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PSYCHOLOGICAL EFFECTS OF READING: THE ROLE OF NOSTALGIA IN RE-
READING FAVORITE BOOKS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
at Virginia Commonwealth University

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Acknowledgements

I would like to thank my advisor, Dr. Jeff Green, sincerely for his guidance and support throughout my graduate career. In addition, I would like to say thank you to my committee members, Drs. Kirk Brown and David Coogan, for their insight into this interdisciplinary project. I would like to thank Athena Cairo for her thoughts on study design and analysis. I am very appreciative of my parents, siblings, and friends who have supported me unconditionally throughout this process. Finally, I would like to thank Sam for his encouragement and patience, and my sister, Chelsea, for reminding me each day to never shy away from ambition.

Table of Contents

	Page
Acknowledgements.....	2
List of Tables.....	4
List of Figures.....	5
Abstract.....	6
Introduction.....	7
Nostalgia Definition.....	7
Nostalgia Triggers.....	9
Outcomes of Nostalgia.....	10
Why might re-reading elicit nostalgia?.....	12
Declines in Reading Books.....	13
Benefits Associated with Reading, and Limitations of Past Research.....	13
Transportation Theory.....	15
Additional Potential Benefits of Reading.....	16
Overview of Studies.....	17
Study 1	
Hypotheses.....	18
Method.....	18
Results.....	24
Discussion.....	26
Study 2	
Hypotheses.....	28
Method.....	29
Results.....	37
Discussion.....	47
General Discussion.....	49
References.....	52
Appendix I.....	57
Vita.....	86

List of Tables

Table 1.	25
<i>Correlations with re-reading frequency, re-reading enjoyment, and trait measures.</i>	
Table 2.	26
<i>Correlations with participation in reading, enjoyment in reading, and well-being (psychological well-being via six subscales and subjective well-being via Satisfaction with Life).</i>	
Table 3.	38
<i>Correlations among the three reading conditions on the outcome variables.</i>	
Table 4.	40
<i>Means and Standard Deviations of Reading Condition on Loneliness, Meaning in Life, and Social Connectedness, as well as the two mediators: narrative involvement and nostalgia.</i>	
Table 5.	46
<i>Means and Standard Deviations of Reading Condition on Life Satisfaction, Psychological Well-Being, Autonomy, and Competency.</i>	

List of Figures

<i>Figure 1.</i> Serial-multiple mediation for reading condition on state loneliness.	41
<i>Figure 2.</i> Serial-multiple mediation for reading condition on meaning in life.	42
<i>Figure 3.</i> Serial-multiple mediation for reading condition on social connectedness.	43
<i>Figure 4.</i> Nostalgia mediating the relation of reading condition and loneliness.	43
<i>Figure 5.</i> Nostalgia mediating the relation of reading condition and meaning in life.	44
<i>Figure 6.</i> Nostalgia mediating the relation of reading condition and social connectedness.	45

Abstract

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There are many positive outcomes from feeling nostalgic, including reductions in loneliness and greater meaning and social connectedness. My primary research goal was to investigate whether I could trigger feelings of nostalgia from re-reading an old favorite book, and whether this elicited nostalgia would increase feelings of connectedness and meaning in life and reduce loneliness. I designed a two-study package (one correlational study and one experiment) to assess re-reading novels. Trait nostalgia was positively associated with enjoyment of re-reading books (Study 1). Re-reading a favorite novel, relative to reading a new novel or a set of newspaper articles, elicited nostalgia. Further, nostalgia mediated the relation between reading condition on loneliness, meaning in life, and social connectedness (Study 2). Future work should focus on evaluating the nostalgic benefits of other forms of storytelling.

Psychological Effects of Reading: The Role of Nostalgia in Re-Reading Favorite Books

Reading in recent years may be dropping precipitously (Bureau of Labor Statistics, 2017), due in part to the ubiquity of smart phone usage (Twenge, Martin, & Spitzberg, 2018). However, there may be significant psychological benefits to reading for pleasure. This thesis tests two key questions related to reading. My primary goal was to assess whether re-reading a favorite novel might elicit a state of nostalgia, a bittersweet reflection of the past. Overall, nostalgia has been found to lead to several positive psychological outcomes, including increased social connectedness, greater meaning, and reduced loneliness. Nostalgia has been induced experimentally by smells, recollections from the past, and music (e.g., Reid, Green, Wildschut, & Sedikides, 2015); might reading a favorite book also elicit nostalgia, which in turn would increase social connectedness and meaning, and reduce loneliness?

