Processing Fluency Affects Behavior More Strongly among People Higher in Trait Mindfulness

Leigh Ann Vaughn
Ithaca College, lvaughn@ithaca.edu

Abigail Seo-Youn Dubovi

N. Paul Niño

Follow this and additional works at: http://digitalcommons.ithaca.edu/psych_fac_pubs

Part of the Personality and Social Contexts Commons, and the Social Psychology Commons

Recommended Citation
http://digitalcommons.ithaca.edu/psych_fac_pubs/6

This Article is brought to you for free and open access by the Psychology Department at Digital Commons @ IC. It has been accepted for inclusion in Psychology Department Faculty Publications and Presentations by an authorized administrator of Digital Commons @ IC.
Processing Fluency Affects Behavior more Strongly Among People Higher in Trait Mindfulness

Leigh Ann Vaughn, Abigail Seo-Youn Dubovi, and N. Paul Niño

Ithaca College

Author Note

Leigh Ann Vaughn, Abigail Seo-Youn Dubovi, and N. Paul Niño, Department of Psychology, Ithaca College, United States.

Abigail Dubovi is now at the Department of Education and Counseling Psychology, Albany University, United States. N. Paul Niño is now at the Department of School Psychology, Alfred University, United States.

Correspondence concerning this article should be addressed to Leigh Ann Vaughn, Department of Psychology, 1119 Williams Hall, Ithaca College, Ithaca, NY, 14850-7290. E-mail: lvaughn@ithaca.edu. Phone: (607) 274-7353. Fax: (607) 274-5112.

Reference:
Abstract
Processing fluency is the ease of processing information about a stimulus, which people can attribute to the experience of enjoyment. Despite consistent findings that processing fluency can affect self-reported judgments, little research has examined whether processing fluency or its interactions with personality traits can affect behavior. The current studies demonstrate that processing fluency is more likely to affect behavior among people higher in trait mindfulness. We manipulated processing fluency with rhyming versus nonrhyming maxims in Study 1 and with regulatory fit versus nonfit in Study 2. Participants higher in mindfulness showed a stronger positive effect for processing fluency on the dependent variable: the number of ideas they listed in a task they continued for as long as they enjoyed it.

*Keywords*: mindfulness; Mindful attention awareness scale; processing fluency; regulatory focus; regulatory fit; promotion; prevention; behavior
Processing Fluency Affects Behavior more Strongly Among People Higher in Trait Mindfulness

1. Introduction

The ease of processing information about a stimulus is known as processing fluency (e.g., Alter & Openheimer, 2009). Processing fluency has been the topic of an enormous amount of research (for reviews, see Alter & Oppenheimer, 2009; Greifeneder, Bless & Pham, 2011; Schwarz & Clore, 2007; Winkielman, Schwarz, Fazendeiro & Reber, 2003). However, although a great deal of research shows that manipulations of processing fluency can affect a wide variety of evaluative judgments such as enjoyment, liking, and value (e.g., Alter & Oppenheimer, 2009; Schwarz & Clore, 2007; Vaughn, Childs, Niño & Ellsworth, 2010; Winkielman et al., 2003), little research has explicitly addressed how manipulations of processing fluency affect behavior – that is, observable action such as task persistence (though see Vaughn, Malik, Schwartz, Petkova & Trudeau, 2006). Furthermore, no currently-published research has addressed whether personality traits moderate the impacts of processing fluency on behavior. The current research addresses these issues by examining how trait mindfulness interacts with processing fluency to affect behavior: specifically, the number of words people list in thought-generation activities.

1.1 Mindfulness

Mindfulness as a quality of consciousness is an open, prereflexive state in which people are aware of current internal and external events (e.g., Brown & Ryan, 2003). Most conceptions of mindfulness in Western research and clinical interventions have roots in Buddhism and other spiritual traditions (for reviews, see Baer, Smith, Hopkins, Kriemeyer & Toney, 2006; Brown, Ryan & Cresswell, 2007; Kabat-Zinn, 1990; Keng, Smoski & Robins, 2011). The scientific study of mindfulness is a relatively recent phenomenon, with most research having occurred since the 1970s. Reflecting its relatively recent addition to the personality literature (Anicha,
Ode, Moeller & Robinson, 2011), current approaches operationalize trait mindfulness in various ways, yet all construe it as being defined by sustained attention to the current moment (e.g., Mrazek, Smallwood & Schooler, 2012). We focused our investigation on trait mindfulness as it is operationalized by the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003), the most widely-used measure of trait mindfulness (e.g., Brown, West, Loverich & Biegel, 2011; Mrazek et al., 2012). This scale measures individual differences in the capacity for sustained, open attention to present experience and events.

