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The Role of Social Agency in Student Learning

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THE ROLE OF SOCIAL AGENCY IN STUDENT LEARNING

BY

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DISSERTATION

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THE ROLE OF SOCIAL AGENCY IN STUDENT LEARNING

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Date

DEDICATION

For my beautiful wife, Rebecca.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

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Although the pedagogical strategy known as the personalization principle has received considerable support in the laboratory, there is little work examining its generalizability, ecological validity, and potential for statistical mediation and moderation. In 5 experiments, these topics are examined in the laboratory as well as in a real classroom setting. Experiment 1a provides evidence for moderation of the effect of the personalization principle by the learner's score on the need to belong scale. Experiment 1b shows support for a variable that measures subjective perceptions of the learning material mediating the effect of the personalization principle on learning outcomes. Experiments 2 and 3 replicate and extend the findings from experiments 1a and 1b, and experiment 4 provides a replication of the personalization principle in a real classroom setting.

The key findings of the 5 experiments provide converging evidence that the personalization principle is moderated by the need to belong variable and may be mediated by the learner's subjective perceptions of the learning materials. These findings were replicated several times using learning material from different disciplines. Interpretations of results and implications for future research and implementation of the personalization principle are discussed.

CHAPTER 1

Introduction

<u>The science of teaching and learning</u>

Today's rapidly advancing technology has made available to users a substantial

assortment of manipulations from which to present course materials. Tapping into this resource,

college and university instructors are using multimedia materials and platforms (e.g., *PowerPoint*

©) in their courses with growing frequency (Cudd, Lipscomb, & Tanner 2003; Govaere Jan, de

Kruif, & Valcke, 2012; Issa, Schuller, Santacaterina, Shapiro, Wang, Mayer, & DaRosa, 2011;

Kennedy, Driver, Pullen, Ely, & Cole, 2013). Decisions instructors need make about how and

when to incorporate different techniques and strategies to enhance student learning in these

contexts can be difficult. As much work has shown, successful instructional strategies must be

informed by what we know about how people learn.

Some of the most informative findings on teaching strategies focus on information

delivery; that is, what are the best ways to construct, organize, and present learning materials in

order to maximize positive learning outcomes? Given the aforementioned trend of the use of

multimedia materials, it is no surprise that the principles of teaching and learning in a

multimedia-specific context have received considerable attention in the research literature.

Indeed, there exists a well-established and comprehensive framework that is tailored to teaching

and learning with multimedia (see Mayer, 2014). From the broadest perspective, research that

examines teaching with multimedia has found that people tend to learn better with words and

pictures than they do from words alone; this is known as the *multimedia principle* (Mayer, 2009).

The multimedia principle, among other principles of Mayer's (2009) cognitive theory of

multimedia learning, is derived from guiding principles in cognitive science that help illuminate

how people receive and process information in a learning environment (Harp & Mayer, 1998; Mayer, 2005; 2009; Mayer & Moreno, 2003; Moreno & Mayer, 1999). As such, the multimedia principle outlines specific design rules that are built on such cognitive theories and their underlying assumptions.

One of the key assumptions of the principles of multimedia learning is that people learn by receiving information from two distinct channels, auditory and visual, that have a limited capacity for processing. Indeed, the argument for this dual-channel model has received considerable empirical support (Clark & Paivio, 1991; Paivo 1990; Paivio, 1991). Another key assumption of the cognitive theory of multimedia learning is the notion that people can only process a finite amount of information at one time, known as cognitive load theory (Chandler & Sweller, 1991; Sweller, 1990). Cognitive load theory posits that individuals are limited in the amount of information they are able to actively process; moreover, exceeding this limit causes interference with such processing. According to the cognitive theory of multimedia learning, both the auditory and visual channels have independent thresholds for cognitive load; that is, either one of the channels may become overloaded without the other experiencing any load at all. Hence, one of the most significant advantages that multimedia materials provide is the potential to engage both channels simultaneously, which, in turn, leads to a greater net amount of active processing (Mayer, 2009).

Given this limited cognitive capacity outlined by cognitive load theory, it is important to pay careful attention to the information that is included in the use of any multimedia materials. For instance, any and all information included in a multimedia presentation may be thought of as either extraneous (i.e., not directly relevant to the important material), or essential (i.e., directly relevant to the important material). In many cases, it is not uncommon to see essential

presentation content being intermingled with extraneous, amusing, or even provocative content, often guided by the logic that attracting students' attention with such details can facilitate information processing. For example, an instructor may strategically place provocative or attention-grabbing graphics in presentation slides with the rationale that the students may be more likely to remember that particular slide, which ostensibly will include the essential content that is directly relevant to the lesson. According to the cognitive theory of multimedia learning, however, such rationale may be misguided. Indeed, research in a laboratory setting has shown that presenting extraneous material not only induces the learner to spend precious time actively processing information that is not directly relevant to the lesson, but it also takes away from the limited resources that are available to actively process the information that *is* important (Harp & Mayer, 1998). Furthermore, classroom studies have shown that after completing a class, college students do tend to remember the provocative details. What tends not to be remembered, however, is the essential course material that is connected to those details (Kintsch & Bates, 1977; Vanderstoep, Fagerlin, & Feenstra, 2000).

In addition to the importance of engaging dual-channels of information processing and attending to the inclusion of extraneous materials in multimedia presentations (i.e., reducing extraneous processing), Mayer's (2009) cognitive theory of multimedia learning outlines a series of strategies that aim to enhance learning outcomes by increasing what is known as *generative processing*. Generative processing is cognitive processing aimed at making sense of incoming material, in addition to organizing and integrating that material with prior knowledge. Although a learner may have the cognitive capacity available to make sense of information, he or she must be motivated to use that capacity and work hard to utilize it efficiently. Hence, the study of

generative processing and strategies for its induction is paramount for maximizing learning outcomes.

According to Mayer (2009), one way that we can foster generative processing in a multimedia context is through the *personalization principle*. That is, the notion that people learn better when material is presented in a personalized, conversational style rather than a more formal style. To understand why this might be the case, we must consider learning as a social event; the most basic construal of which is an interaction between two people. Research on human-to-human interactions has shown that when two people are communicating with one another, there are implicit assumptions that are made regarding the roles of "listener" and "learner". According to what Grice (1975) termed the *cooperation principle*, the speaker will do his or her best to present a message in a clear, concise manner, and, in turn, the listener will work hard to try and understand the speaker's message. Assuming that one has available cognitive resources, the cooperation principle suggests that simply "buying-in" to the role of a listener in a conversation is an impetus for generative processing.

With the ubiquitous use of multimedia materials in today's educational environment, in addition to the advent of online educational platforms, the use of face-to-face discourse as a primary medium for learning is dwindling. Although this trend may seem counter-productive for learning given the aforementioned research regarding the cooperation principle, there is good empirical support for the notion that, even when an individual is alone (i.e., not having a face-to-face conversation), learning may still be construed as a social event, and it is beneficial to study it as such. Indeed, even in the absence of another person, it is well documented that there are numerous social factors that may contribute to learning outcomes (see Ginns, Martin, & Marsh, 2013). Spiro (1977) argued that circumstances that facilitate the integration of new information

into existing schema play a key role in the activation of cognitive processing, and that the degree to which new material can be easily integrated into existing schema can be used to predict learning outcomes. Building on Spiro's (1977) work, Bretzing and Kulhavy (1981) argued that material presented in a "low-formality" style is more effective for updating an individual's existing schema than material presented in a "high-formality" style, ostensibly due to the material being presented in such a way that is consistent with how people tend to think about everyday life. In a similar vein, more recent research has shown that information presented in a narrative style (i.e., telling a story) is more easily understood by a reader than material presented in a definitional or expository style, although the authors admit the underlying mechanisms for those effects are not entirely clear (Graesser, Olde, & Klettke, 2002). Although it falls outside the scope of the present work, the distinction between what Graesser et al. (2002) refer to as "narrative style" and what Mayer (2009) and colleagues' refer to as the "personalization principle" is a potentially important one and should be further investigated in future research.

Furthermore, given the widespread use of computers as a learning tool, it is worthwhile to note that research has shown that people can be easily induced to accept computers themselves as social partners (Reeves & Nass, 1996; Nass & Brave, 2005). Indeed, Mayer's (2005) work suggests that the presence of social cues (e.g., conversational style) in human-to-computer interaction activates the same motivational effort that is exhibited in human-to-human interaction. Altogether, the extant work on the social dynamics of learning suggest that when a learner is convinced he or she has entered into a social contract with a speaker, author, or computer, he or she will be motivated to use his or her available cognitive capacity to try and make sense of the material. According to Mayer's (2009) personalization principle, whether the learner is reading a book or using a computer, generative processing of information can be

promoted by activating a social response in the learner, which, in turn, leads to an increased

motivation to understand the material and ultimately leading to enhanced learning outcomes.

This process by which the personalization principle operates is known as *social agency* (Mayer,

2009).

Moreno and Mayer (2000) first examined the effects of the personalization principle on

learning and found that, across five experiments, students who learned by means of a

"personalized" explanation of material performed better on subsequent transfer (i.e., problem-

solving) tasks than students who received an otherwise identical but "non-personalized"

explanation of the material. In Moreno and Mayer's (2000) experiments, "personalization" was

achieved by taking original material that was presented in a formal, passive, instructional manner

and re-writing them to exhibit a more conversational style by using first- and second-person

sentence constructions (e.g., using the words, "you", "your", or "I"), in addition to adding

completely new sentences that functioned only to directly address the learner in a personal

fashion. For example, when re-writing an instructional booklet on the formation of lightning,

Moreno and Mayer (2000) added the sentence, "Let me tell you what happens when lightning

forms" to the beginning of the booklet. Subsequent work investigating the effects of

personalization has replicated Moreno and Mayer's (2000) initial findings (Kartal, 2010; Mayer,

Fennell, Farmer, & Campbell, 2004; McLaren, DeLeeuw, & Mayer, 2011a, 2011b; Moreno &

Mayer, 2004; Wang, Johnson, Mayer, Rizzo, Shaw, & Collins, 2008).

Although there appears to be extensive empirical support for the personalization

principle, there have been a series of studies with mixed results that suggest limitations related to

its generalizability and, ultimately, its theoretical basis. For example, attempts to replicate the

effects of the personalization principle in languages other than English have achieved mixed

results (Clarebout & Elen, 2007; Kartal, 2007; Kartal, 2010). In addition, studies examining the personalization principle across longer periods of acquisition both in and out of the laboratory have also yielded inconsistent findings (McLaren et al., 2006; Yeung et al., 2009). Regarding its theoretical foundations, Mayer et al. (2004) posited that some of the underlying mechanisms involved in the personalization principle may entail constructs such as perceived friendliness and learning assistance on the part of the learner, in addition to increased interest in the material. Research that endeavored to provide supporting evidence for these specific hypotheses has also yielded mixed results (Kartal, 2010; Mayer et al., 2004).

In light of the aforementioned mixed results, Ginns et al. (2013) conducted a meta-analysis evaluating the effects of the personalization principle, and reported results that were largely consistent with Mayer's (2009) main hypotheses. Specifically, Ginns et al. (2013) found that the use of conversational rather than formal style in instructional materials generated positive learning effects in both knowledge retention and transfer tasks. In general, the findings of the meta-analysis lend support to Mayer's (2009) supposition that learning events are indeed inherently social in nature. Despite this finding, the theoretical underpinnings of this social nature remain unclear, as there has been almost no research examining learning events through a traditional lens of social psychology. That is, although it seems clear that there are more complex social factors directly contributing to the effects of personalization, research with a focus on teaching and learning has not endeavored to explore the crossroads with social psychology at which Mayer's (2009) work on social agency has seemingly left us.