My secondary goal was to assess some additional potential psychological benefits of reading (not simply re-reading), such as increased well-being and satisfying autonomy and competency needs. Because 52.7% of United States adults (126.5 million) have reported reading books that were not required for work or school (National Endowment for the Arts Office of Research & Analysis, 2018), it is important to understand the psychological effects of reading.

Nostalgia Definition

Nostalgia is the social, complex, and self-relevant emotion (Wildschut et al., 2006) often defined as the “sentimental longing for the past” (The New Oxford Dictionary of English, 1998). This definition differs from homesickness, which is defined as “experiencing a longing for one’s home during a period of absence from it” (The New Oxford Dictionary of English, 1998). Many years ago, nostalgia was considered to be a cerebral disease with symptoms including anxiety, persistent thoughts of home, insomnia, and episodes of weeping (McCann, 1941). However, this

faulty view has been dispelled by recent empirical work. Feeling nostalgic is associated with the interactions with close others or important life events that occurred in the past (Wildschut et al., 2006). Johnson-Laird & Oatley (1989) characterize nostalgia as a complex emotion because of its “high-level cognitive processing and propositional content” (Wildschut et al., 2006, p. 977). Wildschut and colleagues (2006) argued that nostalgia is unique in incorporating both positive and negative affect, which differentiates nostalgia from other related past-oriented subjective states.

Nostalgia appears to serve various self, social, and existential functions, including positive self-regard, positive affect, lower attachment anxiety, social bonding, inspiration, optimism, and purpose in life (Wildschut et al., 2006; Cheung et al., 2013; Routledge et al., 2013; Stephan Sedikides, & Wildschut, 2015). Nostalgia increases implicit accessibility of positive self-attributes (Vess et al., 2008). In addition, nostalgia elevates people’s perceptions of social support (Zhou et al., 2008). Nostalgia allows people to travel back in time, linking their present self to their past. This connection to the past, typically to important events or close others, facilitates feelings of self-continuity and meaning in life (Sedikides et al., 2008).

Nostalgia is, on balance, a mixed but mostly positive affective experience (Sedikides et al., 2015) for most individuals. However, those who are higher in attachment-related avoidance may feel reduced connection with others when nostalgic (Abeyta, Nelson, & Routledge, 2019). At the interpersonal level, attachment-avoidant people are less likely to pursue social connection from nostalgic experiences (Abeyta et al., 2014). Future work might reveal more boundary conditions for these benefits of nostalgia, but for the vast majority of individuals, nostalgia contains a restorative element to balance negative states (Sedikides et al., 2015). For example,

experiencing loneliness and meaninglessness seem to trigger nostalgia, which help repair the negative states.

Nostalgia Triggers

Experiencing nostalgia is quite common, with 79% of participants reporting having experienced nostalgia at least once a week if not more (Wildschut et al., 2006). The most common trigger of nostalgic experiences is negative affect (38%), followed by sensory inputs and social interactions (Wildschut et al., 2006). Sensory inputs that have evoked nostalgia include scents and music. In one study, participants smelled 12 scents and rated the familiarity, arousal, and autobiographical relevance of each scent, with those who rated higher levels of each reporting greater nostalgia. Scent-evoked nostalgia predicted state feelings of personal nostalgia, increases in positive affect, social connectedness, meaning in life, self-esteem, self-continuity, and optimism (Reid et al., 2015). Music is another sensory trigger of nostalgic experiences, in which hearing an old familiar song can create sentimental feelings of the past to emerge (Barrett et al., 2010). With the familiarity, arousal, and relevance to a person's past experiences, perhaps an old familiar book would be an additional avenue to elicit nostalgia, which in turn would prompt the downstream benefits of the complex, social, and self-relevant emotion of nostalgia.