People higher in trait mindfulness as measured by the MAAS appear to be more aware of their internal states, even when these states are subtle (Brown & Ryan, 2003; O’Loughlin & Zuckerman, 2008). For example, Brown and Ryan (2003) found that individuals higher in mindfulness showed a stronger concordance between their implicit affect (as measured by the implicit associations task; Greenwald, McGhee & Schwartz, 1998) and their explicit, self-reported affect. Additionally, O’Loughlin and Zuckerman (2008) found that individuals higher in trait mindfulness showed a stronger concordance between a physiological marker of health and immune functioning (dehydroepiandrosterone; DHEA) and self-reported physical health. These findings suggest that people higher in trait mindfulness could be more sensitive to variations in a variety of internal states, including processing fluency.

1.2 Processing Fluency

The fluency or ease of processing information about a stimulus can affect judgments through a feelings-as-information process (for a review, see Schwarz & Clore, 2007). Research shows that the subjective ease of processing information elicits a positive affective response (Winkielman & Cacioppo, 2001; for a review, see Winkielman et al., 2003). People often attribute this affective response to other psychological dimensions, such as liking, truth,
confidence, or frequency (for a review, see Alter & Oppenheimer, 2009) or their enjoyment of an activity (e.g., Vaughn, Malik, et al., 2006). For example, when doing a word-listing activity, someone might wonder, “Am I still enjoying this?” If this person’s feelings at the time suggest enjoyment, she or he is likely to continue the activity more than if his or her feelings suggest a lack of enjoyment (e.g., Martin, Ward, Achee & Wyer, 1993; Vaughn, Malik, et al., 2006).

Feelings can serve as information for many targets of judgment, even a target encountered after an event that caused the feelings. This is because “we have only one window on our experience, [which makes it] difficult to distinguish integral feelings, elicited by the target, from incidental feelings that happen to be present at the time” (Schwarz & Clore, 2007, p. 386; for additional reviews, see Clore, 1992; Greifeneder et al., 2011). Confusion about the source of feelings means that people can attribute an incidental feeling, like processing fluency, to a subsequent target (e.g., Shen, Jiang & Adaval, 2011). Research suggests that the feeling of processing fluency can affect behavior in a task subsequent to the eliciting event - what we call a carry-over effect. It can also affect behavior in the task that caused the feeling of processing fluency – what we call a task-integral effect. In the current research, we show that mindfulness can interact with processing fluency to have carry-over and task-integral effects on behavior in listing activities.

1.3 Summary and Rationale for the Present Research

Despite consistent findings that processing fluency can affect judgments, relatively little research has examined whether processing fluency can affect behavior (e.g., Vaughn, Malik, et al., 2006). Additionally, no prior research has examined interactive effects of personality traits and processing fluency on behavior. The current studies are initial steps in addressing these shortcomings of the research literature.¹ Two studies tested the hypothesis that processing
fluency affects behavior more strongly among people higher in trait mindfulness. We expected people higher in mindfulness to show a stronger positive effect of processing fluency on the number of ideas they listed in thought-generation tasks. Study 1 created conditions of higher versus lower processing fluency with a procedure that involved reading rhyming versus nonrhyming maxims. Then it measured the number of words generated in a subsequent listing task. Thus, Study 1 examined the carry-over effect of the mindfulness and processing fluency interaction on behavior incidental to the processing-fluency task. Study 2 created conditions of higher versus lower processing fluency with a procedure that involved experiencing regulatory fit versus regulatory nonfit (e.g., Vaughn, 2010; Vaughn, Childs, et al., 2010). Additionally, it measured the number of foods listed as part of the regulatory-fit manipulation. Thus, Study 2 examined the interactive effect of mindfulness and processing fluency on behavior integral to the processing-fluency task. Both studies used manipulations of processing fluency that we expected would be subtle enough to affect mainly the participants higher in mindfulness. That said, we also expected a main effect for processing fluency on participants’ behavior in each study.

