An Investigation of Flow in Mind Wandering

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Abstract

Flow, a state of optimal engagement, has been studied almost exclusively in the context of performing external tasks (e.g., sports). However, it is conceivable that flow experiences might arise from engagement with internal thoughts as well. In the present study, we explored episodes of mind wandering that have flow characteristics. In particular, we investigated whether those who deliberately mind-wander with greater frequency experience flow while mind-wandering more frequently that those who find themselves mind-wandering spontaneously. To investigate this question 185 participants completed 3 self-report scales: Deliberate mind-wandering, spontaneous mind-wandering, and the newly developed flow in mind-wandering scales, which was demonstrated to have good psychometric properties. We found that flow during mind wandering was positively correlated with deliberate but not spontaneous mind-wandering. One theory explaining this finding is that people who experience flow during mind wandering may seek to deliberately mind wander more often.

Introduction

In the last 30 years, the concept of "flow" – a state in which one is optimally engaged - has been studied in many contexts, from sports (Jackson & Csikszentmihalyi, 1999), to music (Bakker, 2005; Fritz & Avsec, 2007), and even video games (Cowley et al., 2008; Seger & Potts, 2012). In nearly all cases, flow has been studied in in the context of performance in external tasks (i.e. when external stimuli drive the flow experience; Csikszentmihalyi, 1999). The goal of this project is to extend the concept of flow to an internal context; it is conceivable that engagement with internal thoughts may cause one to experience flow as well. In particular, we investigate whether there is a relation between the experience of internal flow and the common experience of mind-wandering. In what follows, we 1) briefly review the current literature on the "flow" state, 2) briefly review the current literature on mind wandering, and then 3) present the details of the present study.

Flow

In the late 70's, while trying to define the experience of someone *being in the zone,* Csikszentmihalyi coined the term "flow". In his early work, Csikszentmihalyi (1988) construed flow as an optimal experience of feeling engaged in the activity being done and he proposed that the self would intrinsically try to reproduce the feeling of flow (Csikszentmihalyi, 1988). Over the years, Csikszentmihalyi studied artists, musicians, athletes and many others who could typically be described as being passionate about their work (Nakamura & Csikszentmihalyi, 2002). During his studies he observed that there were times when no matter the activity that was carried out, people experienced a type of intense focus and directed attention. Based on participant self-reports collected after flow experiences, Csikszentmihalyi noted that many flow experiences had several similar characteristics. For instance, participants often described the

flow experience as *pleasant*, despite at times outwardly appearing to struggle and work hard at a task. Participants also often found flow experiences *intrinsically rewarding*. In fact, they sometimes engaged in the activities for no other reason than to pursue the flow experience. Finally, participants often described being fully present in the moment while in flow and that they didn't think about anything other than the task-at-hand (Csikszentmihalyi, 1988).

As more data accumulated the list of flow characteristics has grown and a more complete list was offered by Nakamura and Csikszentmihalyi (2002). According to Nakamura and Csikszentmihalyi (2002) common characteristics of flow include:

1) Intense concentration on the task at hand

2) A merging of action and awareness

3) Little or no self consciousness

4) A perception that skills meet all challenges and vice versa

5) A feeling that time passes more quickly than normal

6) Engagement in the activity is its own reward

7) A feeling of being in control

Examples of these characteristics can be found in interviews and questionnaires about the flow experience administered across many groups of people from elite athletes (Jackson, 1995; Jackson 1996) to prominent poets and novelists (Perry 1996; Perry, 1999) to even students (Clarke & Haworth, 1994). For example, Jackson (1996) interviewed elite rugby players about their flow experiences and found that intense concentration was central to their feeling of what flow was. When describing a match during which the player felt particularly in flow, they

described it as “80 whole minutes of uninterrupted concentration”. They didn’t remember anything else – not the fans, not the announcers but they knew every detail about what happened in the game; not once was their concentration broken.

