (i.e., a full range of possible scores). Further, the Cronbach's alpha score for the STAI: Y-6 item was good, removing the possibility of problems with the internal consistency of the scale itself.

A second possibility is that assuming that state anxiety was elevated, the nature of the present study was insufficient to motivate individuals to regulate their state anxiety. This rationale is based on McClelland's (1951) motivation theory, where he proposed that individuals are motivated to achieve in two ways: the desire for success, and the desire to avoid failure. Based on this, the anonymity provided by the nature of the present study may have removed participants' desire to avoid failure, and the lack of personal importance of the Tetris task may have removed the participants' desire for success. Previous research by Gross, Sheppes, and Urry (2011) explored the role of a person's will to influence their emotional trajectory, through employing emotion regulation strategies (e.g., metacognitive strategies); specifically, that individuals will only engage in these strategies when they are motivated to influence their emotional trajectory. In this way, an individual who does not have the will to excel at a particular task (e.g., the Tetris task) may not be motivated to employ metacognitive strategies in order to facilitate optimal performance. It is possible that if this same experimental paradigm was replicated with a different task that was more meaningful or personally enjoyable for the participant, or where one's performance on the task had the potential to be seen by others, that participants may have been more motivated to employ metacognitive strategies in order to regulate their anxiety and perform better at the task at hand. Although the nature of this study may have been insufficient to motivate individuals to employ metacognitive strategies to regulate their anxiety, and is a limitation, it also provides an important

basis for future research. Specifically, the roles of personal enjoyment, meaningfulness, performance setting, or other factors as motivators in regulating anxiety in game performance.

### **Limitations and Future Research**

A variable that was indirectly examined in the present study is self-efficacy. The manipulation phase of the Tetris task may have served to manipulate an individuals' self-efficacy at Tetris, by systematically changing the game difficulty to be either more or less of a challenge than the participant had anticipated. Previous research suggests that a person's self-efficacy can be related to experiences of anxiety, where negative expectations about one's success may lead to perceptions and experiences of anxiety (Martens, Vealey, & Burton, 1990). In this way, a person who believed that they had a low skill level at Tetris may have experienced higher levels of anxiety, regardless of whether they participated in the boring, or overload condition. Further, these individuals may have been less motivated to employ metacognitive strategies if they already believed that they would fail, compared to individuals who believed that they could succeed at the task (Flavell, 1979). In this way, although the present study did not directly examine the relationship between self-efficacy and our variables of interest (i.e., anxiety, metacognition, game performance, and the flow experience), it is possible that it may indeed have played a role. For this reason, exploring more directly the potential role self-efficacy might play in these relationships is a direction for future research.

A final consideration in regards to the non-significant relationship of metacognition in both flow, and game performance was the choice of the scale used to measure metacognitive beliefs. As previously noted, the MCQ-30 was selected for use for two reasons: 1) its basis on the S-REF model (i.e., an individual's metacognition will affect how a person engages in self-regulation strategies; Wells, 2000; Wells & Matthews, 1994, 1996), which we proposed would relate to a

person's ability to regulate their anxiety; and 2) the individual subscales within the MCQ-30 [i.e., the subscales of cognitive confidence, and cognitive self-consciousness which are related to self-efficacy, which was manipulated (along with anxiety) during the manipulation phase]. Although measurement error is a possibility, it is unlikely considering the strong correlations found between two of the subscales (i.e., negative beliefs about uncontrollability and danger and lack of cognitive confidence) and anxiety, indicating a sound choice in measurement tool.

Related to measurement error, and a limitation in any research that uses self-report data is individual differences in interpretation. A study previously conducted by Dutton and Aaron (1974) that examined the role of the attribution of cause to physiological arousal eloquently highlights the potential for interpretative differences within our experimental paradigm. Specifically, Dutton and Aaron (1974) found that individuals often experience ambiguous physiological arousal first, before attempting to detect the cause of that arousal. That arousal may then be accurately or inaccurately labelled depending on the way that the person interprets the arousal (Dutton & Aaron, 1974). Following the same rationale as Dutton and Aaron's (1974), it is possible that as individuals participated in the Tetris task experiment, they may have been met with physiological arousal which may have been interpreted differently across individuals. For example, an individual who was met with physiological arousal may have interpreted their arousal as excitement if they viewed the game as an exciting challenge and something that they could be successful at. Alternatively, the same arousal may have been interpreted as fear or distress if they viewed the game as an impossible challenge. Take the second statement on the STAI: Y-6 item for example: the question reads, "I am tense" (Marteau & Bekker, 1992). The individual who views their arousal as excitement may circle "not at all," while the individual who views their arousal as fear or distress may circle "very much." These differences in thinking about feelings involve an individual's