2. Study 1

To begin this investigation, we varied processing fluency in an initial task and measured its carry-over effect on behavior in a subsequent task. We adapted our manipulation of processing fluency from research by McGlone and Tofighbakhsh (2000). These researchers used a within-subjects design in which participants rated the accuracy of both rhyming and nonrhyming versions of the same maxims. Rhyming maxims feel easier to process. McGlone and Tofighbakhsh’s (2000) dependent variable was the judged accuracy of the maxims. In contrast, we used a between-subjects design in which participants did an initial task in which
they rated the accuracy of either rhyming or nonrhyming versions of the same maxims and a subsequent task in which they generated words from the letters of longer words for as long as they enjoyed it. Our dependent variable was the number of words listed.

We expected that participants would list more words in the high-fluency condition. Additionally, we expected that mindfulness would interact with processing fluency, such that the positive effect of processing fluency on the number of words listed would be stronger among participants higher in mindfulness.

2.1 Method

2.1.1 Participants and Design

One hundred thirty-nine undergraduate students at our institution participated in the online study for extra credit in their psychology courses. They were enrolled in courses ranging from Introduction to Psychology to Senior Seminar in Psychology. We removed five participants’ data from analyses, three because they did not follow directions and two because they were outliers on the number of words listed (3.89 and 4.06 SDs above the mean of that variable), leaving a sample of 134 participants. In this study, 78.6% of the participants were female, 84.3% were White, 8.2% were Hispanic or Latino/a, 6.7% were Asian, 3.7% were Black or African-American, and 0.7% indicated that their ethnicity was “Other.” The ethnic composition of the sample adds up to more than 100% because participants could indicate more than one ethnicity. The average age in Study 1 was 19.09 years, $SD = 1.04$, with a range of 18 to 22 yrs.

2.1.2 Materials and Procedure

Approximately 2.5 weeks before the main study, participants completed an initial, online questionnaire that included the MAAS, along with other materials unrelated to the current study.
The MAAS is a 15-item questionnaire that measures the subjective experience of mindful attention in various contexts (e.g., “I tend not to notice feelings of physical tension or discomfort until they really grab my attention”). Participants respond on a 6-point Likert-type scale that ranges from 1 (almost always) to 6 (almost never), so that higher scores indicate greater mindfulness. Research shows that the MAAS has good psychometric properties, including 4-week test-retest reliability (Brown & Ryan, 2003). In the current study, the MAAS Cronbach’s alpha = .86, $M = 3.76$, $SD = 0.70$, and range = 1.93 to 5.67.

After participants completed this initial questionnaire, we invited them to participate in a subsequent online study, which was the main study. This online study included several ostensibly unrelated tasks. The first task contained the manipulation of processing fluency. We randomly assigned participants to read rhyming maxims in the high-fluency condition versus nonrhyming maxims of equivalent meaning in the low-fluency conditions. Examples of rhyming maxims were “Life is mostly strife” and “Variety prevents satiety,” and examples nonrhyming maxims were “Life is mostly toil” and “Variation prevents satiety.” All maxims were from McGlone and Tofighbakhsh (2000). Carefully reading these maxims was crucial for the manipulation of processing fluency. Thus, to enhance the likelihood that the participants read the maxims carefully, we also asked them to rate the accuracy of each maxim, as in the experiment by McGlone and Tofighbakhsh (2000). However, unlike McGlone and Tofighbakhsh (2000), these ratings were not the main focus of our investigation. Rather, it was how many words participants listed in the subsequent, idea-generation task.

The idea-generation task was titled, “Words That Come to Mind” and contained a brief version of the word-generation activity used by Vaughn, Malik, et al. (2006, Study 3, p. 606). Participants read the following introduction:
In this task we are interested in learning about things that come to people’s mind. Do not pay attention to what other people are doing, because they are getting different instructions from you. We would like to find out what words people generate from the letters of each of the longer words below. For example, from the letters of the word: Starboard, one could generate words like “star”, “a”, or “dart”.

Then participants read, “As you are generating words, ask yourself ‘Do I feel like continuing with this task?’ As long as the answer is ‘yes,’ continue listing. When the answer becomes ‘no,’ then stop. There is no best or worst time to stop. Stop when you feel that you no longer enjoy generating words.”

On that page, participants generated sets of shorter words from the letters of each of the following words: artichoke and archaeology. We provided a text box beside each word for this purpose. To arrive at the number of words generated, we counted both correctly and incorrectly spelled words. At the end of this questionnaire, participants answered demographic questions and read a debriefing page.

2.2 Results

There were no significant main or interactive effects involving gender in either Study 1 or Study 2. Therefore, we do not discuss this variable further.