Perry (1996, 1999) interviewed notable writers about how they got into flow while writing. During the discussions, novelist Judith Freeman talked about how she would get absorbed into a story that she was writing, demonstrating a merging of action and awareness and a loss of self-consciousness:

> “You start walking into the story first in a kind of pedestrian way, a very conscious way, in which you’re aware of sitting there rereading what you’ve written . . . And then it really is as though you’re starting to enter a landscape . . . I see myself beginning to descend into a much more timeless, realm”

A world-class cyclist described a similar sensation of merging with his bike when he entered the flow experience during an interview with Jackson (1996), saying that it felt like “he and the bike were one piece of machinery”. He also said that he felt like he was born with the bike and that it was so natural to move on it; there was no distinction between where his body ended and where the bicycle began.

In another interview with Olympic rowers, Jackson (1995) asked about motivation and enjoyment with respect to the flow state. One rower commented that the feeling of flow was so enjoyable it kept him going through the other moments. He talked about how while rowing, each stroke of the oars was different and that there are occasionally a series of bad rows. During these times he would rely on the fact that he would eventually find his stride and be in flow again and that knowing that the flow state existed motivated him when he felt he was performing poorly.

While in a state of flow, there are some universal similarities in the experience, such that an athlete, a chef, and a surgeon will all feel as if their attention is fully concentrated on their task. While their experience of flow may manifest in the same way *during* a flow experience, there could nonetheless be differences in how often they have flow experiences. Indeed, previous research has indicated that individual differences in the propensity to experience flow are reliably related to individual differences in the big five personality inventory (Ullen et al, 2012), such that those who are more neurotic are less likely to experience flow, while those higher in conscientious experience flow more often.

In reviewing the flow literature, Nakamura and Csikszentmihalyi (2002) state, "A given individual can find flow in almost any activity… It is the subjective challenges and subjective skills, not objective ones, that influence the quality of a person's experience." Nonetheless, the activities in which flow has been studied share a common theme, namely that these activities are external in nature. In contrast, there has been relatively little research investigating flow when attention is directed inwards onto one's thoughts. Given that many different external experiences can produce flow, it is conceivable that internal experiences can also produce flow states in an individual. One type of internal experience during which flow might occur is everyday mind-wandering.

Mind Wandering

Mind Wandering is a phenomenon common and familiar to us all. According to Smallwood and Schooler (2006) mind wandering is a sifting of attention away from a primary task towards internal information. Most of us have had the experience of losing ourselves in our thoughts when considering an interesting problem and finding ourselves in a deep state of intense concentration, sometimes to the detriments of some external task that we are supposed to be

engaged in at the time. It is also possible to even lose awareness that one is mind wandering (Smallwood & Schooler, 2007). Smallwood and Schooler suggest that mind wandering can be a goal driven process - just towards internal concerns and not towards a primary task (Smallwood & Schooler, 2006, p. 955). In addition, mind wandering can certainly be enjoyable; people may enjoy doing it because it feels rewarding. Interestingly, such intense concentration, loss of self-awareness, goal directed focus and rewarding sensations are considered to be key characteristics of flow. The similarities between flow characteristics and the experience of mind wandering have led to the current study of flow in mind wandering. However, to date, there is no direct measure of flow during a mind wandering episode.

There are several key ways that peoples' mind wandering is assessed in studies of mind wandering. To measure state levels of mind wandering, experience-sampling methods are commonly employed (Kahneman et al., 2004; Smallwood & Schooler, 2006). These methods typically involve intermittently asking (i.e., probing) people whether they were on task or mind wandering just before the probe was presented. In addition, researchers have developed self-report scales to measure peoples' trait-level tendencies to mind wander, such as the Mind Wandering Spontaneous (MW-S) scale and the Mind Wandering Deliberate (MW-D) scale, which measure unintentional and intentional mind wandering, respectively (Carriere et al., 2013). We propose to use a similar self-report scale as a direct measure of individual differences of flow experiences during mind wandering episodes.

The Present Study

The primary goals of the present study were to (1) develop an individual difference measure of flow during mind wandering and then (2) to examine whether there is a relation

between people's propensities to experience flow during mind wandering and the extent to which they mind wandering spontaneously or deliberately.