Nostalgia has been successfully induced many times via a personal reflection writing task (Hepper et al., 2012; Wildschut et al., 2006; Vess, Arndt, Routledge, Sedikides, & Wildschut, 2012; Van Tilburg et al., 2013; Fraley et al., 2000) in which participants write about a nostalgic event from their past for 5 minutes. Inducing nostalgia through the event reflection task affects various psychological outcomes. For example, nostalgia via the event reflection task has increased optimism by increasing social connectedness and self-esteem, but the effect is only evident for those who are highly nostalgic (Cheung, Sedikides, & Wildschut, 2016). Nostalgia

can act as a self-affirming buffer that can protect against threats to self-esteem (Vess et al., 2008). Thus, evoking nostalgic experiences can protect people's sense of self; those who are experiencing negative consequences to their self-esteem can use nostalgia as a tool to repair their negative self-esteem. Some research has suggested that the event reflection task manipulation elicits more positive nostalgic experiences, relative to a control writing task about an ordinary event experienced in the past week (Newman, Sachs, Stone, & Schwarz, 2019). If this is the case, then some of the empirically derived positive outcomes of nostalgia may be overstated to some extent, suggesting that additional manipulations of nostalgia are needed. Additional manipulations for nostalgic experiences can be beneficial for replication purposes. Therefore, the re-reading induction in Study 2 provides time to re-experience reading the book again.

Outcomes of Nostalgia

The subsequent outcomes of nostalgia often include alleviating levels of loneliness, as well as elevating a sense of meaning in life and social connectedness to others. Loneliness is the psychological state of discomforting emotions and cognitions when alone (Anderson, Miller, Riger, Dill, & Sedikides, 1994). Feelings of loneliness can be alleviated in college students by seeking out social support networks (Lee & Goldstein, 2016). The stress-buffering model explains how social support functions as a buffer against threats to individual well-being (Cohen & Wills, 1985). Social networks can be a powerful resource in alleviating threats to negative emotional states.

Loneliness triggers nostalgia, which in turn reduces loneliness through increased feelings of social connectedness, suggesting a healing element to nostalgia when people feel lonely (Zhou, Sedikides, Wildschut, & Gao, 2008). Through a series of four studies, using both correlational and experimental designs, the researchers manipulated either loneliness (Study 2) or

nostalgia (Study 3) and evaluated the potential loneliness-reducing benefits of nostalgia. Researchers randomly assigned participants to a high loneliness induction or a low loneliness induction and then assessed their levels of nostalgia. Those in the high-loneliness condition reported higher levels of nostalgia and rated higher on the items relating to social connections (i.e., “my family,” “the way people were,” and “someone to rely on”) and lack of worrying (i.e., “not having to worry”) (Wildschut et al., 2006). Nostalgia acted as a mediator for the relation between loneliness and perceived social support: manipulated loneliness triggered nostalgic feelings, which in turn increased perceptions of social support. This pattern was consistent across several diverse samples: migrant children, undergraduate students, and factory workers. When people feel lonely, nostalgia acts as a mechanism through which the loneliness is alleviated. Thus, I hypothesized that nostalgia induced via re-reading a favorite book would play a similar function in reducing state loneliness as well as increasing feelings of social connection.

The existential function of nostalgia explains how experiencing nostalgia increases a person’s perceptions of meaning in their life (Sedikides et al., 2015). Nostalgia enhances meaning at the personal level. As important past life events are often the subject of a nostalgic reflection (Wildschut et al., 2006), they can serve as reassurance of one’s purpose to support perceptions of presence of meaning and significance in one’s life (Wildschut et al., 2006). People who have a good sense of their life’s purpose are more likely to be higher in nostalgia proneness. In an experimental setting, however, inducing nostalgia helps people feel enhanced meaning in life, and a reduced need to search for additional meaning (Routledge et al., 2012). After being randomly assigned to a nostalgic reflection or a recent positive event (control) reflection task, participants completed measures of searching for meaning and the presence of meaning. Nostalgia, through feelings of social connectivity, increased perceived presence of meaning and

decreased searching for meaning, compared to reflecting about a positive past event (Routledge et al., 2012). Nostalgia was a mitigating source can help people navigate their own mortality concerns, as well as preserved meaning in their lives (Routledge et al., 2011). This existential function relates to feelings of life as meaningful is a valuable outcome of nostalgia.