For the main analyses in this study, we followed Aiken and West’s (1991) suggested procedure for multiple regression with interaction effects to obtain standardized coefficients, which uses the Friedrich (1982) procedure for calculating unbiased standardized solutions. Specifically, we standardized scores on the MAAS, effect-coded maxims condition (-1 = nonrhyming, 1 = rhyming), and standardized the dependent variable. To obtain the Maxims X MAAS interaction term, we multiplied the scores from the effect-coded maxims variable and the
standardized MAAS variable. In this analysis, Bs are the correct standardized solution. For ease of interpretation, we report the Bs from this procedure as Betas (βs).

Simultaneously regressing the number of words listed onto MAAS scores, maxims condition, and the interaction term revealed a significant interaction; \( \beta = .20, t = 2.37, p = .02 \). Neither main effect was significant; \( \beta < .09, t < 1.01, p > .31 \). We decomposed this interaction using simple slopes tests at \( \pm 1 SD \) from the mean of MAAS scores (Aiken & West, 1991). At \( +1 SD \) on the MAAS, there was a significant maxims effect on the number of words generated, with participants generating more words in the rhyming condition (\( \beta = .29, t = 2.39, p = .02 \)). At \( -1 SD \) on the MAAS, the maxims effect nonsignificantly reversed (\( \beta = -.12, t = -0.97, p = .34 \)). Fig. 1 displays these results at \( \pm 1 SDs \) from the mean of MAAS scores.²

2.3 Discussion

These results provide the first demonstration of the interactive effect of mindfulness and processing fluency on behavior. Specifically, only participants higher in trait mindfulness showed a significant effect for our manipulation of processing fluency on the number of words they listed in the subsequent word-generation task, which we had asked them to continue as long as they enjoyed it. If these participants had read maxims that rhymed in an initial task, they generated more words than if they had read maxims that did not rhyme. These results suggest that people higher in trait mindfulness are more attuned to the experience of processing fluency, an experience that people can attribute to enjoyment of what they are doing (e.g., Freitas & Higgins, 2002; Vaughn, Malik, et al., 2006). Additionally, these results provide support for the hypothesis that processing fluency experienced in an initial task can have carry-over effects on behavior in a subsequent task.
Unexpectedly, there was no significant main effect for our manipulation of processing fluency on participants’ word-generation behavior. In contrast to McGlone and Tofighbakhsh (2000), there also was no significant effect for processing fluency on the perceived accuracy of the maxims \( (p = .27) \); nor were there any significant main or interactive effects involving mindfulness on perceived accuracy \( (ps > .52) \). A possible reason for the absence of processing-fluency main effects in Study 1 is that this study had a between-subjects manipulation of processing fluency, in contrast to prior research that had a within-subjects manipulation of processing with these stimulus materials (McGlone & Tofighbakhsh, 2000). Thus, Study 1 did not capitalize on the experience of discrepant fluency (Laham, Alter & Goodwin, 2009), in which a current experience of processing fluency deviates from a preceding experience of processing fluency (also see Hansen, Dechêne, & Wänke, 2008; Whittlesea, 2004; Whittlesea & Williams, 1998, 2000; Willems & Van der Linden, 2006). The experience of discrepant fluency is necessary for some processing-fluency effects to occur (e.g., Hansen et al., 2008; Laham et al., 2009). McGlone and Tofighbakhsh’s (2000) within-subjects design could have helped their participants reliably notice and report differences in the perceived accuracy of the maxims. In contrast, it appears that our between-subjects design may have contributed to the lack of a main effect for the processing-fluency manipulation in Study 1.

The goal of Study 2 was to see if the results of this study would conceptually replicate with a different between-subjects manipulation of processing fluency. The between-subjects design of Study 2 was the same as earlier research that had produced significant effects without relying on discrepant fluency (Vaughn, Malik, et al., 2006). We also examined whether the results of Study 1 would conceptually replicate with behavior integral to the processing-fluency
manipulation (Vaughn, Malik, et al., 2006). Specifically, in Study 2 we varied and examined the behavioral effects of regulatory fit (e.g., Higgins, 2000).