With regard to the first goal, we formulated six questions to capture the experience of flow while mind-wandering via introspection, following a review of the flow literature. These questions are presented in Appendix A and form the Flow in Mind Wandering (FIM) scale. An important feature of these questions is that they have been designed to primarily tap the flow facet of intense concentration. While there are many facets to the flow experience, we believe that a good scale of internal flow should primarily tap this facet alone. One reason for this becomes obvious upon examining the way in which previous scales of flow were developed, that is, from interviews with athletes engaged in sports—an external flow activity (Jackson et al, 1997). Some of these facets derived from external activities may not apply when experiencing flow during mind-wandering. Consider the facet of action and awareness merging. This facet comes from athletes describing their movements during sport, where for example they feel as if a baseball bat or golf club has become an extension of their arm because of how natural it feels to use during the game. When flow is taking place during mind-wandering—an internal activity—this facet may no longer occur, given the lack of action for awareness to merge with. Furthermore, in their seminal review of flow, Nakamura and Csikszentmilhalyi (2002) note that the feeling of intense focus may be the defining characteristic of the flow experience, particularly when it feels as though one's attention is fully, and effortlessly, engaged (Csikszenmilhalyi & Nakamura, 2010). For these reasons, the questions on our scale have focused on deep, effortless, concentration, the facet that perhaps best encapsulates the flow experience, and translates across both internal and external flow activities.

With regard to the second goal, we conducted a large survey study in which participant completed the FIM as well as the Mind Wandering-Deliberate (MW-D) and Mind Wandering-Spontaneous (MW-S) scales. We hypothesised that the degree to which people differ in the way they mind-wander may be meaningfully related to the frequency with which they find themselves experiencing flow while engaged with their internal thoughts. It may be the case that those who experience flow while mind-wandering also mind-wander at higher rates in general, in which case we would expect a positive relation between flow and both spontaneous and deliberate mind-wandering. Another possibility is that flow while mind-wandering depends on the type of mind-wandering one has engaged in. Specifically, it seems reasonable to postulate that flow is experienced more frequently when people choose to engage in mind-wandering, rather than when their thoughts drift away spontaneously. If this is the case, we would expect to see a stronger relationship between deliberate mind-wandering and flow experience than between flow and spontaneous mind-wandering.

Methods

Participants

Participants were 203 undergraduate students from the University of Waterloo who completed the study questionnaires for partial course credit. Participants were excluded from the analyses if they had missing responses for any of the questionnaires. In addition, participants who took less than 2.5 minutes in total to complete all of the questionnaires were excluded from the analysis due to a possible lack of reasonable consideration of the scale items when generating their response. The missing response and timing restrictions reduced the sample size by 18 participants, to 185.

Measures

The questionnaires included in the study were the Mind Wandering Deliberate (MW-D) scale, the Mind Wandering Spontaneous (MW-S) scale and the Flow in Mind Wandering (FIM) scale. Several other measures assessing attentional ability were also included (see section Other Measures section below) but these were for exploratory purposes only. All of the questionnaires used in the current study are seven-point Likert scales, and we created a composite score for each scale by averaging the individual items on each scale. Each of these measures is described below.

The MW-D and MW-S: The MW-D and MW-S scales (Carriere et al., 2013) are four item measures of deliberate mind wandering tendencies and spontaneous mind wandering tendencies respectively. For both scales, participants are provided the simple instruction, "For each of the following statements, please select the response that most accurately reflects your everyday experiences." Items are scored on a 7-point Likert scale ranging from never (1) to always (7). Higher valued responses reflect greater tendencies to engage in deliberate and spontaneous mind wandering, respectively. During initial development, these scales showed good psychometric properties and internal consistency in a large sample (N=244, Alpha = 0.902, 0.875 for MW-D and MW-S respectively; Carriere et al., 2013). In addition, the scales demonstrated construct validity when analyzed alongside the Attentional Control Scale (Derryberry and Reed, 2002) and the Spontaneous Activity Questionnaire (Carriere et al., 2013).