metacognition, where differences in metacognition may affect the responses that they provided on the STAI: Y-6 item. In this way, although the present study did not find a moderating effect of metacognition on the relationship between anxiety and flow, or anxiety and game performance, it is possible that metacognition may have indirectly exerted an influence on this relationship through affecting how a person responded to the questions on the STAI: Y-6 item. In future research, monitoring the physiological arousal of participants (e.g., via a heart rate monitor) in combination with a self-report measure of anxiety may remedy this limitation.

### **Conclusions**

The results of the present study yielded important insights regarding the relationships between anxiety and metacognition in the flow experience. We were able to show support for previous research that suggests that experiencing anxiety interferes with a person's ability to enter a state of flow using an experimental, rather than correlational design. Further, this study adds to the existing literature on the relationship between anxiety and performance by revealing that the debilitating effects of anxiety on game performance may not exist in all contexts, as found in our study.

The present study was not able to show support for the moderating effect of metacognition on either the anxiety and flow relationship, or on the relationship between anxiety and game performance. The non-significant role of metacognition in these relationships provides important information in the potential role of human motivation in influencing emotional trajectory. Future research should consider other potential factors in addition to metacognition, such as personal enjoyment, meaningfulness, self-efficacy, and performance setting.

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Table 1  
*Participants' Scores Across Different Measures*

	<i>N</i>	Range	<i>M</i>	<i>SD</i>
Anxiety Scores (Manipulation Phase)	40	7 - 22	12.450	3.529
Boring Condition	20	7 - 22	11.850	3.787
Overload Condition	20	9 - 19	13.050	3.235
Anxiety Scores (Adaptive Phase)	40	6 - 22	12.450	3.862
Boring Condition	20	8 - 22	12.800	4.137
Overload Condition	20	6 - 21	12.100	3.640
Metacognition Scores	40	41 - 93	65.125	13.677
Flow Scores	40	75 - 149	119.325	18.677
Game Scores (Manipulation Phase)	40	0 - 9	1.875	1.842
Boring Condition	20	0 - 3	1.300	.978
Overload Condition	20	0 - 9	2.450	2.305
Game Scores (Adaptive Phase)	40	0 - 33	10.300	7.835

*Note.* *M* = Mean. *SD* = Standard Deviation. Participants' rated skill level at Tetris ranges from 0 (no experience) to 6 (excellent).

Table 2  
*Correlations Between Scores*

Variable	Skill Level	Anxiety Difference	Flow Score	Manipulation Game Score	Adaptive Game Score	MCQ-30 Score	Anxiety Total (Manipulation)
Skill Level	--						
Anxiety Difference	.055	--					
Flow Score	.571**	.170	--				
Manipulation Game Score	.110	-.112	.170	--			
Adaptive Game Score	.449**	.242	.584**	.278	--		
MCQ-30 Score	-.217	.304	-.075	-.090	.114	--	
Anxiety Total (manipulation)	-.225	.433**	-.417**	.084	-.005	.377*	--
Anxiety Total (adaptive)	-.258	-.567**	-.545**	.185	.238	.051	.496**