Why might re-reading elicit nostalgia?

Often, when people read a novel, they are transported into the story itself, and they become a close observer to the story itself. Perhaps revisiting the fictional characters from a familiar novel will induce nostalgia because of their involvement in previous readings. These interactions relate to a person's parasocial relationship with a fictional character, similar conceptually to a one-sided relationship. Characteristics of parasocial interactions include a "level of intimacy beyond the experienced viewing time, role adoption, non-mutual and non-dialectic communication" (Ingram & Luckett, 2019, p. 148). Parasocial interactions contain a level of connection with the target character or person. Parasocial relationships can be with fictional characters, celebrities, and pets. The ease of cognitive accessibility in a book triggers a parasocial relationship through reading pleasure and the feeling of presence (Liebers & Schramm, 2017). In a study using television characters, increased psychological transportation positively predicted cognitive overlap with fictional characters. Researchers argued that transportation created psychological closeness to the characters which in turn aided relationship development (Sheldoksy-Shoemaker et al., 2014). In addition to these possible parasocial relationships with the book's characters, it could also be the writing itself, the plot, or the theme of the novel that elicits nostalgia from revisiting the story. Thus, my primary research goal was to test the potential for a nostalgic experience via re-reading a favorite book, as well as to test whether some of the same consequences of nostalgia found via other manipulations—changes in

loneliness, meaning, and social connectedness—would extend to nostalgia elicited via re-reading a favorite book.

Next, I discuss a secondary goal of this thesis: to examine other possible beneficial psychological outcomes of reading novels.

Declines in Reading Books

A recent American Time Use Survey found large declines in leisure reading (Bureau of Labor Statistics, 2017). In addition, the Monitoring the Future survey report, used to track the trends at a cohort level, asking the same questions to the same ages across several decades, found similar declines in reading; for 12th graders in a large nationally representative U.S. sample, the trends have drastically decreased for reading books or magazines every day, from 60% in the late 1970s to 16% in 2016 (Twenge, Martin, & Spitzberg, 2018). These U.S. adolescents seem to have shown declines in both their daily reading habits and their TV consumption, while showing increases in their social media use over time. The number of 12th graders who indicated not reading any books for pleasure in the past year almost tripled from the late 1970s to 2016 (Twenge, Martin, & Spitzberg, 2018). In the United Kingdom, a 2015 report captured several reasons why people were not reading for pleasure, including depression, lack of time, and transition to parenthood for women (Billington, 2015). In addition, a survey evaluated the barriers to leisure reading, which included lack of time, fatigue, financial costs, and a lack of desire for additional reading in their free time during their studies (Watson, 2016).

Benefits Associated with Reading, and Limitations of Past Research

Reading for entertainment, information, and enjoyment is sometimes referred to as “voluntary reading” in the literature, particularly for children and adolescents (Richardson & Eccles, 2007). Some researchers conducted 35 structured qualitative interviews within a larger

adolescent sample. The goal was to better understand the psychological, compared to the academic, benefits of reading voluntarily. While the study was qualitative in nature, it began exploring the various themes associated with reading, including identity development through voluntary reading (Richardson & Eccles, 2007). Thus, compared to the academic achievement benefits, preliminary psychological effects associated with reading for pleasure allow for a deeper investigation into the psychological outcomes of reading.