Frameworks in social psychology

Seminal work in social psychology has focused on the impact of interpersonal relationships on human functioning (see Baumeister & Leary, 1995). The need to belong

hypothesis, in particular, has received a great deal of empirical support on multiple fronts (e.g., cognition, emotion, behavior), suggesting that the need to belong is indeed a fundamental human motivation (Baumeister & Leary, 1995). Viewing the thoughts, feelings, and behavior of human beings through this basic lens has yielded an abundance of research avenues ranging from broad ideas such as relationship satisfaction and intimacy to increasingly sophisticated and specialized theory. Despite the plethora of distinct, often nuanced constructs that comprise the burgeoning field of relationship science, the notion that humans are fundamentally oriented toward creating and maintaining bonds with others remains a core organizing principle. Indeed, this fundamental need to belong has been shown to influence a wide range of processes and outcomes, from individual differences in how people view the self and others (Leary & Downs, 1995) to how well we can predict the details of someone's memory (Gardner, Pickett, & Brewer, 2000). There are few constructs in social psychology that can elude the influence of humans' fundamental need to belong, and the perhaps most widely researched construct among them is certainly no exception: self-esteem.

The study of self-esteem may predate social psychology itself as an area of scientific interest. The recognition and importance of self-esteem in psychological science can be traced back as far as William James in the 19th century. Indeed, James famously referred to self-esteem as an "elementary endowment of human nature" (1890). James' thoughts on self-esteem have since been evidenced by the fact that the Rosenberg (1965) self-esteem scale (RSE), originally developed in the 1960s to measure the self-esteem of high-school students, has been used to measure the self-esteem of a wide variety of different groups of people, and remains one of the most reliable and widely used psychological scales in history (Tomas & Oliver, 1999). Indeed, the RSE has been the subject of more psychometric analysis and empirical validation than any

other measure (Byrne, 1996). Clearly, self-esteem is one of the most prominent and well-established constructs in the field of psychology.

In addition to prolific nature of its psychometric use, the construct of self-esteem has been pervasive in the research literature such that researchers have found relationships between an individual's self-esteem and a multitude of meaningful life outcomes, including job salary, marital success, criminal behavior, and academic success (Baumeister, Campbell, Krueger, & Vohs, 2003). Although the influence of self-esteem seems to have achieved ubiquitous status in social psychology, many researchers continue to argue that its fundamental function is best described as a primary source of interpersonal motivation and remains directly tied to the human need to belong motive (Leary & Baumeister, 2000).

Understanding self-esteem as a form of interpersonal motivation is perhaps best encapsulated by a framework known as the sociometer theory of self-esteem (Leary, Tambor, Terdal, & Downs, 1995). Broadly speaking, sociometer theory posits that people are constantly vigilant for cues in their environment that may indicate opportunities to maintain or enhance their relative social standing, and, in turn, how they feel about themselves. Moreover, this hyper-vigilance for social cues is thought to be a driving influence that is responsible for a wide range of human beings' thoughts, feelings, and behavior (Leary & Baumeister, 2000; Leary & Downs, 1995; Leary & Guadagno, 2004; Leary et al., 1995).

One area of particular relevance to the sociometer theory of self-esteem is goal-directed behavior. Several researchers have made the argument that there exists a motive to seek self-esteem because the achievement and maintenance of self-esteem enhances people's willingness to strive toward personal goals (Bandura, 1977) and to persist in striving toward goals in the face of obstacles and setbacks (Greenwald, 1980). Indeed, it has been shown that individuals with

high self-esteem do tend to work harder at accomplishing a task, and continue to perform better than their low self-esteem counterparts even after experiencing an initial failure (Shrauger & Sorman, 1977). Alternatively, the motive to seek and maintain self-esteem has been explained by suggesting that self-esteem acts as a buffer against anxiety and otherwise negative affect (Pyszcynski, Greenberg, Solomon, Arndt, & Schimel, 2004). Whether an individual is striving to achieve a goal or to avoid negative affect, the motivation to achieve and maintain a high level of self-esteem is an omnipresent feature of the human psyche.

According to sociometer theory, state self-esteem (as opposed to trait self esteem; see Heatherton & Polivy, 1991) may be thought of as the affective component of an individual's present self-evaluation, and is subject to constant fluctuations depending on the situation. Hence, the sociometer system of state self-esteem is essentially a subjective marker of an individual's current inclusionary status. As such, this system must continuously monitor one's environment for cues indicating opportunities to further secure inclusion and potential threats of exclusion. When exclusion or rejection is detected, the sociometer system provides feedback by way of the individual experiencing a decrease in self-esteem. The consequences of this decrement to self-esteem have been shown to entail an increased motivation for prosocial behavior (Leary et al., 2004) as well as cognitive changes (Murray, Griffin, Rose, & Bellavia, 2003) designed to compensate for the potential threat of rejection.

Just as there may be within-person variability in state self-esteem that fluctuates depending on the situation, there may also be between-person differences in the sensitivity of how the sociometer system functions. Namely, there may be individual differences in the extent to which people value belongingness and acceptance of other people that the sociometer system is designed to monitor. Although it can be argued all people desire to form and maintain bonds

with others on some level (Baumeister & Leary, 1995), people have been shown to differ in the strength of this motivation using a construct called the need to belong (NTB) scale (Leary, Kelley, Cottrell, & Schreindorfer, 2005). Individual differences in this need to belong motivation have been shown to predict a wide range of human behavior and cognition, independent of other related constructs such as self-esteem, extraversion, or sociability (Leary et al., 2005). Coupled with sociometer theory, the NTB scale not only sheds light on the driving influence behind myriad human behavior, but also on *which* individuals are more or less likely to behave in a particular fashion. For instance, in a situation that features a stimulus representing a possible threat for interpersonal rejection, an individual's need to belong might provide an indication of how likely he or she is to perceive that stimulus as threatening, and his or her state self-esteem might provide an index of to what extent that threat has actually been registered.

With regard to social cues, the need to belong construct has been shown to predict both efficacy and accuracy in "decoding" stimuli in a social situation. Pickett, Gardner, and Knowles (2004) found that individuals high in the need to belong were particularly attentive toward and accurate in identifying vocal tone and facial emotion. In a similar vein, Gardner et al. (2000) found that manipulating social exclusion predicted better memory for socially related information as opposed to non-social information among individuals who were made to feel socially excluded. Even when compared to otherwise negative and non-social exclusionary experiences, social exclusion has been shown to increase sensitivity to social information (Pickett et al., 2004). Although it can be experimentally manipulated, conceptualizing the need to belong as an individual's baseline level of social sensitivity has proven useful across a wide array of research in social psychology (Leary & Baumesiter, 2000).

Merging the science of teaching and learning with social psychology

When it comes to predicting learning outcomes, the research domain of teaching and learning has largely ignored social psychology frameworks such as sociometer theory and the need to belong. Given that such empirically supported theories as the personalization principle have been included under an umbrella termed "social-agency", it seems appropriate to attempt to integrate the findings of Mayer (2009) and others with the extensive body of work that social psychology, and interpersonal dynamics in particular, has to offer. Consider, for instance, how the theoretical underpinnings of social agency in learning refers to an "activation of a social response" in the learner that results in motivational changes that ultimately affect how well the individual learns the material. It seems logical to ask the question of what is actually happening, psychologically speaking, when an individual experiences such "social activation", and furthermore, what are the factors that contribute to whether such activation is achieved? Mayer (2009) and others have paved the way in beginning to answer the latter of these questions. According to Ginns et al. (2013), the alteration of learning materials to reflect a more informal, conversational style increases the probability of the social activation response that motivates the learner to put forth more effort toward learning the material. From this point, an important empirical question to ask is, *why* do such seemingly subtle alterations elicit a response that leads to significantly better learning outcomes?

If we revisit the work of Grice (1975) using the lens of interpersonal dynamics, whereby the cooperation principle outlines an implied social contract between teacher and learner, it seems fair to assume that the learner must at some point be vigilant for cues indicating that such a social contract is imminent. If we apply the framework of sociometer theory and the need to belong hypothesis, one might also venture to theorize that it is a similar, if not identical monitoring system that is detecting the presence of the implied social contract of the learner that

also functions to detect social cues in the environment and protect self-esteem (i.e., the sociometer). Viewed in this way, what Mayer (2009) has referred to as social agency is tantamount to a stimulus that alerts an individual to the potential for self-esteem maintenance. That is, just as an individual's sociometer system functions to monitor and affect behavior while having a social interaction with another person, there may be a similar mechanism involved in learning that is designed to monitor content for social cues and affect the motivation to more deeply process and understand material while engaging in a learning activity. Furthermore, as a potential corollary, there may be individual differences in this monitoring system that are akin to the need to belong construct. To date, modeling social agency as an interpersonal motivational process, including individual differences that moderate that process, has not been attempted.

Several hypotheses follow from the application of sociometer theory and the need to belong hypothesis to social agency. If we use Mayer's (2009) path model for social agency as a guide (see figure 1 below), the instructional message containing social cues represents a social stimulus, and the activation of a social response in the learner represents a functioning sociometer system. The increase in active processing (i.e., generative processing) that results is analogous to an increased motivation for prosocial behavior when an opportunity for self-esteem maintenance is detected. Just as a prosocial response is likely to elicit positive feedback from others, the increase in generative processing is likely to lead to the perceived fulfillment of the implied social contract outlined by the cooperation principle (Grice, 1975), which may be quantified as an enhanced learning outcome.

How Social Cues Prime Deeper Learning

Instructional message with social cues	→	Activation of social response	→	Increase in active cognitive processing	→	Increase in quality of learning outcome

How Lack of Social Cues Does Not Prime Deeper Learning

Instructional message without social cues	→	No activation of social response	→	No increase in active cognitive processing	→	No increase in quality of learning outcome

Figure 1. Mayer's (2009) path model for social agency

Using the framework of sociometer theory and the need to belong hypothesis, the present research plans to experimentally test Mayer's (2009) model of social agency, and explore the role of the need to belong and state self-esteem with regard to social cues encountered in a learning environment. In particular, this research aims to investigate whether instructors' use of the personalization principle is responsible for priming the self-esteem motive, leading to increased motivation for students to understand the material in hopes of maintaining, enhancing, and avoiding decrements to his or her self-esteem. This motivation, in turn, may underlie the process for deeper, generative cognitive processing that produces the observed learning benefits.

CHAPTER 2

Experiment 1a

Research Aim

Learning materials that are delivered in a relatively casual, conversational style may lead, under some circumstances, to better learning outcomes than the same material being produced in a more formal, expository style (e.g., Moreno & Mayer, 2002). The purpose of the present experiment is to examine the aforementioned effect by replicating what has been termed the *personalization principle* using the same materials used by Moreno and Mayer (2002). Furthermore, this study aims to examine possible moderating effects of individual differences in social sensitivity on the learning outcomes that are differentiated by using personalized learning materials.

Experiment 1a is a direct replication of research done by Moreno and Mayer (2002) showing that using personalized learning materials predicts enhanced learning outcomes in college students. In addition, experiment 1a adds an important extension to Moreno and Mayer's (2002) work by examining effects of learning of individual differences among participants in the need to belong (Leary, 1995) variable. The data for this extension can be easily collected without altering the original procedures that are targeted for replication, and may provide meaningful insight into the underlying mechanisms that drive the personalization effect.