Note: \* =  $p < .05$ ; \*\*  $p < .01$

Table 3

*Results of the Multiple Regression Analyses for Predicting Flow Scores*

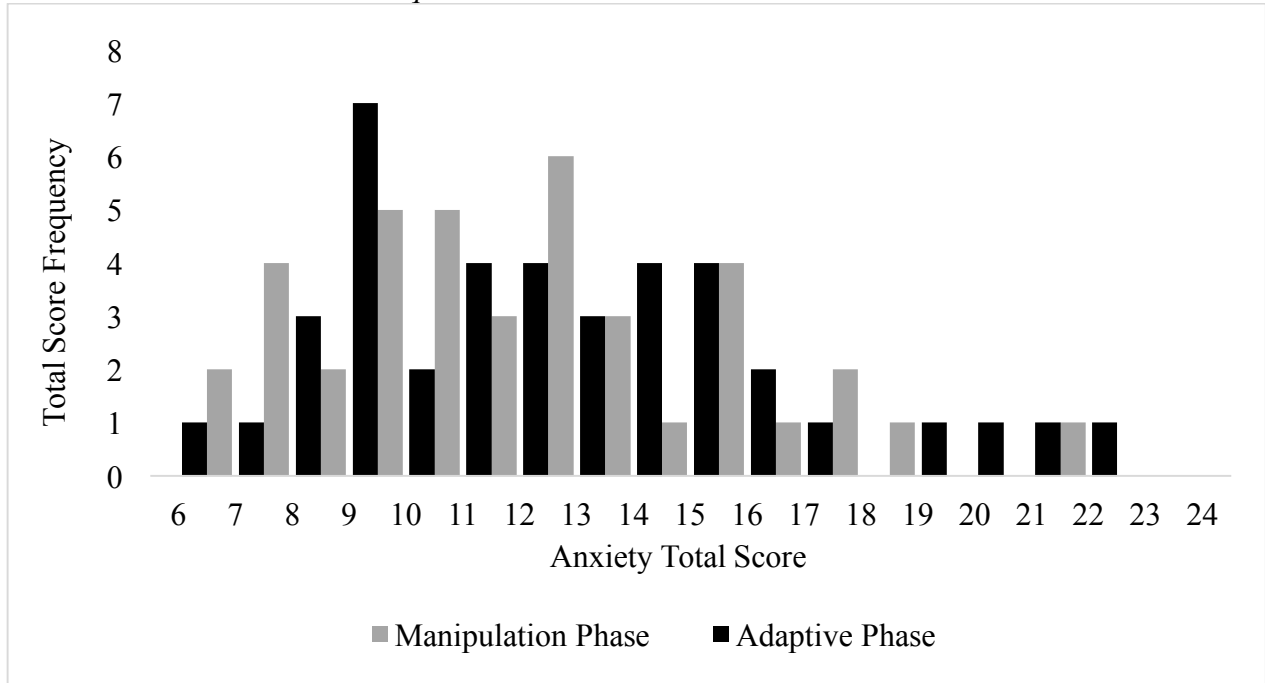
	<i>t</i>	<i>p</i>	$\beta$	<i>F</i>	<i>df</i>	<i>p</i>	Adj. $R^2$
Model 1							
Overall model				4.106	2, 37	.025	.137
Total metacognition scores	.596	.555	.096				
Total anxiety scores	-2.397	.008	-.453				
Model 2							
Overall model				3.407	3, 36	.028	.156
Total metacognition scores	-1.082	.286	-.529				
Total anxiety scores	- 2.026	.050	-1.278				
Anxiety X metacognition scores	1.351	.185	1.224				

Table 4

*Results of the Multiple Regression Analyses for Predicting Game Performance*

	<i>t</i>	<i>p</i>	$\beta$	<i>F</i>	<i>df</i>	<i>p</i>	Adj. $R^2$
<b>Model 1</b>							
Overall model				.296	2, 37	.746	-.037
Total metacognition scores	.769	.447	.135				
Total anxiety scores	-.318	.752	-.056				
<b>Model 2</b>							
Overall model				.197	3, 36	.898	-.066
Total metacognition scores	.133	.895	.073				
Total anxiety scores	-.195	.846	-.138				
Anxiety X metacognition scores	.120	.905	.122				

Figure 5  
*STAI: Y-6 item Total Score Frequencies*



Appendix A

Certificate of Research Ethics Clearance



University Research Ethics Board (UREB)

Certificate of Research Ethics Clearance

<input checked="" type="checkbox"/> Clearance	<input type="checkbox"/> Secondary Data Clearance	<input type="checkbox"/> Renewal	<input type="checkbox"/> Modification	<input type="checkbox"/> Change to Study Personnel
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<b>Effective Date</b>	<b>February 13, 2019</b>	<b>Expiry Date</b>	<b>February 12, 2020</b>
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File #:	2018-126
Title of project:	Examining the Relationship Between Metacognition and Anxiety with the Flow Experience
Researcher(s):	Mikayla Kerr
Supervisor (if applicable):	Michell Eskritt
Co-Investigators:	n/a
Version :	1

The University Research Ethics Board (UREB) has reviewed the above named research proposal and confirms that it respects the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* and Mount Saint Vincent University's policies, procedures and guidelines regarding the ethics of research involving human participants. This certificate of research ethics clearance is valid for a period of **one year** from the date of issue.