3. Study 2

Regulatory fit occurs when one’s goal pursuit strategy sustains one’s current self-regulatory orientation (Crowe & Higgins, 1997; for reviews, see Higgins, 2000, 2005, 2006, 2009; Higgins & Spiegel, 2004). We varied fit with experimentally manipulated self-regulatory orientations of prevention versus promotion focus. According to regulatory focus theory (Higgins, 1997, 1998; for reviews see Forster & Werth, 2009; Higgins & Spiegel, 2004; Higgins & Molden, 2003; Molden, Lee & Higgins, 2007), promotion involves a focus on ideals, hopes, and aspirations, and more generally on the presence or absence of positive outcomes. Eagerness-related strategies of goal pursuit naturally fit a concern with aspirations and accomplishment and a desire not to miss anything good. A behavioral example of enacting an eager strategy is listing foods one could eat more of to attain good health (Vaughn, Malik, et al., 2006). In contrast, prevention involves a focus on oughts, duties, and obligations, and more generally the absence or presence of negative outcomes. Vigilance-related strategies of goal pursuit naturally fit a concern with responsibilities and protection and a desire to not make mistakes. A behavioral example of enacting a vigilant strategy is listing foods one could avoid in order to prevent poor health (Vaughn, Malik, et al., 2006).

It is easier to process information in a way that fits one’s current regulatory focus than in a way that does not fit (e.g., Lee & Aaker, 2004; Vaughn, 2010; Vaughn, Childs, et al., 2010). Indeed, prior research shows that many processing fluency-related outcomes are enhanced under conditions of regulatory fit compared to nonfit (for reviews of processing-fluency research, see Alter & Oppenheimer, 2009; Reber, Schwarz & Winkielman, 2004). These outcomes include
ease or fluency of processing (Lee & Aaker, 2004; Vaughn, 2010) and judgments of liking or enjoyment (Freitas & Higgins, 2002), confidence (Cesario, Grant & Higgins, 2004), pleasantness (Higgins, Idson, Freitas, Spiegel & Molden, 2003), and rightness or correctness (e.g., Camacho, Higgins, & Luger, 2003; Cesario et al., 2004; Cesario & Higgins, 2008; Freitas & Higgins, 2002; Freitas, Liberman, & Higgins, 2002; Higgins et al., 2003; Vaughn, Harkness & Clark, 2010; Vaughn, Hesse, Petkova & Trudeau, 2009; Vaughn, Malik, et al., 2006; Vaughn, O’Rourke, et al., 2006).

Study 2 varied regulatory fit and measured the number of ideas listed in part of the regulatory-fit manipulation. It thus examined the interactive effect of mindfulness and processing fluency on behavior integral to the processing-fluency task. We used a between-subjects manipulation of regulatory fit that had produced effects in earlier research – that is, one that did not rely on discrepant fluency (Vaughn, Malik, et al., 2006, Study 2). Specifically, participants did an initial promotion or prevention-priming activity and a subsequent, ostensibly unrelated, food-listing activity that either fit or did not fit their primed focus. The promotion-priming condition asked participants to list five of their current hopes or aspirations, whereas the prevention-priming condition asked participants to list five of their current duties or obligations. Then the regulatory-fit condition paired promotion priming with listing of eager strategies - namely, listing foods to eat more of to attain good health - or paired prevention priming with listing of vigilant strategies - namely, listing foods to avoid to prevent poor health. In contrast, the regulatory-nonfit condition paired promotion priming with vigilant strategies or paired prevention priming with eager strategies. As in prior research (Vaughn, Malik, et al., 2006), the dependent variable was the number of foods participants listed.
We expected that the effect of regulatory fit on the number of foods listed would be stronger among participants higher in mindfulness. Because prior research had showed a significant effect for this between-subjects manipulation of regulatory fit on how many foods participants listed (Vaughn, Malik, et al., 2006), we expected that there would be a significant main effect for regulatory fit in Study 2. However, we did not expect any significant effects of primed promotion versus prevention focus in this study, in keeping with the results of prior research that has used this procedure for manipulating regulatory fit (Vaughn, Malik, et al., 2006; also see Cesario et al., 2004; Hong & Lee, 2008; Koenig, Cesario, Molden, Kosloff, & Higgins, 2009; Vaughn et al., 2009; Vaughn, O’Rourke, et al., 2006).

3.1 Method

3.1.1 Participants

Eighty-nine undergraduate students at our institution participated in the online study for extra credit in their psychology courses. As in Study 1, these students were enrolled in courses ranging from Introduction to Psychology to Senior Seminar in Psychology. We removed one participant’s data from analyses because he was an outlier on the number of words listed (5.53 SDs above the mean of that variable). In this study, 67% of the participants were female, 84% were White, 6.8% were Asian, 6.8% were Hispanic or Latino/a, 1.1% were Native American or Alaska Native, and 2.3% indicated that their ethnicity was “Other.” The ethnic composition of the sample adds up to more than 100% because participants could indicate more than one ethnicity. The average age in Study 2 was 19.05 years, SD = 1.15, with a range of 18 to 22 yrs.