Hypotheses for Experiment 1a

Hypothesis 1: The Personalization Principle

Consistent with prior laboratory work (Moreno & Mayer, 2002), I hypothesize that participants who read from a learning booklet that has been altered to adhere to the personalization principle will score higher on a concurrent test of their learning than participants

who read from a learning booklet that does not contain elements of the personalization principle. In the original series of experiments, Moreno and Mayer (2002) measured learning outcomes in two different ways, using a test of information retention and also a test of information transfer. Throughout a series of studies, Moreno and Mayer (2002) generally found statistically significant differences between the personalization and non-personalization groups for tests of both retention and transfer, although there were several exceptions. For example, in several of Moreno and Mayer's (2002) studies, statistically significant effects were found for transfer learning, but not for retention learning. Given that there is no theoretical reason to expect that these outcomes should differ, for the present study I have combined retention and transfer into one single outcome: overall learning. By using one overall index of participant learning, I hope to eliminate the potentially confounding discrepancy between different types of learning outcomes, as well as increase the overall reliability of the criterion variable.

Hypothesis 2: The Need to Belong as a Moderator

Another strength of this study is the use of the need to belong (Leary, 1995) variable. The need to belong variable measures the extent to which an individual possesses a social motivation to build and maintain bonds with others, which I theorize may have central importance to producing the effect of the personalization principle on learning outcomes. Moreno and Mayer's (2002) work documents the existence of the personalization principle using a brief, multimedia learning experience, and theorizes that this effect is driven by social agency. The framework for social agency is limited, however, by a lack of detailed explanation for what is referred to "social activation". Mayer (2009) posits that learning from personalized materials leads to such social activation, which, in turn, leads to an increase in cognitive processing that ultimately yields an enhanced learning outcome. According to Mayer's (2009) social agency

theory, it remains unclear exactly why individuals should experience this social activation, and, furthermore, why such activation should lead to an increase in cognitive processing. According to Baumeister and Leary (1995), the need to belong is a fundamental motivation that humans will strive to achieve and maintain across the lifespan. In addition to being a fundamental human motivation, individual differences in the need to belong have been shown to predict behavior in different ways (Baumeister & Leary, 1995; Gardner et al., 2000; Leary et al., 2005). Mayer's (2009) social agency theory intimates that being "socially activated" by the learning material will produce a cognitive change in the learner that will benefit that person in the form of increased learning. Furthermore, Mayer's (2009) explanation of the personalization principle using social agency does not address the possibility of systematic within-groups variability. Hence, it is a goal of this study to extend the prior work on the personalization principle by examining the possibility that individual differences in the need to belong may correspond to individual differences in social activation upon being exposed to personalized learning materials. I hypothesize that individuals' need to belong will positively interact with their experimental condition. More specifically, I hypothesize that the simple effects of the aforementioned interaction will reveal a statistically significant increase in overall learning for participants in the experimental (i.e., personalization) condition who are relatively high (one standard deviation above the mean) in need to belong (high NTBers). Conversely, I hypothesize that participants in the experimental condition who have a relatively low need to belong (one standard deviation below the mean; low NTBers) will not exhibit learning outcomes that are statistically different from the control condition.

Method for Experiment 1a

<u>Participants</u>

Participants were undergraduate students enrolled in psychology courses at the University of New Hampshire. The students who participated were fulfilling a course requirement for research participation. The sample for this experiment was comprised of 168 participants (*M* age = 19.31 years, *SD* = .46), of whom 94.6% identified as white or Caucasian, 3.2% Hispanic, and 2.2% Asian or other ethnicity. Participants were granted one hour of research participation credit for this study.

<u>Procedure</u>

The participants were tested in one laboratory session lasting approximately one hour. The same researcher conducted all of the data collection sessions. Upon arrival to the laboratory, participants completed documents indicating their informed consent and demographic variables before being issued an individual paper booklet containing a multimedia lesson on lightning formation. Participants were randomly assigned to either the control or experimental condition, which determined the specific contents of their learning booklet. The researcher then gave instructions for the participants to carefully read their booklet one time, and to read with the expectation that they would be asked questions about the lesson afterward. All participants finished reading the booklets in less than 10 minutes, at which point they were issued a timed test of information retention. The participants had 6 minutes to complete the retention test, after which they were issued a series of four open-ended transfer questions and given 2.5 minutes each to complete them. Finally, following the completion of the retention and transfer tests, participants completed a questionnaire featuring the need to belong scale. Participants were then thanked, debriefed, and dismissed.

Materials

The multimedia learning booklets that were used in this experiment, along with the retention and transfer tests, were identical to those used in prior experiments by Moreno and Mayer (2002). The 10-item need to belong scale was used to measure individual differences in social sensitivity using a 7-point Likert scale (*1: strongly disagree, 7: strongly agree*). The need to belong scale had adequate internal consistency (Cronbach's α = .81). The complete set of materials can be found in the appendix. All materials were completed using paper and pencil.

Results for Experiment 1a

Analyses for Hypothesis 1: The Personalization Principle

Two separate coders who were blind to participants' condition scored tests of retention and transfer for the lightning lesson individually. The scoring system used was to the same as the one used in prior work by Moreno and Mayer (2002). The retention test consisted of one open-ended question, "Please write down an explanation of how lightning works". For the retention test, each coder assigned a score from 0-9 according to how many of the 9 key points were included in the participants' response (*0=none of the key ideas included, 9=all of the key ideas included)*. Inter-rater reliability for the scoring of the retention test was excellent (Cronbach's α = .91), and so the two scores for each participant were averaged to create one index of retention. For the transfer test, each coder assigned a score according to how many unique solutions to each question were included in the participants' response. Scores for the transfer test ranged from 0-9. The transfer test consisted of the following four questions. Cronbach's α is provided in parentheses to index inter-rater agreement. "What could be done to increase the intensity of a lightning storm?" (Cronbach's α = .91); "What does air temperature have to do with lightning?" (Cronbach's α = .85); "Suppose you see clouds in the sky, but no

lightning. What explanations are there for the absence of lightning?" (Cronbach's α = .95);

"What causes lightning?" (Cronbach's α = .94). Scores on all four transfer questions were then

averaged to create a mean transfer score for each participant. Overall inter-rater reliability for

mean transfer score was excellent, Cronbach's α = .96, and so the two transfer scores for each

participant were averaged to create one index of transfer. As mentioned in the overview of this

study, the retention and transfer scores for each participant were then combined to create one

overall index of learning.

I computed an independent samples t test to evaluate the difference in learning outcomes

for participants in the control and in the experimental conditions. As predicted, the experimental

condition scored higher on the index of learning (M = 3.19, SD = 1.21) than the control condition

(M = 2.70, SD = 1.16). The difference between the groups was statistically significant, t (166) =

2.69, p < .01, Cohen's d = .42. These results suggest a medium effect size, according to Cohen's

guide (Cohen, 1988), and a successful replication of the effect of the personalization principle.

Analyses for Hypothesis 2: The Need to Belong as a Moderator

To test the hypothesized interaction between experimental condition and need to belong,

I conducted an ordinary least squares regression. First, a test of main effects including

experimental condition and need to belong revealed a significant main effect for condition, b =

.5, p < .01, but not for the need to belong, p = .73. To test the effect of a condition by need to

belong interaction, a product term representing an interaction between experimental condition

and need to belong was added to the model. As predicted, the interaction was statistically

significant, b = .82, p < .05. Tests of simple effects revealed a statistically significant effect of

experimental condition at relatively high (1 SD above the mean) levels of need to belong, b =

1.08, p < .001, but not at relatively low (1 SD below the mean) levels of need to being, p = .68.

These results suggest a boundary condition for the personalization principle; that is, in this experiment, the personalization principle benefited learning primarily for those individuals who reported higher scores on the need to belong scale. The interaction described above is plotted in figure 2 below.
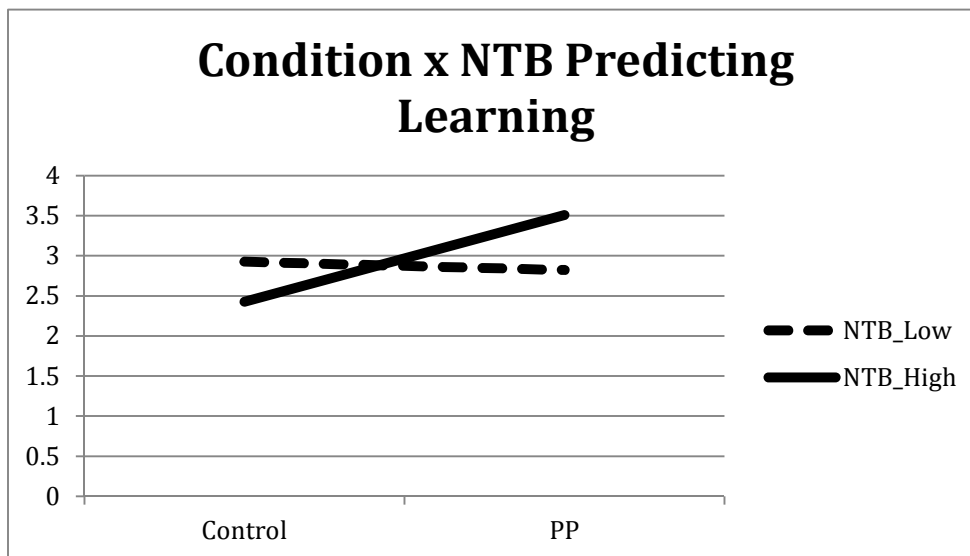

Figure 2. Experiment 1a. Interaction of experimental condition and the need to belong predicting learning outcomes.

CHAPTER 3

Experiment 1b

Research Aim

Although there is considerable evidence for the effect of the personalization principle (see Ginns et al., 2003), no work to date has examined the theoretical underpinnings for exactly why using personalized learning materials should lead to enhanced learning outcomes. Mayer (2009) speculated that the effect of the personalization principle is driven by a "social activation" that occurs in the learner that leads to an increase in cognitive processing. The aim of the present experiment is to further examine Mayer's (2009) framework for the personalization principle and isolate a variable that may mediate the effect of social activation on enhanced learning outcomes.

Experiment 1b is another replication of Moreno and Mayer's (2002) work showing evidence for the effect of the personalization principle on learning outcomes. In addition to examining the effect of the personalization principle, experiment 1b extends research in this area by examining a potential mediator variable that may help explain why the personalization principle works the way that it does. The procedures used in the present study were adapted from experiment 1a to include measurement of the hypothesized mediator variable.

Hypotheses for Experiment 1b

Hypothesis 1: The Personalization Principle

The first hypothesis for experiment 1b is identical to hypothesis 1 in experiment 1a. I hypothesize that participants who read from a learning booklet that has been altered to adhere to the personalization principle will score higher on a concurrent test of their learning than participants who read from a learning booklet that does not contain elements of the

personalization principle. Learning outcomes will once again be evaluated based on a composite measure of both retention and transfer learning.