Researchers are reminded of the following requirements:	
<b>Changes to Protocol</b>	Any changes to approved protocol must be reviewed <u>and</u> approved by the UREB prior to their implementation. <b>Form: REB.FORM.002      Info: REB.SOP.113      Policy: REB.POL.003</b>
<b>Changes to Research Personnel</b>	Any changes to approved persons with access to research data must be reported to the UREB immediately. <b>Form: REB.FORM.002      Info: REB.SOP.113      Policy: REB.POL.003</b>
<b>Annual Renewal</b>	Annual renewals are contingent upon an annual report submitted to the UREB prior to the expiry date as listed above. You may renew up to four times, at which point the file must be closed and a new application submitted for review. <b>Form: REB.FORM.003      Info: REB.SOP.116      Policy: REB.POL.003</b>
<b>Final Report</b>	A final report is due on or before the expiry date. <b>Form: REB.FORM.004      Info: REB.SOP.116      Policy: REB.POL.003</b>
<b>Privacy Breach</b>	Researchers must inform the UREB immediately and submit the Privacy Breach form. The breach will be investigated by the REB and the FOIPOP Officer. <b>Form: REB.FORM.015</b>
<b>Unanticipated Research Event</b>	Researchers must inform the UREB immediately and submit a report to the UREB within seven (7) working days of the event. <b>Form: REB.FORM.008      Info: REB.SOP.115      Policy: REB.POL.003</b>
<b>Adverse Research Event</b>	Researchers must inform the UREB immediately and submit a report to the UREB within two (2) working days of the event. <b>Form: REB.FORM.007      Info: REB.SOP.114      Policy: REB.POL.003</b>

\*For more information: <http://www.msvu.ca/ethics>

Daniel Seguin, Chair  
University Research Ethics Board

Halifax Nova Scotia B3M 2J6 Canada  
Tel 902 457 6350 • [msvu.ca/ethics](http://msvu.ca/ethics)

## Appendix B

### Participant Demographic Questionnaire

Participant ID: \_\_\_\_\_

**Please answer the following questions:**

1. What is your age? \_\_\_\_\_
2. What is your gender?  
*Male* \_\_\_\_\_ *Female* \_\_\_\_\_ *Non-binary/other* \_\_\_\_\_
3. Do you have normal or corrected-to-normal vision (Y/N)? \_\_\_\_\_
4. Do you have any motor difficulties (Y/N)? \_\_\_\_\_
5. Have you previously participated in any other Tetris related studies (Y/N)? \_\_\_\_\_
6. Have you ever played Tetris before (Y/N)? \_\_\_\_\_
  - a. If yes, how would you rate your skill level at Tetris?  
*Poor* \_\_\_\_\_ *Fair* \_\_\_\_\_ *Average* \_\_\_\_\_ *Good* \_\_\_\_\_ *Excellent* \_\_\_\_\_

**Appendix C**

## Consent Form

**Student Investigator:** Mikayla Kerr**Supervisor:** Michelle Eskritt-Keck, PhD

Statement: I, \_\_\_\_\_, agree to participate in the research study on how to optimize the gaming experience. The nature and possible complications of the research have been explained to me as outlined in the Information Letter of which I have received a copy.

I understand the risks and benefits of the study that have been explained to me.

I understand that I may skip any questions I do not wish to answer and may withdraw from the study at any time without penalty.

I will not be identified in any scientific presentation or publication.

I may keep a copy of the information sheet and I may withdraw from participation at any time.