3.1.2 Materials and Procedure

Participants learned that this study contained several unrelated parts. The first page contained the regulatory-focus manipulation used by Vaughn, Malik, et al. (2006, Study 2).
Specifically, the first section of the questionnaire, which was titled “Hopes and Aspirations” (or “Duties and Obligations”), contained the regulatory focus prime. Participants read a brief introduction stating that this part of the questionnaire was about students’ goals at this time of the semester and answered two questions about their year in college and their age. Then they listed five hopes and aspirations or five duties and obligations, depending on their randomly-assigned condition. Participants also rated how much they ideally would like to achieve each of the hopes and aspirations they listed, or believed they ought to achieve each of duties and obligations they listed.

The second page of the questionnaire contained the food-listing task, and it was titled, “Information that Comes to Mind.” The introduction to that section stated that students at their college tend to be very health conscious, and “In this task we are interested in learning about foods you can think of. Do not pay attention to what other people are doing, because they are getting different instructions from you. We would like to find out what examples you bring to mind of…” (Vaughn, Malik, et al., 2006, p. 605). The remainder of the sentence was printed on its own line, in large font, and constituted the manipulation of the type of food to list. In the promotion-fitting condition, participants listed “examples of foods one can eat more of to attain good health.” In the prevention-fitting condition, participants listed “examples of foods one could avoid to prevent poor health.” Under these instructions, participants also read (Vaughn, Malik, et al., 2006, p. 605),

As you are making your list of foods, ask yourself, “Do I feel like continuing with this task?” As long as the answer is “yes”, continue listing. When the answer becomes “no,” then stop. There is no objectively best or worst time to stop. Stop when you feel that you
no longer enjoy listing foods that one can avoid eating in order to prevent poor health
[can eat more of in order to attain good health].

We provided a text box on that page for participants to list their examples. To arrive at the
number of foods listed, we counted superordinate categories and specific examples within those
categories as separate items. For example, “fruits and veggies (apples and salads)” counted as
four items.

After the listing task, participants received the MAAS. To check for possible
experimental effects on the MAAS, we submitted it to a Regulatory Fit X Regulatory Focus of
Goals ANOVA. This analysis revealed no significant main or interactive effects for the
manipulated variables on participants’ MAAS scores (all \( p \)s > .12). In this study, the MAAS
Cronbach’s alpha = .87, \( M = 3.70, SD = 0.75, \) and range = 1.33 to 5.27. At the end of the
questionnaire, participants answered demographic questions and read a debriefing page.

3.2 Results

There were no significant main or interactive effects involving the regulatory focus of
recalled goals, replicating previous research with this kind of regulatory-fit manipulation (e.g.,
Cesario et al., 2004; Hong & Lee, 2008; Koenig et al., 2009; Vaughn et al., 2009; Vaughn,
Malik, et al., 2006; Vaughn, O’Rourke, et al., 2006). Therefore, we do not discuss effects of this
variable further.

For the main analyses, we followed Aiken and West’s (1991) recommendations for
calculating standardized solutions in multiple regression with interaction effects. Specifically,
we effect-coded regulatory fit (-1 = nonfit, 1 = fit), standardized MAAS scores, and standardized
the dependent variable. To obtain the Regulatory Fit X MAAS interaction term, we multiplied
the scores from the effect-coded regulatory fit variable and the standardized MAAS variable. In
this analysis, Bs are the correct standardized solution. For ease of interpretation, we report the Bs from this procedure as Betas (βs).

The pattern of results that we observed in Study 1 replicated in Study 2. Simultaneously regressing the number of foods listed onto MAAS scores, regulatory fit, and the interaction term revealed a significant interaction; β = .24, t = 2.21, p = .03. Neither main effect was significant; βs < .07, ts < 0.56, ps > .52. We decomposed this interaction using simple slopes tests at ± 1 SD from the mean of MAAS scores (Aiken & West, 1991). At +1 SD on the MAAS, there was a significant effect for regulatory fit on the number of foods listed, with participants generating more words in the regulatory-fit condition (β = 31, t = 2.01, p = .05). At -1 SD on the MAAS, the effect for regulatory fit nonsignificantly reversed (β = -.17, t = -1.12, p = .26). Fig. 2 displays these results at ± 1 SDs from the mean of MAAS scores.3

3.3 Discussion

The results of Study 2 further demonstrate the interactive effect of mindfulness and processing fluency on behavior: only participants higher in trait mindfulness showed a significant effect for our manipulation of processing fluency. These participants listed more foods when they experienced regulatory fit rather than nonfit in a task that we asked them to continue as long as they felt like it. The results of this study thus provide additional support for the hypothesis that people higher in trait mindfulness are more likely to translate the enjoyable experience of processing fluency into engagement in an activity. Additionally, it extends this finding to a different source of processing fluency and to the effect of processing fluency on behavior integral to the processing-fluency task.