The FIM: The Flow in Mind Wandering scale was developed for this study. It is a six-item measure assessing flow experiences during mind wandering episodes. In the Flow in Mind Wandering scale, items are scored on a 7-point Likert scale ranging from almost never (1) to always (7) with higher scores reflecting a higher proportion of flow experiences while mind

wandering. Participants were provided the instruction, “Please indicate how often you experience the following while in an episode of mind wandering". The specific items included in the scale are shown in Appendix A. As can be seen from the items, the scale focuses on what is thought to be the core of the flow experience, which is the experience of deep, effortless concentration (Csikszenmilhalyi & Nakamura, 2010).

Other Measures: In addition to questionnaires for the present study, measures of attentional errors like the Attention-Related Cognitive Errors Scale (ARCES) and the Mindful Attention Awareness Scale -Lapses Only (MAAS-LO), internal and external flow, and cellphone usage (CU) were added to the survey for exploratory analysis. These questionnaires always appeared after the FIM, MW-S and MW-D scales to prevent any effect they would have on the present study. These additional measures were not considered to be part of the thesis project and so were not analyzed.

Procedure

The questionnaires were administered in the form of an online survey. Upon signing up for the study, participants received a link to complete the survey. Participants were first presented with information about the study and a consent form. Once consent was given, the participant advanced to the first questionnaire. Participants were presented the Flow in Mind Wandering (FIM) scale, the Mind Wandering Deliberate (MW-D) scale and the Mind Wandering Spontaneous (MW-S) scale. To avoid ordering effects, both the questionnaires and the items within the questionnaires were presented in a random order. Each questionnaire was presented on its own page. Participants’ responses were being timed but the participants did not know this. Upon completion of the survey, participants were debriefed on the nature of the study and given the opportunity to follow up with any questions via e-mail.

Results

The Psychometric Properties of the FIM

Overall, the Flow in Mind Wandering scale has good psychometric and distributional properties. The mean score of the measure, averaged across participants, was roughly in the middle of the scale (mean = 4.37) and the standard deviation of the responses was reasonable (SD = 1.02). There skewness (0.19) and kurtosis (-0.28) not deviating significantly from normality. Critically, the internal consistency was quite good (Cronbach's alpha = 0.86) and above the recommended cut-off (alpha = 0.80) for reasonable alpha values (Cortina, 1993).

Table 1 shows the item total correlations and the corrected item total correlations for the FIM. As can be seen in the table, each item showed a reasonably strong positive correlation with the total scale. Taken together, these results show that the FIM is a reliable and well-structured scale.

Table 1
Psychometric Properties of the Flow in Mind Wandering (FIM) Scale (N = 185)

Items	Means	SD	Item Total Correlations	Corrected Item Total Correlations
FIM1	0.34*	0.09	0.70	0.60
FIM2	0.21*	-0.03	0.82	0.74
FIM3	0.15	-0.18*	0.74	0.64
FIM4	0.16	-0.15*	0.84	0.77
FIM5	0.30*	0.14	0.73	0.62
FIM6	0.31*	0.14	0.76	0.67

The Relations Among FIM, MW-S and MW-D

Having established the reliability of the FIM, we next examined the relations between the FIM and the MW-S and the MW-D. The Pearson correlations among the measures are shown in Table 2. As can be seen in the table, there was modest but significant relation between the MW-S and the MW-D, replicating previous demonstrations (Carriere et al., 2013). Critically, however, the table shows that the FIM was positively correlated with the MW-D but showed virtually no association with the MW-S. These results suggest that flow during mind wandering is associated with deliberate mind wandering but not spontaneous mind wandering.

Table 2
Pearson Product-Moment Correlations of All Measures (N = 185)

	FIM	MW-S	MW-D
FIM		0.01	0.32**
MW-S			0.35**
MW-D			

** represents significance at $p<0.01$

A multiple regression analysis was done to evaluate the unique contributions of MW-S and MW-D when predicting FIM. As shown in Table 3, MW-D offered a unique contribution to FIM but MW-S did not.