\_\_\_\_\_  
Signature of Volunteer

\_\_\_\_\_  
Date (DD/MM/YYYY)

I wish to have my name entered into a draw for a Tim Horton's gift certificate. If I win, the researcher can contact me at this email address: \_\_\_\_\_

I wish to receive a summary of the results of the study once it is complete. The information can be sent to this email address: \_\_\_\_\_

Please pass my name onto my professor so that I can receive credit for participating in the research study.

Professor's Name: \_\_\_\_\_

Course # and Section: \_\_\_\_\_  
(e.g., PSYC 1110\_01)

**Appendix D****INFORMATION SHEET**

**Institutional Affiliation:** Mount Saint Vincent University

**Student Investigator:** Mikayla Kerr, BA (Hons), MA School Psychology Candidate

**Research Assistant:** Bailey Thompson

**Supervisor:** Michelle Eskritt-Keck, Ph.D

Mikayla Kerr is conducting a study on how to optimize the gaming experience as part of the requirements for her master's thesis in school psychology. The purpose of this study is to examine the fit between skill level and game difficulty in relation to thinking and performance. You will be asked to play the video game *Tetris* twice, for a period of two minutes and five minutes, respectively. In between playing Tetris, you will be asked to complete questionnaires that ask you demographic questions, your feelings about the game experience, general feelings during the study, and feelings on a daily basis. Participation in this study will take approximately 20 – 30 minutes.

The nature of this study does not exceed minimum risk. It is possible that you might get frustrated while playing the computer game. You are free to stop at any time without consequence. You are also free to refuse to answer any questions that you do not wish to answer on the questionnaire.

Your individual results from this study will be completely confidential and your name will not be associated with any of your responses. Your data will be identified using an arbitrary participant number and all hard copies of your data will be kept secure in a locked cabinet, and electronic data will be stored on a secure server and/or on a password-protected laptop. Anonymous data from this study may be kept on a password-protected laptop computer and duplicated on a password protected USB drive. All copies of the data will be destroyed five years after it has been published in an academic journal.

The results of this study will be presented at future conferences, and potentially in a scholarly publication, such as a journal article. In exchange for your time, you can expect to gain some understanding of research and some of the ideas currently being explored in psychology. If you decide to participate in this study, you can provide your name and contact information to be

entered into a draw for a chance to win a \$20 *Tim Horton's* gift card. At the discretion of your professor (i.e., the professor of the class form which you have been recruited), you may also receive participation/bonus points for participating. If so, we will pass your name on to your professor. This information will only be used to let your professor know you participated, and will not be linked to any of your personal data. Non-participation in this study or withdrawal will not affect your grades or your instructor's evaluation of your performance in any way.

If you have any questions or concerns about your participation in this study at any point, please let the experimenter know immediately. If, after you leave here today, you have any questions or concerns please feel free to contact either the Student Investigator, Mikayla Kerr, ([mikayla.kerr3@msvu.ca](mailto:mikayla.kerr3@msvu.ca)) or supervisor, Dr. Michelle Eskritt-Keck, ([michelle.eskritt@msvu.ca](mailto:michelle.eskritt@msvu.ca)).

The ethical components of this research study have been reviewed by the University Research Ethics Board of the Department. If you have questions about how this study is being conducted and wish to speak to someone not directly involved in the study, you may contact the Chair of the University Ethics Board (UREB) c/o MSVU Research Office, at (902) 457-6350 or via e-mail at [research@msvu.ca](mailto:research@msvu.ca)

## Appendix E

### The Spielberger State-Trait Anxiety Inventory 6-item

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the most appropriate number below the statement to indicate how **you feel right now, at this moment**. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1. I feel calm.

1	2	3	4
<i>Not at all</i>	<i>Somewhat</i>	<i>Moderately</i>	<i>Very much</i>

2. I am tense.

1	2	3	4
<i>Not at all</i>	<i>Somewhat</i>	<i>Moderately</i>	<i>Very much</i>

3. I feel upset.

1	2	3	4
<i>Not at all</i>	<i>Somewhat</i>	<i>Moderately</i>	<i>Very much</i>

4. I am relaxed.

1	2	3	4
<i>Not at all</i>	<i>Somewhat</i>	<i>Moderately</i>	<i>Very much</i>

5. I feel content.

1	2	3	4
<i>Not at all</i>	<i>Somewhat</i>	<i>Moderately</i>	<i>Very much</i>

6. I am worried.

1	2	3	4
<i>Not at all</i>	<i>Somewhat</i>	<i>Moderately</i>	<i>Very much</i>

## Appendix F

### The Flow State Scale

Please answer the following questions in relation to your experience playing the computer game you have just completed. These questions relate to the thoughts and feelings you may have experienced during the game. There are no right or wrong answers. Think about how you felt during the game and answer the questions using the rating scale below. Circle the number the best matches your experience from the options below each question.