<u>Hypothesis 2: Lesson Perceptions as a Mediator</u>

The only procedural modification to experiment 1b is the completion of a questionnaire inquiring about the participants' perceptions of the learning booklet that is administered immediately upon completion of the reading task. The questionnaire contains 12 Likert-scale items that are designed to gauge the participants' general sentiments toward the lesson (e.g., "the lesson was interesting"; "the lesson makes me want to explore that topic further"). According to Mayer's (2009) framework for the personalization principle, the social activation resulting from reading personalized learning materials leads to an increase in cognitive processing, although it is not made clear why this might be the case. Given the propensity for social motivation to affect cognitive outcomes such as memory (Gardner et al., 2000) and the structural similarity of personalized learning materials to the narrative-style genre (Graesser et al., 2002), a logical theory to explain an increase in cognitive processing as a result of the personalization principle is an overall increase in positive evaluation of the material. For experiment 1b, I hypothesize that the effect of the personalization principle on learning outcomes will be fully mediated by positive evaluations of the learning material. In particular, the extent to which participants' evaluate the learning materials in a positive manner should directly predict the increase in learning outcomes for individuals in the experimental condition.

Method for Experiment 1b

<u>Participants</u>

Participants were undergraduate students enrolled in psychology courses at the University of New Hampshire. The students who participated were fulfilling a course requirement for

research participation. The sample for this experiment was comprised of 89 participants (*M* age = 19.63 years, *SD* = .47), of whom 97.3% identified as white or Caucasian, 2% Hispanic, and 0.7% Asian or other ethnicity. Participants were granted one hour of research participation credit for this study.

Procedure

The procedure for experiment 1b was identical to that of experiment 1a, with one exception. After the participants finished reading the learning booklet, they were immediately given the questionnaire containing the items that comprise the hypothesized mediator variable. Once again, all participants finished reading the booklets in less than 10 minutes. After completing the questionnaire containing the mediator variable, participants were issued the timed test of information retention, followed by the transfer and need to belong measures that were used in experiment 1a. All participants were then thanked, debriefed, and dismissed.

Materials

The materials used in experiment 1b were identical to those used in experiment 1a, with one exception. The present experiment included a 12-item measure of participant perceptions of the learning materials that was hypothesized to mediate the effect of personalization. The 12-item measure was used a 7-point Likert scale (*1: strongly disagree, 7: strongly agree*), and had excellent internal consistency (Cronbach's α = .93). The complete set of materials can be found in the appendix. All materials were completed using paper and pencil.

Results for Experiment 1b

Analyses for Hypothesis 1: The Personalization Principle

All analyses conducted for hypothesis 1 in experiment 1b are identical to those of hypothesis 1 in experiment 1a. For experiment 1b, as predicted, the experimental group scored

higher on the index of learning (M = 4.08, SD = 1.29) than the control group (M = 3.56, SD = 1.01). The difference between conditions was statistically significant, t (87) = 2.12, $p < .05$, Cohen's d = .45. These results suggest a medium effect size, according to Cohen's guide (Cohen, 1988), and a successful replication of the effect of the personalization principle.

<u>Analyses for Hypothesis 2: Lesson Perceptions as a Mediator</u>

The mediation model was tested following the procedures recommended by Baron and Kenny (1986). First, I conducted an ordinary least squares regression featuring experimental condition as the predictor variable and overall learning as the criterion, which revealed significant effect of experimental condition, β = .22, t (88) = 2.12, $p < .05$. Second, I conducted an ordinary least squares regression analysis using experimental condition as the predictor variable and lesson perceptions, the presumed mediator, as the criterion. The experimental condition was revealed to predict lesson perceptions at a statistically significant level, β = .23, t (88) = 2.15, $p < .05$. Finally, I regressed learning outcomes on both experimental condition and lesson perceptions, which revealed a statistically significant effect for lesson perceptions, β = .41, t (88) = 4.17, $p < .001$, but not for experimental condition, p = .19. These results suggest that perceptions of the lesson fully mediated the effect of experimental condition on learning outcomes. The path model for the mediation analysis described above is pictured in figure 3 below.
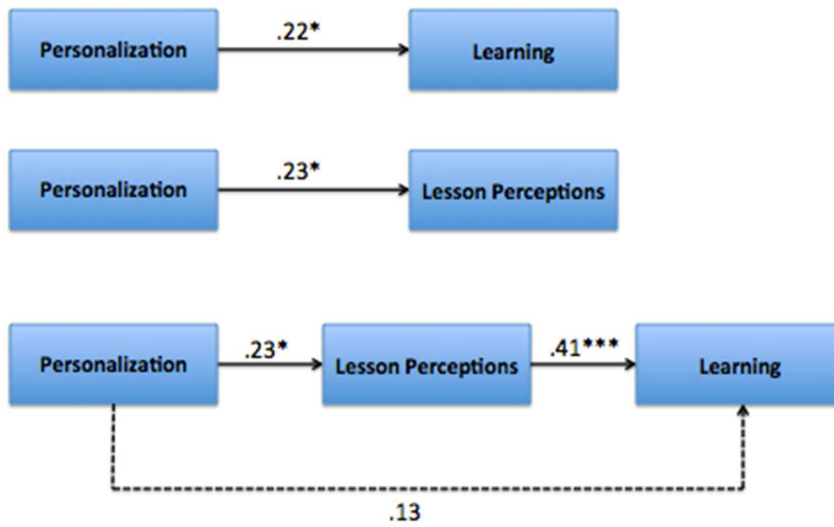
Figure 3. Experiment 1b. Lesson perceptions mediates the effect of the personalization principle on learning outcomes

CHAPTER 4

Experiment 2

Research Aim

According to the sociometer framework for self-esteem, people are constantly monitoring

their environments for signs of social inclusion and exclusion. Moreover, when signs of

inclusion or exclusion are registered, they can have a direct impact on individuals' state self-

esteem (Leary et al., 1995). Although much of the work on the relationship between social

cognition and self-esteem has focused on the negative effects of exclusion or rejection, there are

findings that suggest that feelings of inclusion are associated with positive state self-esteem as

well (Leary et al., 1995). Mayer's (2009) framework for the personalization principle features a

component of "social activation" that also appears to predict a positive outcome; namely, an

increase in learning when the material is socially activating. Given the apparent association

between social activation resulting from engaging in personalized learning materials and the

increase in positive perceptions of the materials found in experiment 1b, it could be the case that

what is driving the "social activation" is a perceived signal of social inclusion.

The nature of the alterations made to learning materials with respect to the

personalization principle include an increase in the use of pronouns such as "we", "you", and

"us", as well elements of a more conversational presentation style. In fact, most of the materials

that have been used to demonstrate the personalization principle, including Mayer's (2009),

make a point very early on to signal the reader that he or she is personally involved in the

learning activity. As to why such personal involvement should lead to better learning outcomes,

Grice's (1975) cooperation principle offers a potential explanation. Grice (1975) argued that a

social contract exists for the learner in which he or she is bound to make an effort to understand

the material and make sense of the information being presented. Based on Grice's (1975) theory and Mayer's (2009) framework for the personalization principle, it could be the case that the effort extended by the learner varies with the perceived salience of the cooperation principle. That is, the personalization principle may operate by underscoring the existence of the social contract between teacher and learner and, in turn, further motivate the learner to become invested in the learning event. Viewed through the lens of sociometer theory, however, the personal involvement that is evoked via the personalization principle may instead represent a signal of social inclusion, and lead to a corresponding increase in state self-esteem (Leary et al., 1995). Furthermore, a sociometric approach to the personalization principle is not mutually exclusive with the cooperation principle, because increases in self-esteem have been shown to be linked to prosocial behavior as well as effort and persistence toward a challenging task (Greenwald, 1980; Kernis, 1995).

The aim of the present experiment is to evaluate the possibility that what Mayer (2009) refers to as social activation vis-à-vis the personalization principle acts a signal of social inclusion, and that the subsequent increase in cognitive processing of the learner is a result of an increase in state self-esteem. More specifically, after learning with personalized materials, participants may experience an increase in their state self-esteem, causing them to evaluate the materials in a more positive fashion, and, in turn, lead to an increase in cognitive effort and investment that ultimately yields better learning outcomes.

Hypotheses for Experiment 2

Hypothesis 1: The personalization principle

Consistent with studies 1a, 1b, I hypothesize that learning outcomes will be better by a statistically significant margin for participants in the experimental condition than for participants

who were assigned to the control condition. Furthermore, I also hypothesize that experimental condition will directly predict participants' perceptions of the lesson, with participants in the experimental condition evaluating the lesson more positively than participants in the control condition.

Hypothesis 2: Personalization as a signal of inclusion

In the event that reading personalized learning materials acts as a signal for social inclusion, the individuals receiving those materials should exhibit an increase in state self-esteem that is not exhibited by individuals in the control group. I hypothesize that, on a measure of state self-esteem that is administered immediately following the completion of the learning materials, participants in the experimental group will show higher levels of state self-esteem than participants in the control group.

Hypothesis 3: Self-esteem as a mediator

In addition to hypothesizing an increase in state self-esteem for participants in the experimental group, I hypothesize that this increase in self-esteem will directly predict the extent to which participants positively evaluate the learning materials, even when controlling for experimental condition. Furthermore, given that results of experiment 1b suggest that lesson perceptions mediate the effect of the personalization principle on learning outcomes, I hypothesize that state self-esteem will act as a mediator between the effect of experimental condition on participants' positive evaluations of the lesson.

Hypothesis 4a: Lesson Perceptions as a Mediator

Hypothesis 4 aims to further extend the findings from experiment 1b by replicating the mediation model using participants' perceptions of the lessons as a mediator of the effect of the personalization principle on learning outcomes. Specifically, I hypothesize that the effect of the

personalization principle on learning outcomes will be fully mediated by positive evaluations of the learning material. In particular, the extent to which participants' evaluate the learning materials in a positive manner should directly predict the increase in learning outcomes for individuals in the experimental condition. The mediator variable for the present experiment is identical to the measure used in experiment 1b.

Hypothesis 4b: Lesson Perceptions as a Moderated Mediator

Given the evidence of both moderation and mediation from experiments 1a and 1b, I hypothesize that the proposed mediation model featuring lesson perceptions as the mediator variable for the effect of the personalization principle on learning will be moderated by the need to belong. More specifically, I hypothesize that the interaction between the need to belong and the experimental condition will positively predict learning outcomes. In addition, I hypothesize that the same need to belong by condition interaction will positively predict lesson perceptions. In turn, I predict that when I include lesson perceptions in the model with the interaction between the need to belong and the experimental condition with learning outcomes as the criterion, lesson perceptions will positively predict learning outcomes while the moderated effect of the personalization principle will drop to zero.

Hypothesis 5: The Need to Belong as a Moderator

Hypothesis 5 aims to provide further evidence for the moderating effect of the need to belong variable that was found in experiment 1a. Hence, I hypothesize that individuals' need to belong will positively interact with their experimental condition. More specifically, I hypothesize that the simple effects of the aforementioned interaction will reveal a statistically significant increase in overall learning for participants in the experimental (i.e., personalization) condition who are relatively high (one standard deviation above the mean) in need to belong.

Conversely, I hypothesize that participants in the experimental condition who have a relatively low need to belong (one standard deviation below the mean) will not exhibit learning outcomes that are statistically different from the control condition. The need to belong measure will be completed electronically at the outset of the study, independent of and prior to any of the lessons being completed.

Method for Experiment 2

Participants

Participants were undergraduate students enrolled in introductory level psychology courses at the University of New Hampshire. Students participated to earn course credit toward a research participation requirement. The sample for this experiment was comprised of 122 participants (*M* age=19.24 years, *SD*= .51), of whom 97% identified as white or Caucasian, 2% Hispanic, and 1% Asian or other ethnicity. Participants were awarded one hour of research participation credit for participating in this study.