Unexpectedly, there was no main effect for processing fluency in Study 2. The between-subjects design of Study 2 was the same as earlier research that had produced significant effects
without relying on discrepant fluency (Vaughn, Malik, et al., 2006). Thus, even though the between-subjects manipulation of processing fluency in Study 1 is a highly plausible explanation for the lack of a main effect for processing fluency in the first study, the between-subjects manipulation of processing fluency in Study 2 cannot plausibly explain the lack of a main effect for processing fluency in the second study. With that said, there are numerous other differences between the current Study 2 and Vaughn, Malik, et al.’s (2006) research that could have contributed to the absence of a main effect for regulatory fit in the current Study 2. For example, Malik, et al.’s (2006) Study 2 was run in fall semester, whereas the current Study 2 was run in spring semester. Research shows that undergraduate students report more academic exhaustion in spring semester than in fall semester (Galbraith & Merrill, 2012). Higher levels of academic exhaustion could lower engagement with a study. Additionally, Vaughn, Malik, et al.’s (2006) research was run online in a laboratory, whereas the current Study 2 was run completely online. Thus, participants in the current Study 2 could complete the study at any time of day, in any location, with any web connection, and with any degree of other distractions. These situational differences also could have contributed to the lack of a main effect for regulatory fit in the current Study 2.

4. General Discussion

Research shows that people higher in trait mindfulness are more attuned to variations in subtle internal states (Brown & Ryan, 2003; O’Loughlin & Zuckerman, 2008). The current research extends these findings to experimental variations in processing fluency, the subjective ease of processing information about a stimulus. Prior work suggests that the enjoyable experience of processing fluency can motivate participants to continue idea-generation activities (Vaughn, Malik, et al., 2006). The current studies showed that participants higher in
dispositional mindfulness listed more words or ideas under conditions of processing fluency than under conditions of processing dysfluency. Specifically, in Study 1, participants in the high versus low-fluency conditions read and rated the accuracy of various maxims that rhymed versus did not rhyme and did a subsequent task in which they generated words from the letters of longer words. Participants higher in mindfulness generated more words in the higher-fluency, rhyming condition. In Study 2, we used a different processing-fluency manipulation: participants in the high versus low-fluency conditions experienced regulatory fit versus regulatory nonfit when doing the target food-listing activity (Vaughn, Malik, et al. 2006). Conceptually replicating Study 1, participants who were higher in mindfulness listed more foods if they were in the high-fluency, regulatory-fit condition. To our knowledge, the current studies are the first to demonstrate that processing fluency is more likely to affect behavior among people higher in dispositional mindfulness.

We had expected our manipulations of processing fluency to be subtle enough to affect mainly the participants higher in mindfulness. However, we had also expected main effects for processing fluency, which we did not find in these studies. Although it may be tempting to want the same explanation for the lack of a main effect in the two studies, these studies used different manipulations of processing fluency, and these manipulations also differed in how similar they were to the manipulations used in previous research. Therefore, the most plausible explanations for the nonsignificant main effects differ between Studies 1 and 2. The research on which we based Study 1 (McGlone & Tofighbakhsh, 2000) used a within-subjects design for manipulating processing fluency that capitalized on discrepant fluency, which is an experience necessary for some processing-fluency effects to occur (e.g., Hansen et al., 2008; Laham et al., 2009). The between-subjects design of Study 1 was in contrast to this earlier research, and the fact that
Study 1 did not capitalize on discrepant fluency is a strong explanation for why there was no significant main effect for processing fluency in Study 1.

The same explanation for the absence of a main effect for processing fluency is not plausible for Study 2, because Study 2 used a between-subjects design that had produced effects in earlier research (Vaughn, Malik, et al., 2006) – that is, without the experience of discrepant fluency. However, Vaughn, Malik, et al.’s (2006) research was run in a laboratory in the fall, whereas Study 2 was run completely online in the spring. These differences could have contributed to students being less motivated or able to engage as fully with the current Study 2. Future research could examine how these and other situational factors moderate processing-fluency effects.