1. I was challenged, but I believed my skills would allow me to meet the challenge.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

2. I made the correct movements without thinking about trying to do so.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

3. I knew clearly what I wanted to do.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

4. It was really clear to me that I was doing well.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

5. My attention was focused entirely on what I was doing.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

6. I felt in total control of what I was doing.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

7. I was not concerned with what others may have been thinking of me.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

8. Time seemed to alter (either slowed down or speeded up).

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

9. I really enjoyed the experience.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

10. My abilities matched the high challenge of the situation.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

11. Things just seemed to be happening automatically.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

12. I had a strong sense of what I wanted to do.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

13. I was aware of how well I was performing.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

14. It was no effort to keep my mind on what was happening.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

15. I felt like I could control what I was doing.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

16. I was not worried about my performance during the event.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

17. The way time passed seemed to be different from normal.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

18. I loved the feeling of that performance and want to capture it again.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

19. I felt I was competent enough to meet the high demands of the situation.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

20. I performed automatically.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

21. I knew what I wanted to achieve.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

22. I had a good idea while I was performing about how well I was doing.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

23. I had total concentration.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

24. I had a feeling of total control.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

25. I was not concerned with how I was presenting myself.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

26. It felt like time stopped while I was performing.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

27. The experience left me feeling great.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

28. The challenge and my skills were at an equally high level.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

29. I did things spontaneously and automatically without having to think.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

30. My goals were clearly defined.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

31. I could tell by the way I was performing how well I was doing.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

32. I was completely focused on the task at hand.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

33. I felt in total control of my body.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

34. I was not worried about what others may have been thinking of me.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

35. At times, it almost seemed like things were happening in slow motion.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

36. I found the experience extremely rewarding.

1	2	3	4	5
<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neither agree Nor disagree</i>	<i>Agree</i>	<i>Strongly agree</i>

## Appendix G

### The Metacognitions Questionnaire-30

This questionnaire is concerned with beliefs people have about their thinking on a daily basis. Listed below are a number of beliefs that people have expressed. Please read each item and circle a number to indicate how much you generally agree with it. There are no right or wrong answers.

1. Worrying helps me to avoid problems in the future.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

2. My worrying is dangerous for me.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

3. I think a lot about my thoughts.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

4. I could make myself sick with worrying.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

5. I am aware of the way my mind works when I am thinking through a problem.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

6. If I did not control a worrying thought, and then it happened, it would be my fault.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

7. I need to worry in order to remain organized.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

8. I have little confidence in my memory for words and names.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

9. My worrying thoughts persist, no matter how I try to stop them.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

10. Worrying helps me to get things sorted out in my mind.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

11. I cannot ignore my worrying thoughts.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

12. I monitor my thoughts.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

13. I should be in control of my thoughts all of the time.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

14. My memory can mislead me at times.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

15. My worrying could make me go mad.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

16. I am constantly aware of my thinking.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

17. I have a poor memory.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

18. I pay close attention to the way my mind works.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

19. Worrying helps me cope.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

20. Not being able to control my thoughts is a sign of weakness.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

21. When I start worrying, I cannot stop.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

22. I will be punished for not controlling certain thoughts.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

23. Worrying helps me to solve problems.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

24. I have little confidence in my memory for places.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

25. It is bad to think certain thoughts.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

26. I do not trust my memory.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

27. If I could not control my thoughts, I would not be able to function.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

28. I need to worry, in order to work well.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

29. I have little confidence in my memory for actions.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>

30. I constantly examine my thoughts.

1	2	3	4
<i>Do not agree</i>	<i>Agree slightly</i>	<i>Agree moderately</i>	<i>Agree very much</i>