Procedure

The participants were tested in one laboratory session lasting approximately one hour. Upon arrival to the laboratory, participants were assigned to a computer that ran a software program that administered the study. Participants first were presented with electronic documents indicating their informed consent and demographic variables before being randomly assigned to either the experimental (i.e., personalization) condition or the control condition. Depending on their condition, participants were presented with an electronic version of the lesson on lightning formation used in experiment 1 that either contained elements of the personalization principle or did not. The lightning lessons themselves and all instructions were identical in content to those used in experiment 1. Immediately following the completion of the

lightning lesson, participants were administered a state self-esteem scale (Heatherton & Polivy, 1991), followed by the 12-item measure of perceptions of the lesson that was used in experiment 1. Following the completion of the self-esteem and lesson perceptions measures, participants were tested on retention and transfer learning using a multiple choice quiz that was based on the open ended questions used in experiments 1a and 1b. All participants were then thanked, debriefed, and dismissed.

<u>Materials</u>

All of the materials used in the present study are identical to those used in experiment 1, with the exception of completing all study documents electronically. In addition, participants completed the state self-esteem scale immediately following the reading of the lightning lesson. The state self-esteem scale (Heatherton & Polivy) is a well-validated and reliable measure that has been successfully used in dozens of research studies (Google Scholar, 2015). The full measure can be found in the appendix. Participants also completed a questionnaire featuring scales that are not material to these analyses.

Results for Experiment 2

<u>Analyses for hypothesis 1: The personalization principle</u>

Participants' mean scores on the lightning lesson quiz for each condition were calculated. I performed an independent samples *t* test to evaluate the difference in learning outcomes for participants in the control condition and participants in the experimental condition. The results of the *t* test did not reveal a significant difference between the two groups, $p = .48$. I conducted another independent samples *t* test to evaluate the difference between the two groups in lesson perceptions. As predicted, there was a significant difference between the two groups, with the personalization condition reporting significantly more positive perceptions of the lightning

lesson, t (120) = 1.61, p = .05 (one-tailed), Cohen's d = .30. These results suggest a small-to-medium effect size, according to Cohen's guide (Cohen, 1988), for the experimental condition's effect on perceptions of the lightning lesson.

Analyses for hypothesis 2: Personalization as a signal of inclusion

To evaluate differences between groups in the measure of state self-esteem, an independent samples t test was conducted. In this instance, the t test did not reveal a significant difference between the experimental and control conditions, p = .65.

Analyses for hypothesis 3: Self-esteem as a mediator

The mediation model with self-esteem as the presumed mediator of the effect of the personalization principle on learning outcomes was tested following the procedures recommended by Baron and Kenny (1986). First, I conducted an ordinary least squares regression featuring experimental condition as the predictor variable and learning outcome as the criterion, which did not reveal a significant difference, p = .48. Because the experimental condition failed to predict both learning outcomes and state self-esteem in this instance, further mediation analyses were abandoned.

Analyses for Hypothesis 4a: Lesson Perceptions as a Mediator

The mediation model was tested following the procedures recommended by Baron and Kenny (1986). First, I conducted an ordinary least squares regression featuring experimental condition as the predictor variable and the quiz score as the criterion, which failed to reveal a significant effect of experimental condition, p = .48 I also conducted an ordinary least squares regression analysis using experimental condition as the predictor variable and lesson perceptions, the presumed mediator, as the criterion. The results revealed a significant difference between the groups for lesson perceptions, with the experimental condition perceiving the lightning lesson

more positively than the control condition, $\beta = .15$, $t\,(121) = 1.61$, $p = .05$ (one-tailed). Because the learning outcome criterion was not predicted by the experimental condition in this instance, further mediation analyses were not appropriate.

Analyses for Hypothesis 4b: Lesson Perceptions as a Moderated Mediator

The moderated mediation model was tested following the procedures for mediation recommended by Baron and Kenny (1986). First, I conducted an ordinary least squares regression featuring a product term of experimental condition and the need to belong as the predictor variable and the quiz score as the criterion, which revealed a statistically significant interaction, $b = .064$, $t\,(120) = 2.06$, $p < .05$. Second, I conducted an ordinary least squares regression analysis using the condition by need to belong product term as the predictor variable and lesson perceptions, the presumed mediator, as the criterion. The test again revealed a significant interaction, $b = .72$, $t\,(120) = 1.97$, $p < .05$. Lastly, when both the condition by need to belong product term and lesson perceptions were included as predictors of learning outcomes, lesson perceptions significantly predicted learning outcomes, $b = .04$, $t\,(120) = 3.65$, $p < .001$. The final model also tested the effect of the condition by need to belong interaction on learning outcomes while including lesson perceptions in the model. Although the interaction term still significantly predicted learning outcomes, $b = .061$, $t\,(120) = 2.05$, $p < .05$, the unstandardized interaction coefficient became smaller when lesson perceptions was included in the model. These results suggest partial mediation of the personalization principle/need to belong interaction by participants' perceptions of the learning lesson in predicting learning outcomes.

Analyses for Hypothesis 5: The Need to Belong as a Moderator

To test the hypothesized interaction between experimental condition and need to belong, ordinary least squares regression was used. First, a test of main effects including experimental

condition and need to belong revealed no significant main effects for condition, $p = .51$, or the need to belong, $p = .36$. To test the effect of a condition by need to belong interaction, a product term representing an interaction between experimental condition and need to belong was added to the model. As predicted, the interaction was statistically significant, $b = .06, p < .05$. Upon further probing of the interaction, tests of simple effects revealed a statistically significant effect of experimental condition at relatively high (1 *SD* above the mean) levels of need to belong, $b = .10, p < .05$, but not at relatively low (1 *SD* below the mean) levels of need to belong, $p = .321$. These results are consistent with the hypotheses for this experiment as well as experiment 1b in that they suggest that the personalization principle is only applicable for individuals who are relatively high in the need to belong. The interaction described above is plotted in figure 4 below.
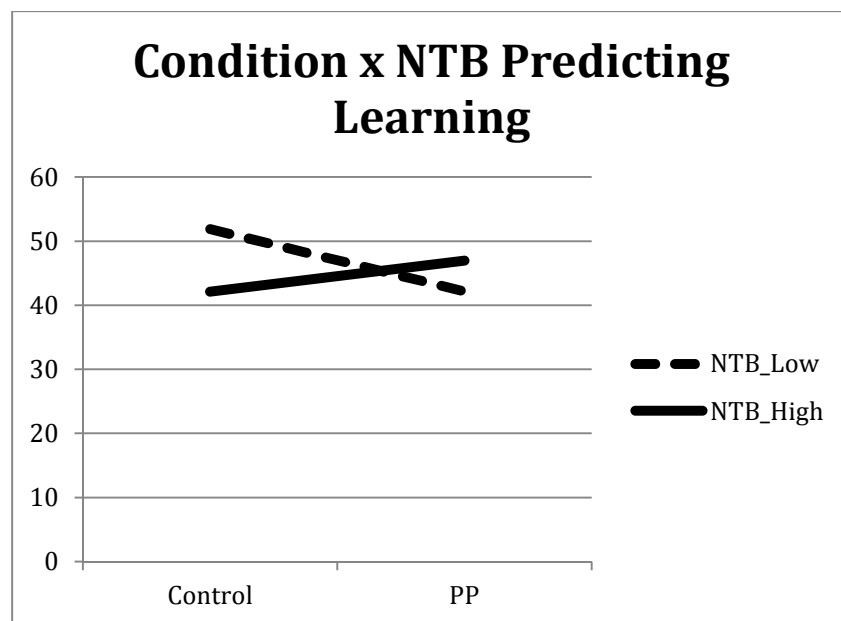

Condition x NTB Predicting Learning

Legend:
- NTB_Low (dashed)
- NTB_High (solid)

X-axis: Control, PP
Y-axis: 0 to 60

Figure 4. Experiment 2. Interaction of experimental condition and the need to belong predicting learning outcomes.

Chapter 5

Experiment 3

<u>Research Aim</u>

The research aim of experiment 3 is to once again replicate the effects of moderation and mediation that were found and replicated already in a laboratory via the lightning lesson in experiments 1a, 1b, and 2. Experiment 3, however, aims to replicate the aforementioned effects using a different learning lesson, albeit this time in the laboratory rather than in a live classroom. Moreover, the lesson used in experiment 3 is taken directly from an introductory psychology course that used the lesson as part of its online curriculum. Just as the empirical support the personalization principle has received in the laboratory created a need to examine the effect in a live classroom, the natural next step after repeated replications of moderation and mediation using a lightning lesson is to examine these effects using a different kind of lesson altogether. The generalizability of findings related to the personalization principle has been critically evaluated in multiple learning disciplines (Ginns, et al., 2013), and in order to achieve a broader level of generalizability for the findings pertaining to mediation and moderation, the same standards should apply.

The present research aims to address the aforementioned limitations, and provide a replication of Mayer's (2009) personalization principle using an authentic undergraduate lesson in a laboratory setting. Furthermore, the present experiment aims to replicate the findings of moderation and mediation from experiments 1a and 1b, respectively, as well as those from experiment 3. Consequently, the procedures for this experiment closely follow those used in experiment 3; the measures containing the mediator variable will be administered immediately following completion of the lesson and before the administration of the quiz. Once again, the

materials used in this experiment were constructed using words alone. The reasons for the absence of a multimedia component in the learning materials are once again twofold; 1) There have not been, to the best of my knowledge, replications of the personalization principle using a non-multimedia lesson; and 2) given the relative unpredictability associated with using these learning materials for the first time in the laboratory, including multimedia may only serve to confound the results due a ceiling effect, whereas there is no good theoretical reason why words alone should not produce the hypothesized effects. To avoid this potential confound, the personalization principle as it pertains to experiment 3 will be examined in isolation from other known principles of the cognitive theory of multimedia learning.

Hypotheses for Experiment 3

Hypothesis 1: The personalization principle

Consistent with experiments 1a, 1b, and 2, I hypothesize that learning outcomes will be better by a statistically significant margin for participants in the experimental personalization condition than for participants who were assigned to the control condition. Furthermore, I also hypothesize that experimental condition will directly predict participants' perceptions of the lesson, with participants in the experimental condition evaluating the lesson more positively than participants in the control condition.

Hypothesis 2a: Lesson Perceptions as a Mediator

Hypothesis 2 aims to further extend the findings from experiments 1b and 2 by replicating the mediation model using participants' perceptions of the lessons as a mediator of the effect of the personalization principle on learning outcomes. Specifically, I hypothesize that the effect of the personalization principle on learning outcomes will be fully mediated by positive evaluations of the learning material. In particular, the extent to which participants'

evaluate the learning materials in a positive manner should directly predict the increase in learning outcomes for individuals in the experimental condition. The mediator variable for the present experiment is identical to the measure used in experiment 3.

<u>Hypothesis 2b: Lesson Perceptions as a Moderated Mediator</u>

Given the evidence for moderated mediation in experiment 3, I hypothesize that the proposed mediation model featuring lesson perceptions as the mediator variable for the effect of the personalization principle on learning will be moderated by the need to belong. More specifically, I hypothesize that the interaction between the need to belong and the experimental condition will positively predict learning outcomes. In addition, I hypothesize that the same need to belong by condition interaction will positively predict lesson perceptions. In turn, I predict that when I include lesson perceptions in the model with the interaction between the need to belong and the experimental condition with learning outcomes as the criterion, lesson perceptions will positively predict learning outcomes while the moderated effect of the personalization principle will drop to zero.