Table 3
Regression Testing for Unique Contributions to Flow in Mind Wandering (FIM) by Spontaneous and Deliberate Mind Wandering (MW-S, MW-D) (N = 185)

Dependent Variable: FIM	β	*t*	*P*
MW-S	-0.10	-1.624	0.11
MW-D	0.31	4.84	0.00

Final Model: $R = 0.34$, $F\ (2, 182) = 11.72$ $p < 0.001$

A likelihood ratio test was done to test the hypothesis that the contributions from MW-S and MW-D to FIM are equal, i.e. $\beta_{MWS} = \beta_{MWD}$. The models used for this analysis are shown in Figure 1. Under the constraint of the null hypothesis, the model fit was significantly different from the unconstrained (perfect) model fit ($\chi^2\ (5) = 15.204$, $p<0.01$). In other words, the model fit is significantly reduced if the zero order correlations of the mind wandering scales with the FIM are set to be equal (if $\beta_{MWS} = \beta_{MWD}$). Thus, the null hypothesis was rejected.

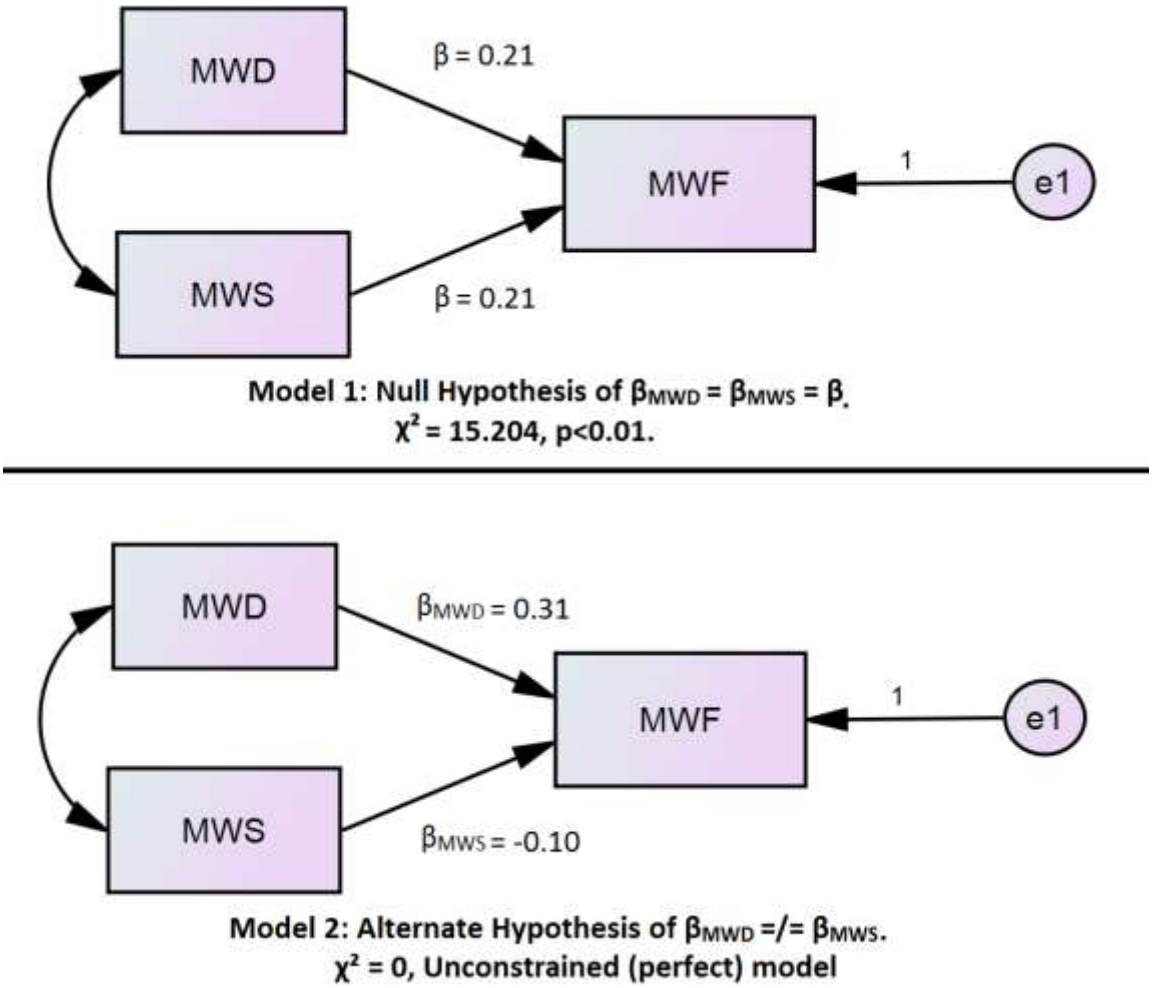

Figure 1: Likelihood ratio test of the hypothesis $\beta_{MWS} = \beta_{MWD}$

An additional exploratory analysis was done. If the FIM is internally consistent then each of its items should behave similarly. That is, if the FIM is correlated with the MW-D and not with the MW-S, each of its items should behave as such as well since it is internally consistent. We test these assumptions with an exploratory analysis of internal consistency: the FIM scale was broken into its individual items, which were analyzed for correlations with the MW-S and MW-D. This was meant to look deeper into both FIM's internal consistency and its relationship to MW-S and MW-D. The individual item Pearson product-moment correlation coefficients are presented in Table 4.

Table 4
Pearson Product-Moment Correlations between Individual Items of the FIM and the MW-D and MW-S scales (N = 185)

Correlations	MW-D	MW-S
FIM1	0.34*	0.09
FIM2	0.21*	-0.03
FIM3	0.15	-0.18*
FIM4	0.16	-0.15*
FIM5	0.30*	0.14
FIM6	0.31*	0.14

* represents significance at $p<0.05$

All of the items on the FIM were significantly positively correlated to the MWD with small – medium coefficients except for FIM3 and 4. All of the items except for FIM3 and FIM4 were not correlated with the MW-S. It's interesting to note that while items 3 and 4 were not significantly correlated with MW-D, they were negatively correlated with MW-S.

General Discussion