While there were documented declines in reading books, there appear to be some psychological benefits with reading for pleasure. However, the extant research has been almost entirely correlational, a critical weakness in this literature. Reading for pleasure was significantly correlated with increased creativity in college students (Kelly & Kneipp, 2009). A pilot study explored reports in older adult populations via interviews asking their frequency of reading for pleasure. The interviews occurred in a veteran's hospital outpatient clinic, in which older adults were asked a series of questions regarding their leisure habits, including pleasure reading, and various social factors involved in loneliness. Reading for pleasure was significantly associated with decreased loneliness (Rane-Szostak & Herth, 1995). Older adults who read more for fun also tended to be less lonely, based on the preliminary interview findings. A very small sample of 15 United Kingdom undergraduate participants took part in a qualitative interview study exploring coping with university life. Reading was a source of distraction from loneliness as well as a source of enjoyment, relieving stress levels, and a sense of accomplishment, as evidenced from directed content analysis technique to analyze the interview data (Vasileiou, 2019). In a survey of health science students, nearly 70% of the students reported having read a book for pleasure in the past week (Watson, 2016). While this survey did not use a specific measure of empathy, the item "do you feel that reading books has helped you develop empathy for others"

was included to assess health science students' feelings of empathy, in which 72% of the respondents agreed that reading novels helped in the development of empathy. In a survey study of 474 Korean college students, reading hours were significantly associated with greater happiness levels (Jung, Lee, & Shim, 2017). As daily reading hours increase, students' happiness levels were more likely to increase. In summary, this research has typically been correlational, or even qualitative, and examined a rather limited set of psychological processes, such as loneliness and empathy.

In one of the only experimental tests of reading fiction, Bal and Veltkamp (2013) designed two studies investigating how emotional transportation can induce empathy through reading fiction versus reading newspaper selections. The researchers used the Davis (1980) definition of empathy for their experimental study: "the cognitive and intellectual ability to recognize the emotions of other persons and to emotionally respond to other persons." This definition takes into account the cognitive and emotional ability components of empathy that may theoretically relate to emotional transportation into a narrative. They randomly assigned Dutch participants to read either an online fiction short story or two selected stories from a Dutch newspaper and measured empathy immediately after the reading session and again one week afterwards. Participants who experienced high emotional transportation, compared to low transportation, in reading their fiction story showed elevated feelings of empathy over time, relative to the control reading condition. They found that those who transported into the fictional story showed significant increases in empathy in a one-week follow-up.

Transportation Theory

Transportation theory is the extent to which a person transports him- or herself into a narrative story as a distinct mental process conceptualized through a combination of "attention,

imagery, and feelings” where someone immerses themselves into an alternative world (Green & Brock, 2000, p. 701). This immersion into an alternative space allows readers to turn their attention to both fictional and non-fictional stories (Appel & Richter, 2010). The researchers further suggested that assigned reading might elicit less transportation because it is not their choice to do so (Green & Brock, 2000). These broader implications take into consideration the potential underlying role of autonomy in reading selection to effect emotional involvement in their selected stories. I expect that greater transportation into a story will facilitate a nostalgic experience as well as be related to additional psychological outcomes of reading.

Additional Potential Benefits of Reading

When people read for leisure purposes, they may experience enhanced well-being, based on the theoretical frameworks that have begun to link leisure activities to psychological functioning. Newman and Diener (2014) proposed a model that explains how leisure activities promote subjective well-being, through the psychological mechanisms of detachment-recovery, autonomy, mastery, meaning, and affiliation. While they provided an overview for broad implications of well-being as a consequence of leisure activities, I argue that the mechanism of autonomy can be applied to leisure reading, based on the self-determination theoretical framework.

Self-determination theory (1985) proposes three basic psychological needs that are critical for optimal functioning for social development and personal well-being: need for autonomy, need for relatedness, and need for competence (Deci & Ryan, 2000). A sub-theory of self-determination theory, cognitive evaluation theory (1985) explains how people are intrinsically motivated to participate in activities that have intrinsic value to them: the activities need to be novel, challenging, or contain aesthetic values to the person (Deci & Ryan, 2000).

While there are many avenues to personal well-being, two to distinguish are psychological well-being and subjective well-being. Psychological well-being, which refers to the levels of positive functioning, contains six dimensions according to Ryff and Keyes (1995): self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth. On the other hand, subjective well-being, or one's affective judgments of satisfaction with life, includes both positive and negative affect as well as life satisfaction (Diener, Emmons, Larsen, & Griffin, 1985). Fulfilling psychological needs can increase well-being at the intrapersonal level.