<u>Hypothesis 3: The Need to Belong as a Moderator</u>

Hypothesis 3 aims to provide further evidence for the moderating effect of the need to belong variable that was found in experiments 1a and 3. Hence, I hypothesize that individuals' need to belong will positively interact with their experimental condition. More specifically, I hypothesize that the simple effects of the aforementioned interaction will reveal a statistically significant increase in overall learning for participants in the experimental (i.e., personalization) condition who are relatively high (one *SD* above the mean) in need to belong. Conversely, I hypothesize that participants in the experimental condition who have a relatively low need to belong (one *SD* below the mean) will not exhibit learning outcomes that are statistically different

from the control condition. The need to belong measure will be completed electronically at the outset of the study, independent of and prior to any of the lessons being completed.

Method for Experiment 3

Participants

       Participants for experiment 3 were undergraduate students enrolled in introductory level psychology courses at the University of New Hampshire. Students participated to earn course credit toward a research participation requirement. The sample for this experiment was comprised of 84 participants (*M* age=18.7 years, *SD*= .58, of whom 98% identified as white or Caucasian, < 2% Hispanic, and < 1% Asian or other ethnicity Participants were awarded one hour of research participation credit for participating in this study.

Procedure

       The participants were tested in one laboratory session lasting approximately one hour. Upon arrival to the laboratory, participants completed documents indicating their informed consent, demographic variables, and the need to belong measure before being randomly assigned to either the experimental condition or the control condition. After group assignment, the participants were presented with a brief electronic lesson on the topic of schizophrenia. The length of the lesson as well as the instructions for completing the schizophrenia lesson were identical to those given to participants for the lightning lessons in experiments 1 and 3. Participants in the personalization condition were presented with a lesson constructed according to the personalization principle, and participants in the control group were presented with a lesson that did not feature elements of the personalization principle. Immediately following the completion of the lesson, participants were tested on retention and transfer learning using a 10-item multiple choice test. All of the quiz questions have been used in prior work using identical

methodology and have been validated insofar as they are a useful measure of differentiated learning outcomes as a result of interventions pertaining the cognitive theory of multimedia learning. All participants were then thanked, debriefed, and dismissed.

Materials

All of the materials used in the present study were identical to those used in experiment 3, with the exception of the use of a lesson on schizophrenia instead of a lightning lesson, and its corresponding 10-item multiple choice test. In addition, participants completed several other scales as part of a questionnaire that was not directly relevant to these hypotheses.

Results for Experiment 3

Analyses for hypothesis 1: The personalization principle

Participants' mean scores on the multiple choice test for the schizophrenia lesson were calculated for each condition. An independent samples t test was conducted to evaluate the difference in learning outcomes for participants in the control condition and participants in the experimental condition. The results of the t test did not reveal a significant difference between the two groups, $p = .24$. Another independent samples t test was conducted to evaluate the difference between the two groups in lesson perceptions. As predicted, there was a significant difference between the two groups, with the personalization condition ($M = 4.80$, $SD = 1.16$) reporting significantly more positive perceptions of the schizophrenia lesson than the control group ($M = 4.32$, $SD = 1.02$), $t (120) = 1.61$, $p = .05$ (one-tailed), Cohen's $d = .43$. These results suggest a medium effect size, according to Cohen's guide (Cohen, 1988).

Analyses for Hypothesis 2a: Lesson Perceptions as a Mediator

The mediation model was tested following the procedures recommended by Baron and Kenny (1986). First, I conducted an ordinary least squares regression featuring experimental condition as the predictor variable and the quiz score as the criterion, which failed to reveal a significant effect of experimental condition, $p = .60$. I also conducted an ordinary least squares regression analysis using experimental condition as the predictor variable and lesson perceptions, the presumed mediator, as the criterion. The results revealed a significant difference between the groups for lesson perceptions, with the experimental condition perceiving the schizophrenia lesson more positively than the control condition, $\beta = .26$, $t (83) = 2.29$, $p < .05$. Because the learning outcome criterion was not predicted by the experimental condition in this instance, further mediation analyses were not appropriate.

Analyses for Hypothesis 2b: Lesson Perceptions as a Moderated Mediator

The moderated mediation model was tested following the procedures recommended by Baron and Kenny (1986). First, I conducted an ordinary least squares regression featuring a product term of experimental condition and the need to belong as the predictor variable and the quiz score as the criterion, which revealed a statistically significant interaction, $b = .97$, $p < .05$. Second, I conducted an ordinary least squares regression analysis using the condition by need to belong product term as the predictor variable and lesson perceptions, the presumed mediator, as the criterion. The test did not reveal a significant interaction, $p = .368$ Because the presumed mediator variable, lesson perceptions, was not predicted by the condition by need to belong interaction, further testing for moderated mediation was not appropriate.

Analyses for Hypothesis 3: The Need to Belong as a Moderator

To test the hypothesized interaction between experimental condition and need to belong, ordinary least squares regression was used. First, a test of main effects including experimental

condition and need to belong revealed no significant main effects for condition, $p = .66$, or the need to belong, $p = .26$. To test the effect of a condition by need to belong interaction, a product term representing an interaction between experimental condition and need to belong was added to the model. As predicted, the interaction was statistically significant, $b = .97$, $p < .05$. Upon further probing of the interaction, tests of simple effects revealed a statistically significant effect of experimental condition at relatively high (1 *SD* above the mean) levels of need to belong, $b = 1.30$, $p = .05$, but not at relatively low (1 *SD* below the mean) levels of need to belong, $p = .187$. These results are consistent with the hypotheses for this experiment as well as experiments 1b and 3 in that they suggest that the personalization principle may be only applicable for individuals who are relatively high in the need to belong. The interaction described above is plotted in figure 5 below.
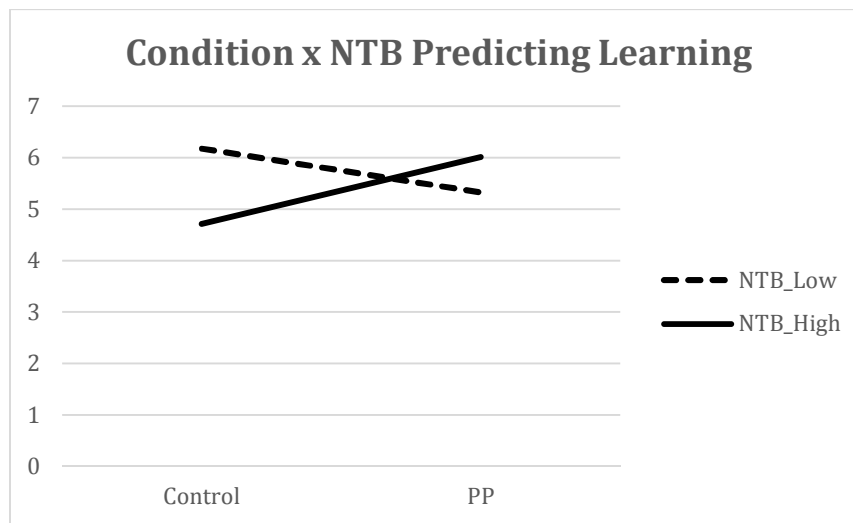

Figure 5. Experiment 3. Interaction of experimental condition and the need to belong predicting learning outcomes.

CHAPTER 6

Experiment 4

Research Aim

Like much of the work researching Mayer's (2009) principles of multimedia learning, there has been a considerable amount of evidence for the personalization principle in a laboratory setting (see Ginns et al., 2013) . Given the empirical support the personalization principle has received in the laboratory, examining the application of these principles in a live classroom environment is the next important challenge for researchers in this area. This challenge has already begun to receive attention, yielding promising results that are consistent with laboratory findings for several of the principles of multimedia learning (Govaere Jan et al., 2012; Issa et al., 2011). Such work suggests that the application of the principles of the cognitive theory of multimedia learning may have some ecological validity. These studies, however, have several limitations that constrain the generalizability of their findings. This work attempting to demonstrate such external validity has been limited in its scope both with regard to the type of information being learned as well as its population of learners. For instance, extant work has only examined the effects of the principles of multimedia learning using a single study pertaining to only one topic of learning (Govaere et al., 2012; Issa et al., 2011). In addition, the demographic of the participants in these studies has been unique (i.e., students in medical school or other graduate level courses). Moreover, in the context of the present study, the effect of the personalization principle in particular has not been tested in a live classroom setting at all. In order to further generalize the laboratory findings regarding the personalization principle, more

replications using a variety of learning topics and a more representative samples of students is needed.

The present research aims to address the aforementioned limitations and provide a valid account of Mayer's (2009) personalization principle in an authentic undergraduate classroom setting. Furthermore, the present study aims to replicate the findings of moderation and mediation from experiments 1a and 1b, respectively. Consequently, the procedures for this experiment closely follow those used in experiment 1b; the measures containing the mediator variable will be administered immediately following completion of the lesson and before the administration of the quiz. One important distinction between the present study and prior work examining the personalization principle is that the materials used in this experiment were constructed using words alone. The reasons for the absence of a multimedia component in the learning materials are twofold; 1) there has not been, to my knowledge, a replication of the personalization principle using non-multimedia materials; and 2) the added "noise" of conducting the present study with actual students in a classroom setting may attenuate the effect of the personalization principle. It could be the case, for example, that the effect of using multimedia materials causes learning outcomes to approach a statistical ceiling. To avoid this potential confound, the personalization principle was examined in isolation from other known principles of the cognitive theory of multimedia learning.

Hypotheses for Experiment 4

Hypothesis 1: The Personalization Principle

The present experiment is a series of replications of the personalization principle, conducted using electronic materials administered to a large section of an introductory psychology course at the University of New Hampshire. I hypothesized that, across two separate

replications using two different learning topics, undergraduate students in an introductory level course will show better learning outcomes (i.e., higher quiz scores following the presentation of materials) when provided with materials constructed according the personalization principle, compared to students who are provided with materials that were constructed without the use of personalization. The learning outcomes that are hypothesized to differ between the experimental groups are comprised of 10 multiple-choice transfer quiz questions that are completed by the participants following the reading of the materials.

Hypothesis 2: The Need to Belong as a Moderator

Just as hypothesis 1 aims to provide evidence of ecological validity for the effect of the personalization principle, hypothesis 2 aims to provide similar evidence for the moderating effect of the need to belong variable that was found in experiment 1a. I hypothesize that individuals' need to belong will positively interact with experimental condition. More specifically, the simple effects of the aforementioned interaction will reveal a statistically significant increase in overall learning for participants in the experimental (i.e., personalization) condition who score relatively high (one standard deviation above the mean) on need to belong scale. Conversely, participants in the experimental condition who have score relatively low on the need to belong scale (one standard deviation below the mean) will not exhibit learning outcomes that are statistically different from the control condition. The need to belong measure will be completed electronically at the outset of the study, independent of and prior to any of the lessons being completed.

Hypothesis 3: Lesson Perceptions as a Mediator

Hypothesis 3 aims to further extend the findings from experiment 1b by replicating the mediation model using participants' perceptions of the lessons as a mediator of the effect of the

personalization principle on learning outcomes. I hypothesize that the effect of the personalization principle on learning outcomes will be fully mediated by positive evaluations of the learning material. In particular, the extent to which participants' evaluate the learning materials in a positive manner should directly predict the increase in learning outcomes for individuals in the experimental condition. The mediator variable for the present study is an abbreviated 6-item version of the 12-item Likert-scale measure used in experiment 1b.