4.1 Limitations and Future Research

Our studies drew on a college population, and future research will need to examine whether the current findings extend to community samples and across cultures. Furthermore, the current studies assessed trait mindfulness with the most commonly-used measure (Brown & Ryan, 2003). Future research may examine whether similar results occur with other measures of mindfulness (for reviews, see Baer et al., 2006; Brown et al., 2007).

Another limitation of the current studies is that we did not experimentally manipulate mindfulness, which leaves open the possibility that the findings may have been due to variables associated with mindfulness. Future experimental studies of short-term mindfulness inductions (e.g., Arch & Craske, 2006) or longer-term mindfulness interventions (e.g., Shapiro, Brown & Biegel, 2007) could examine the possible causal role of mindfulness in moderating the effects of processing fluency on behavior.
We only examined the interactive effects of processing fluency and mindfulness on one kind of outcome: how many ideas or words participants listed in a research setting. Future research could examine the interactive effect of mindfulness and processing fluency on evaluative judgments of the self, others, beliefs, products, and other targets. Additionally, it could examine whether mindfulness affects how much the fit between persons and their environments influences thoughts, feelings, and behavior. Processing fluency can occur more frequently in settings that are a better fit for an individual’s personal characteristics (e.g., Fulmer et al., 2010; Stephens, Fryberg, Markus, Johnson & Covarrubias, 2012). If people higher in mindfulness are more aware of variations in processing fluency and more likely to translate them into action, they may be more sensitive to variations in person-environment fit. They could also be more motivated to improve a lack of fit.

A final question is whether similar effects occur with different kinds of processing fluency. There are many ways to manipulate processing fluency (for a review, see Alter & Oppenheimer, 2009), including ways to manipulate psychological fit with self-regulatory orientations (e.g., Avnet & Higgins, 2003; Higgins, Cesario, Hagiwara, Spiegel & Pittman, 2010; Hong & Sternthal, 2010; Kim, Rao & Lee, 2009; Lisjak, Molden & Lee, 2012; Mannetti, Giacomantonio, Higgins, Pierro & Kruglanski, 2010; Vaughn, Baumann & Klemann, 2008). It will be important for future research to examine a broader range of processing-fluency manipulations to test the generalizability of their interactions with mindfulness. Nonetheless, the current research takes an important first step in extending the scope of processing-fluency effects to behavior and in demonstrating that processing fluency is more likely to affect behavior among people higher in trait mindfulness.
Acknowledgements

We thank Katharine Childs, Ashley Ellenberger, Rachael Ellsworth, Madeline Lormand, Arielle Manganiello, Claire Maschinski, Ellen O’Malley, Molly Saldo, Gregory Spirer, and Stephanie Swan for help with materials development, data collection, and posters about this research, and John Luginsland for feedback about earlier versions of the manuscript.
References


Figure Captions

*Figure 1.* Number of words generated as a function of maxims condition and trait mindfulness; Study 1. Maxims condition was effects coded. Results are represented at ± 1 SD of trait mindfulness.

*Figure 2.* Number of foods listed as a function of regulatory fit and trait mindfulness; Study 2. Regulatory fit condition was effects coded. Results are represented at ± 1 SD of trait mindfulness.
Footnotes

1 Many psychological subdisciplines, such as social and personality psychology, have favored use of self-report measures of internal states rather than behavioral measures (Baumeister, Vohs & Funder, 2007). Thus, processing-fluency research has not been unique in this regard.

2 We also carried out simple slopes tests at $\pm 2.5 SD$ from the mean of trait mindfulness, to capture the pattern of results among the participants with the highest and lowest scores on the MAAS. At 2.5 $SD$s above the mean of trait mindfulness, there was a significant rhyming effect on the number of words generated ($\beta = .60, t = 2.57, p = .01$). The reversal of this effect at 2.5 $SD$s below the mean of trait mindfulness did not reach significance ($\beta = -.42, t = -1.83, p = .07$).

3 We also carried out simple slopes tests at $\pm 2.5 SD$ from the mean of trait mindfulness, to capture the pattern of results among the participants with the highest and lowest scores on the MAAS. At 2.5 $SD$s above the mean of trait mindfulness, there was a significant regulatory-fit effect on the number of foods listed ($\beta = .66, t = 2.28, p = .02$). The reversal of this effect at 2.5 $SD$s below the mean of trait mindfulness did not reach significance ($\beta = -.53, t = -1.82, p = .07$).