The present study is one of the first studies to investigate flow in an internal context. In this study we developed a new scale, the Flow in Mind Wandering scale and tested its psychometric and distributional properties. We found that it had satisfactory properties and good internal consistency. We also found that the FIM scale was correlated with the deliberate mind wandering (MW-D) scale but not with the spontaneous mind wandering (MW-S) scale. In a regression analysis it was found that MW-D significantly predicted FIM but MW-S did not. A likelihood ratio test established evidence against the hypothesis that the regression coefficients of MW-S and MW-D were equal. These results demonstrate that flow during mind wandering is associated with deliberate mind-wandering but not spontaneous mind-wandering.

While we expected that flow during mind wandering would be more strongly correlated with the deliberate mind wandering than spontaneous mind wandering, it was still surprising to see the non-relationship between spontaneous mind wandering and flow. Previous studies (Carriere et al., 2013) have found that spontaneous and deliberate mind wandering were moderately correlated (rho = 0.50). This correlation was thought to be due to both types of mind wandering still sharing many common features (namely they are both still types of the construct mind wandering). With this in mind, finding that FIM is significantly correlated with MW-D but not MW-S is an unexpected result.

We suggest that the correlation between FIM and MW-D has to do with people's intentional pursuit of flow experiences, whereby people who experience more flow in mind wandering are more likely to deliberately mind wander in pursuit of the flow experience. One important implication of this relationship is that it is a potential answer to the question "Why do people mind wander?" – it may be because people are deliberately pursuing flow experiences. The fact that the FIM is not correlated with the MW-S suggests that mind wandering flow is not associated with a failure of control over attention.

Limitations of the study

There are several notable limitations to the present study. First, while we have presented evidence that the FIM scale is internally consistent, it is still important to establish construct validity. This could be done by examining the relation between the FIM and other measures of flow. Second, while the scale showed a reasonable Cronbach's alpha (reliability), we did find that FIM items 3 and 4 behaved differently from the other items. There do not appear to be any differences from wording or surface characteristics (see Appendix A for the wording of the items) so it would be interesting to see what is driving the differences between these items and

the rest. Third, it is important to note that this study was a correlational one so we are unable to make the strong claim that flow during mind wandering is causing deliberate mind wandering. Additional experimental follow up studies are needed to establish the directionality of this relationship.