Method for Experiment 4

Participants

Participants were undergraduate students enrolled in a large section of an introductory level psychology course at the University of New Hampshire ($N = 248$). The sample for this experiment was comprised of 248 participants (M age = 18.61 years, $SD = .34$), of whom 92% identified as white or Caucasian, 3% Hispanic, and 5% Asian or other ethnicity. Students participated in this study as part of their required course assignments.

Procedure

Participants were asked to complete a series of online learning modules as a requirement for course credit. All participants were randomly assigned to either the experimental group or the control group prior to beginning the experiment. During the semester, students were tasked with completing a learning module as an out-of-class assignment. The content of the learning module roughly corresponded with the material that was to be covered in the students' psychology course at that particular point in the semester. To avoid the confound of prior exposure to content of the module lessons, the module was only able to be completed before its respective chapter had been covered in the course. The learning module was accessible using the Internet, and so the students had the option of completing the module on their own time outside

of class. To complete the module, the students needed to log into their introductory psychology course website and select the appropriate assignment link that contained the module. The learning module contained two separate lessons, each on a different topic (i.e., Gestalt psychology, signal detection theory). Each lesson began with a series of text-only slides presented one at a time at the students' own pace. Immediately following the viewing of the slides, students were asked to complete the abbreviated measure for perceptions of the lesson, followed by a 10-question multiple choice quiz featuring learning transfer questions pertaining to the slides they just viewed. After completing the quiz, the students received credit for completing the learning module. At the end of the semester, all students were contacted with debriefing information regarding the study and given an opportunity to officially opt out of participating. Similar debriefing methods have been used in the past with similar studies without any problems.

<u>Materials</u>

The learning module included two different lessons corresponding to the sensation and perception chapter typically found in an introductory psychology textbook: Gestalt psychology and signal detection theory. In order for the students to receive course credit, they must have completed each of the two module lessons.

The learning module was adapted from modules used in a prior study with identical methodology. These modules were originally constructed by myself with the help of researchers at the Center for Excellence in Teaching and Learning at the University of New Hampshire. The module used in this study was adapted to contain only text (i.e., non-multimedia). In addition, slides that are adapted according to the personalization principle were constructed such that for each lesson, there was a "personalized" set of slides and a "non-personalized" set of slides that

were administered to the experimental group and the control group, respectively. All of the essential information for each lesson remained completely intact for both the experimental and control group. Aside from the components pertaining to the personalization principle, the two sets of slides for each lesson were identical. A sample of the slides from the module lessons can be found in the appendix.

The six-item measure of students' perceptions of the lesson was constructed by condensing the original 12-item measure into six items by combining items and re-wording them to include a comprehensive account of the original measure. The condensed measure can be found in the appendix. All items were completed using a 7-point Likert-scale (*1: strongly disagree, 7: strongly agree*). This six item measure showed excellent internal consistency (Cronbach's α = .91), and was presented with identical item order and scale placement in both lessons.

The transfer quizzes for the learning modules consisted of 10 multiple choice questions per lesson (i.e., two quizzes for the module). All of the quiz questions have been used in prior work using identical methodology and have been validated insofar as they are a useful measure of differentiated learning outcomes as a result of interventions pertaining the cognitive theory of multimedia learning. Each quiz question was worth 10 points. Hence, students' were able to score between 0-100 points on each quiz.

Results for Experiment 4

Analyses for Hypothesis 1: The Personalization Principle

Participants' mean scores on each lesson quiz for each condition were calculated. For the Gestalt lesson, I performed an independent samples *t* test to evaluate the difference in learning outcomes for participants in the control condition and participants in the experimental condition.

As predicted, the experimental group scored higher on the lesson test ($M = 63.0$, $SD = 20.3$) than the control group ($M = 56.6$, $SD = 19.2$). The difference between the groups was statistically significant, t (246) = 2.54, $p < .05$, Cohen's $d = .32$. For the signal detection theory lesson, I performed an independent samples t test to evaluate the difference in learning outcomes for participants in the control condition and participants in the experimental condition. As predicted, the experimental group scored higher on the lesson test ($M = 61.2$, $SD = 18.4$) than the control group ($M = 54.6$, $SD = 20.1$). The difference between the groups was statistically significant, t (246) = 2.66, $p < .05$, Cohen's $d = .34$. These results suggest a medium effect size, according to Cohen's guide (Cohen, 1988), and a successful replication of the effect of the personalization principle with both the Gestalt lesson and the signal detection lesson.

Analyses for Hypothesis 2: The Need to Belong as a Moderator

To test the hypothesized interaction between experimental condition and the need to belong for both the Gestalt and signal detection lessons, I used ordinary least squares regression. First, a test of main effects for the Gestalt lesson including experimental condition and the need to belong revealed a significant main effect for condition, $b = .66$, $p < .05$, but not for the need to belong, $p = .94$. To test the effect of a condition by need to belong interaction, a product term representing an interaction between experimental condition and need to belong was added to the model. The interaction was not statistically significant, $p = .29$. For the signal detection lesson, a test of main effects revealed a significant main effect for condition, $b = .68$, $p < .05$, but not for the need to belong, $p = .82$. To test the effect of a condition by need to belong interaction, a product term representing an interaction between experimental condition and need to belong was added to the model. The interaction was not statistically significant, $p = .36$. These results

suggest that the need to belong did not moderate the effect of the personalization principle in this instance.

Analyses for Hypothesis 3: Lesson Perceptions as a Mediator

The mediation model was tested following the procedures recommended by Baron and Kenny (1986). For the Gestalt lesson, I first conducted an ordinary least squares regression featuring experimental condition as the predictor variable and the quiz score as the criterion, which revealed significant effect of experimental condition, $\beta = .16$, $t(246) = 2.54$, $p < .05$. Second, I conducted an ordinary least squares regression analysis using experimental condition as the predictor variable and lesson perceptions, the presumed mediator, as the criterion. Although the difference between conditions was in the predicted direction, the experimental condition failed to predict lesson perceptions at a statistically significant level, $p = .324$. Because the mediator variable could not be predicted by experimental condition, further mediation analyses were abandoned for the Gestalt lesson. For the signal detection lesson, I first conducted an ordinary least squares regression featuring experimental condition as the predictor variable and the quiz score as the criterion, which revealed significant effect of experimental condition, $\beta = .18$, $t(246) = 2.66$, $p < .05$. Second, I conducted an ordinary least squares regression analysis using experimental condition as the predictor variable and lesson perceptions, the presumed mediator, as the criterion. Although the difference between conditions was once again in the predicted direction, the experimental condition failed to predict lesson perceptions at a statistically significant level, $p = .42$. Because the mediator variable could not be predicted by experimental condition, further mediation analyses for the signal detection lesson were abandoned.

Chapter 7

<u>General Discussion</u>

In four experiments, I examined in detail and attempted to provide a theoretically supported model explaining the effects of social agency on learning outcomes. More specifically, I have examined moderating variables that were hypothesized to interact with the personalization principle in producing better learning outcomes. I have also proposed several mediation models aimed at explaining the underlying mechanism behind social agency. Taken all together at the broadest level, this dissertation represents an examination of the role of individual differences in the effectiveness of the personalization principle as a pedagogical strategy.

The current research provides multiple replications of existing work (Ginns et al., 2013, Mayer, 2009) as well as extends those findings. According to Mayer (2009), social agency represents one of the ways that instructors can foster generative processing with their learning materials. Although Mayer's (2009) cognitive theory of multimedia learning has received considerable attention most recently in the domain of teaching and learning science, the construal of learning as a social event has existed in the research literature for over 30 years, dating back to Grice's (1975) cooperation principle. As I will outline below, it is this essential premise, that there is an implicit agreement between the learner and the author or instructor for the former to try hard to make sense of incoming material, and the latter to try to explain the material as clearly as possible, that is combined with Mayer's (2009) social agency theory to ignite the logic behind the central hypotheses in this dissertation.

The aim of experiments 1a and 1b was to replicate of the effects of Mayer's (2009) personalization principle and provide initial evidence of statistical moderation and mediation

using previously established (i.e., the need to belong) as well as newly created (perceptions of the lesson) measures. Evidence for a model of moderation suggests that the personalization principle may differentially impact learners in different circumstances, while evidence of mediation provides insight toward the underlying mechanisms that drive the effect. Indeed, the results from experiment 1a provide the first evidence, to my knowledge, of statistical moderation of the effect of the personalization principle. The specific hypotheses pertaining to this moderation are founded on the premise that humans have a fundamental need to belong (Baumeister & Leary, 1995), and that triggering that motivation can significantly affect behavior (Leary & Baumeister, 2000; Leary & Downs, 1995; Leary & Guadagno, 2004; Leary et al., 1995). Mayer's (2009) model of social agency posits that embedding social cues in learning materials causes an activation of a "social response" in the learner, which, in turn, increases generative processing and subsequently learning outcomes. Mayer's (2009) work is consistent with most of the research on humans' need to belong, particularly with regard to the notion that people are constantly vigilant for social cues in their environment (Gardner et al., 2000; Pickett et al., 2004).

One element of this social proclivity that Mayer's (2009) social agency theory does not address, however, is the extent to which individuals might dispositionally *vary* in experiencing social activation. If, indeed, social agency functions as Mayer (2009) theorizes (i.e., learners' detection of social cues), then it follows that the extent to which learners are sensitive to such social cues may play an important role. In experiment 1a, there was a main effect overall of the personalization principle, successfully replicating prior work (see Ginns et al., 2013). In addition, I found that a measure of individual differences in what may be colloquially referred to as "social sensitivity" (in this case, the need to belong) played an important role, indeed.

Individuals' need to belong is essentially an indicator of their chronic preoccupation with their social environments. As such, I theorized that this preoccupation directly impacts the likelihood of a social response from a learner when presented with learning materials that are embedded with social cues (i.e., the personalization principle). The results of experiment 1a provide initial evidence for this theory, showing that the enhanced learning outcomes associated with the personalization principle are especially likely for learners with a high need to belong. Moreover, the results of experiment 1a suggest that it may be primarily, or even exclusively, the individuals with a high need to belong that are receiving the learning benefit. In fact, mean quiz scores actually decreased, albeit not significantly, for learners with a low need to belong who received the personalized materials.

In a similar vein as experiment 1a, experiment 1b aimed to foster a better understanding of how social agency works to improve learning outcomes. In experiment 1b, however, the focus was not on potential moderating variables, but rather variables that may explain, through statistical mediation, the underlying mechanism through which "social activation" leads to better learning outcomes. More specifically, the focus was on the second step in Mayer's (2009) social agency model; where the learner goes from the activation of a social response from the learning materials to an increase in generative processing.

One of the properties of the personalization principle that ties it into other areas of research is the notion that people learn better from a "conversational style" of information presentation, rather than a more "formal style" (Bretzing & Kulhavy, 1981), as well as the notion that presenting information in a narrative style (i.e., telling a story) is more easily understood by learners than information presented in more definitional or expository style (Graesser et al., 2002). The common thread between all three lines of work is that, in the conditions of interest,

the learner is presumably perceiving the information in a particular way that facilitates processing and understanding. This is precisely where Mayer (2009) leaves us with his social agency model; the activation of a certain response to the learning material somehow improves information processing. But why would such activation and subsequent benefit exist? What is specifically different about the way the learner perceives the learning materials that should facilitate better learning outcomes?