Finally, one concern that crops up when using any self-report scale is that there may be social desirability biases influencing people's responses. Canonically, mind wandering is often seen with negative connotations (Killingsworth & Gilbert, 2010; Smallwood et al., 2007) and so people may be prone to underreport their propensity to mind wandering in the MW-S and MW-D. In addition, the questions in the FIM portrayed flow experiences positively, using terms like "thinking clearly" or "getting into the zone". As such, the responses on the FIM scale may be over representative of actual flow experiences while mind wandering. At present we assume that these potential biases would only add noise to the measurements.

Directions for future research

The finding that the FIM is an internally consistent scale is an important step in establishing that it is a useful scale. Given the lack of tools available for measuring internal flow states, the FIM scale will be a useful tool in future explorations. For instance, the FIM could be used to assess how flow during mind wandering relates to a person's creativity, since increased levels of mind wandering have been associated with increased creativity (Baird, Smallwood, Mrazek, Kam, Franklin & Schooler, 2012). In addition, it would be interesting to explore how flow during mind wandering as assessed by the FIM relates to learning, especially since mind wandering during live lectures seems to be mostly of the deliberate kind (Wammes, Boucher, Seli, Cheyne & Smilek, 2016).

It would also be interesting to evaluate how the FIM relates to people's propensity to make everyday attentional errors. One prediction is that FIM should have a positive correlation with measures of attentional errors since the more engaged you are in mind wandering, the more errors you are likely to make in your primary task. If this prediction is confirmed, it would reveal a potentially negative side to flow during mind wandering.

There are potential experimental designs for establishing that flow in mind wandering leads to deliberate mind wandering. Nakamura and Csikszentmihalyi (2002) provided several conditions that were critical for entering flow: A skill-challenge balance, immediate feedback and clear goals. One could potentially direct a group of participants to mind wander in such a way that incorporates these conditions so that they are likely to enter flow while a control group is directed to mind wander about a topic of their choice. Some time later, the participant's propensity to deliberately and spontaneously mind wander could be measured and analyzed for differences.

Other directions for future research include looking into the relationship between age and the FIM. The current literature has found that mind wandering – specifically Task Unrelated Thoughts (TUTs) are reduced with age (McVay et al., 2013; Jackson & Baltoa 2012). It is of interest to determine whether flow during mind wandering is constant or if it increases; perhaps as we get older we tune mind wanderings to include more flow experiences. Another area of interest may be whether boredom measures are related to the FIM. It is plausible that those who experience flow in mind wandering use mind wandering as a way of escaping boredom. Finally, it is interesting to explore the link between creativity and flow in mind wandering. Perry (1999) mentions as part of the creative process, that writers need to get lost in their works. It may be that

by entering flow while writing one is able to be more creative and insightful and it would be interesting to see if this effect exists while mind wandering.

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(*Appendices follow*)

Appendix A

Flow in Mind Wandering (FIM) Scale

Item
1 – My thoughts just seem to flow naturally.
2 – I experience deep, effortless concentration.
3 – I think clearly, at a comfortable speed, and without effort.
4 – Sustaining my train of thought is easy, even effortless.
5 – I concentrate so deeply that my thoughts seem to happen automatically.
6 – I get into the zone and my thoughts seem to direct themselves effortlessly.

Instructions: Think of the times in your life that you have mind-wandered. During these times, how often did you experience each of the following

Mind Wandering: Deliberate and Mind Wandering: Spontaneous (MW-D, MW-S) Scales

Item
Deliberate
1 – I allow my thoughts to wander on purpose.
2 – I enjoy mind-wandering.
3 – I find mind-wandering is a good way to cope with boredom.
4 – I allow myself to get absorbed in pleasant fantasy.
Spontaneous
1 – I find my thoughts wandering spontaneously.
2 – When I mind-wander my thoughts tend to be pulled from topic to topic.
3 – It feels like I don't have control over when my mind wanders.
4 – I mind wander even when I'm supposed to be doing something else.

Instructions: For the following statements please select the answer that most accurately reflects your everyday mind wandering.