The findings from experiment 1b begin to shed light on the aforementioned learner perceptions, or social activation, in response to the personalization principle. These results provide evidence for a mediation process involving the learner's subjective perceptions of the learning materials that begins to explain why social activation should lead to better learning outcomes. In fact, in experiment 1b it was the case that the extent to which participants more positively perceived the lesson *fully* mediated the effect of the personalization principle. I theorized that when the learner achieves the stage of social activation, his or her subjective perceptions of the lesson are likely to improve. That is, detection of the social cues embedded in the learning materials should cause learners to *like* the learning experience more than if such cues were not present. To be clear, I am not proposing that simply the extent to which a learner likes the lesson is a driving force behind enhanced learning outcomes. Rather, I argue that the improved subjective evaluation of lessons is merely a symptom of the social activation process. Hence, as ultimately proposed in experiment 2, I believe there is something more complex going on that is causing both the improved subjective perceptions and the enhanced learning outcomes. As it stands, however, the results from experiment 1b represent the only successful findings, to my knowledge, that provide evidence for mediation of the personalization principle by any variable.

Experiment 4 also represents perhaps the first research venture to take on the challenge of implementing pedagogical strategies that have been successful in the laboratory in a real-life classroom. With regard to the cognitive theory of multimedia learning (Mayer, 2009), the extant work attempting to establish such external validity is limited, and perhaps non-existent in the case of the personalization principle. Hence, the findings demonstrating a replication of the effect of the personalization principle with real students in a real undergraduate class are a significant step in the right direction for the live classroom implementation of multimedia principles in general. Given the disadvantage associated with collecting data outside of the laboratory (most data in experiment 4 was acquired from students using their own computers, perhaps most of them in their dorm rooms), the replication in experiment 4 is especially promising. Indeed, the added "experimental noise" that comes with collecting data from a real classroom is one of the greatest challenges for the continued implementation of successful laboratory strategies.

Although I was able to replicate the effect of the personalization principle in experiment 4, the models for both mediation and moderation that were advanced in experiment 1 were not replicated. A challenge for future experiments will be to devise a way to potentially offset the relatively comfortable and uncontrolled setting that most students likely found themselves in while completing the modules, and the need to belong and mediator variables as well.

Experiment 2 aimed to replicate experiments 1a and 1b, as well as provide a novel mediation hypothesis that could further explain the mechanism of social activation improving learning. The successful replication of moderation featuring the need to belong variable and mediation via lesson perceptions using the same lightning lesson with a different sample are excellent indicators for the reliability of those findings. Although it was the case that the same

mediation model used in experiment 1b did not successfully replicate in experiment 2, it is encouraging that the model shows evidence of partial mediation when the experimental condition is moderated by the need to belong (i.e., moderated mediation). These findings provide more evidence for the role of lesson perceptions regarding social activation, as well as converging evidence for the moderating role of the need to belong.

The novel hypothesis of experiment 2, the mediating role of state self-esteem in social activation, represents an attempt to further understand the mechanism that is at work when the learner becomes socially activated, and in turn, tends to perceive the lesson more positively. My theory behind this hypothesis was based on Leary et al.'s (1995) sociometer theory, which argues that an individual's self-esteem at any given moment may be described as a reflection of their current social standing. Furthermore, Leary et al.'s (1995) "sociometer" represents a gauge of sorts, designed to detect social cues in one's environment. The predictive validity of sociometer theory is well documented (Leary & Baumeister, 2000; Leary & Downs, 1995; Leary & Guadagno, 2004; Leary et al., 1995), and so I theorized that it was the sociometer that was working in the learner's favor when learning benefits arose from the personalization principle. More specifically, the sociometer should play a primary role in the detection of social cues (moderated by individual differences in the need to belong, of course), which would in turn motivate the learner to engage the material on a deeper level. It was my thought that by fulfilling their end of the bargain, per Grice's (1975) cooperation principle, especially when presented in the context of a social opportunity, learners would experience an increase in state self-esteem that would in turn mediate the effect of personalization on learning outcomes. This theory hinges on several premises: that the state self-esteem scale that was used is an adequate indicator of the status of one's sociometer, that the detection of social cues via the personalization

principle is tantamount to perceiving a social opportunity, and that exploiting such a social opportunity causes a boost in the individual's sociometer (i.e., their state self-esteem).

The majority of the research literature pertaining to self-esteem and sociometer theory focus on the impact of *decrements* to self-esteem (e.g., Leary, 2004), while very few address the potential for positive gain or its associated effects. Indeed, it could be the case that the social activation involved in social agency does not lead to a measurable self-esteem increase due to a ceiling effect. That is, because most individuals' baseline for self-esteem is quite high, the boost given from sociometer feedback after social activation from the personalization principle may not register on the self-report measure. It could be the case, for instance, that such an effect may be more observable in an instance where an individual's sociometer is relatively low. In addition, there may be other ways to measure the social impact of the personalization principle that could offer insight as to how social activation leads to both positive perceptions of the lesson as well as enhanced learning outcomes; this is surely a challenge for future research.

Finally, experiment 3 serves as yet another attempt at replication of the initial findings of moderation and mediation, this time also increasing the generalizability of the findings by using a real lesson that was developed for use in the classroom. With regard to moderation, the findings of experiment 3 converge quite nicely with those from experiments 1a and 2 to make a strong case for the need to belong as reliable moderator of the personalization principle. Such evidence for the need to belong moderating the effect of the personalization principle on learning outcomes suggests that, indeed, there is a process of social activation as Mayer (2009) argues, and also that there is variability in how sensitive people are to experiencing that process. Furthermore, consistent with the overarching theme of the present research, the evidence from

experiments 1, 2, and 3 suggests that existing theoretical frameworks in social psychology such as the need to belong are quite applicable in an educational setting.

Through three separate samples using two different lessons, the pattern of findings for moderation was the same in each case. Given these results, it seems plausible to make the argument that the personalization principle should only benefit those individuals who are socially preoccupied enough to achieve the social activation in step 2 of Mayer's (2009) social agency theory. Furthermore, for the individuals who are relatively low in the need to belong, there is strong evidence that the personalization principle does nothing to help their learning. Moreover, the results showed a consistent pattern of a decrease in mean test scores for those individuals who were presented with personalized learning materials. It could be the case that in absence of the seemingly beneficial social activation that is achieved by those high in the need to belong, the elements of the personalization principle may only serve as extraneous distractions. It could be the case, for example, that certain individuals learn better in a more formal or expository style. The role of such individual differences with regard to the personalization principle and other pedagogical strategies is another challenge for future research.

Altogether, the present body of research is an attempt to unite empirical observations and theory from the two relatively distinct sub-disciplines in psychological research of classroom teaching and learning and interpersonal dynamics, with the hope of creating a coherent and useful framework that further advances what we know about how people learn. Prior work such as Mayer (2009) has begun to illuminate this path, so to speak, although it is clear that more research is needed to further investigate these connections and reveal the inner workings of the observations that appear to overlap between disciplines. The social component of classroom learning, in general, is a largely under researched area that, if the present research is any

indication, may represent a fruitful line of novel and impactful research that can help bridge the

gap between the laboratory and the classroom.

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APPENDIX A

The Need to Belong Scale (Leary et al., 2005)

Instructions: For each of the statements below, indicate the degree to which you agree or disagree with the statement by writing a number in the space beside the question using the scale below:

1	2	3	4	5	6	7
Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree

1. If other people don't seem to accept me, I don't let it bother me._____

2. I try hard not to do things that will make other people avoid or reject me. _____

3.   I seldom worry about whether other people care about me. _____

4. I need to feel that there are people I can turn to in times of need. _____

5. I want other people to accept me. _____

6. I do not like being alone. _____

7. Being apart from my friends for long periods of time does not bother me. _____

8. I have a strong need to belong. _____

9.   It bothers me a great deal when I am not included in other people's plans. _____

10. My feelings are easily hurt when I feel that others do not accept me. _____

APPENDIX B

The State Self-Esteem Scale (Heatherton & Polivy, 1991)

Instructions: This is a questionnaire designed to measure what you are thinking at this moment. There is, of course, no right answer for any statement. The best answer is what you feel is true of yourself at this moment. Be sure to answer all of the items using the accompanying scale as they are true for you RIGHT NOW.

1	2	3	4	5	6	7
Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree

1. I feel confident about my abilities. _____

2. I am worried about whether I am regarded as a success or failure. _____

3. I feel satisfied with the way my body looks right now. _____

4. I feel frustrated or rattled about my performance. _____

5. I feel that I am having trouble understanding things that I read. _____

6. I feel that others respect and admire me. _____

7. I am dissatisfied with my weight. _____

8. I feel self-conscious. _____

9. I feel as smart as others. _____

10. I feel displeased with myself. _____

11. I feel good about myself. _____

12. I am pleased with my appearance right now. _____

13. I am worried about what other people think of me. _____

14. I feel confident that I understand things. _____

15. I feel inferior to others at this moment. _____

16. I feel unattractive. _____

17. I feel concerned about the impression I am making. _____

18. I feel that I have less scholastic ability right now than others. _____

19. I feel like I'm not doing well. _____

20. I am worried about looking foolish. _____

APPENDIX C

Perceptions of a Learning Experience Scale

Instructions: Below are a series of statements. In the space to the right of each statement, write the number that reflects your degree of agreement with that statement using the accompanying scale.

Statement Ratings

1	2	3	4	5	6	7
Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree

STATEMENT	RATING
The lesson stimulated my curiosity.	
The lesson was interesting.	
The lesson was fun.	
I want to continue investigating the topic on lighting.	
The lesson makes feel curious about the topic.	
The lesson was enjoyable.	
The lesson makes me want to explore the topic further.	
I would be willing to come back and participate in a future experiment that uses this lesson.	
I put a lot of effort into understanding the lesson on lighting.	
If given the opportunity, I would be interested in discussing this topic further with the author of the booklet.	
The presentation of the information in the lesson was engaging.	
As a result of reading this lesson, the next time I observe a lighting storm I'll think about the process of how lighting is created.	

APPENDIX D

Abbreviated Perceptions of a Learning Experience Scale

Instructions: Below are a series of statements. In the space to the right of each statement, write the number that reflects your degree of agreement with that statement using the accompanying scale.

Statement Ratings

1	2	3	4	5	6	7
Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree

STATEMENT	RATING
The presentation of the lesson I just had motivated me to learn	
The lesson I just had was fun and/or enjoyable	
The lesson I just had stimulated my curiosity and/or was interesting	
The lesson I just had makes me want to explore that topic further	
I found myself putting a lot of effort into the lesson I just had	
As a result of reading this lesson, the next time I encounter this topic, I will think more in depth about the processes involved	

APPENDIX E

Sample of Learning Module Slides

<u>Personalization condition</u>

Organization Principles

- Believe it or not, there are certain cues that you use to organize input from a stimulus whenever you see something. These cues include figure/ground, similarity, proximity, good continuation, and closure. All of these cues that you use are known as Gestalt principles.

<u>Control condition</u>

Organization Principles

- There are certain cues that are used to organize input from a stimulus. These cues include figure/ground, similarity, proximity, good continuation, and closure, and are known as Gestalt principles.

APPENDIX F

Institutional Review Board Approval Letters

Hi Mike, I think I can just approve this and place the letter in your file. Your project is now approved, with approval code EOct232014. Approval will expire one year from the date embedded in the code. Becky

Rebecca Warner, Professor
Department of Psychology
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Hello Mike,

Your study, the Science of Learning, is approved by me on behalf of the Psychology DRC. Your IRB codes for the three included studies are: ESept102015A, ESept102015B, and ESept102015C and approval expires one year after the date embedded in this code.

Rebecca Warner, Professor
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