These theoretical frameworks have explained how restricting choice lowers a sense of autonomy and intrinsic motivation, but perceived control leads to greater enjoyment and intrinsic motivation (Schraw, Flowerday, & Reisetter, 1998). In the context of reading, through two experimental study designs, researchers provided one of three short fiction stories and randomly assigned participants to unrestricted choice, denied choice, or a control group. People who were able to choose their reading selections increases affective engagement in the material (Schraw, Flowerday, & Reisetter, 1998). If I can tap into people's intrinsic interests by providing them with the freedom to choose, I could satisfy their needs of autonomy, using the self-determination theory framework, to potentially enhance psychological well-being through reading.

Overview of Studies

Study 1 was an correlational study conducted online. The goal of Study 1 was to collect correlational data on the associations between trait nostalgia, reading frequency, reading enjoyment, and especially re-reading enjoyment on various psychological outcomes. I received the Institutional Review Board approval for both Study 1 and Study 2.

In Study 2, I designed an experiment: participants read an old favorite novel (to induce nostalgia), a new novel, or a neutral newspaper control in order to test for potential psychological benefits of re-reading. Reading an old favorite book may have psychological benefits because of the narrative transportation element from fictional stories and the nostalgic element of interacting with old familiar fictional characters or settings or scenes from a favorite book. While my primary objectives for Study 1 and Study 2 were to provide evidence of the benefits of nostalgia through re-reading a favorite book, I had secondary objectives of exploring additional potential psychological benefits of reading in general. Thus, I had some ancillary objectives regarding the effects of re-reading a favorite book that may extend to reading a new book (compared to a newspaper article reading control condition). These aims focused on general well-being and feelings of autonomy and competence.

Study 1

Hypotheses

Primary Goals

H1: I hypothesized that re-reading *enjoyment* would be associated with trait nostalgia. Those who reported higher nostalgia would enjoy reading a book again compared to those who were low in nostalgia proneness.

H2: I hypothesized that re-reading *frequency* would be associated with trait nostalgia. Those who reported higher nostalgia would participate re-reading more often than those who were low in nostalgia proneness.

Secondary Goals

H3: I hypothesized that reading *enjoyment* would be associated with lower loneliness, greater well-being, greater satisfaction of autonomy, and greater satisfaction of competence.

H4: I hypothesized that reading *frequency* would be associated with lower loneliness, greater well-being, greater satisfaction of autonomy, and greater satisfaction of competence.

Methods

Participants

An a priori power analysis using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) indicated that a minimum of 343 participants would be required to adequately detect a small effect size ($r = .15$) with 80% power. A pilot study of VCU students indicated that 43% read on a regular basis for fun, so I extrapolated that statistic to assume approximately 40-50% of respondents would also report reading for pleasure.

A total of 384 participants were selected through the university's subject pool. A number of participants left the questionnaire entirely blank, which left a final sample of 257 participants. Participants were at least 18 years old ($M = 19.01$, $SD = 1.97$). Participants were compensated either through the course credit or entered into a drawing for a gift card.

Procedure

Participants were college students from a large mid-Atlantic public university who were granted course credit for participation. Participants responded to the online survey, which included measures of trait loneliness, nostalgia, leisure participation and enjoyment, leisure motivation for their favorite activity, leisure reading speed, affect, belongingness needs, empathy, and self-esteem. After concluding the survey, participants were debriefed and thanked for their participation.

Materials

Trait Measures

Nostalgia. Nostalgia proneness was measured using the Southampton Nostalgia Scale (SNS; Routledge et al., 2008), the Batcho Nostalgia Inventory (Batcho, 1995), and the Zimbardo & Boyd (1999) Time Perspective Inventory – Past Positive (ZTPI). For the SNS, participants were given the formal definition of nostalgia and then answered 6 items in a Likert scale format (1 = not at all to 7 = very much) to assess trait nostalgia. SNS revealed good internal consistency ($\alpha = .92$). The Batcho Nostalgia Inventory measured participants' frequency and depth of feeling nostalgic. Participants rated from 1 to 9 (1 = not at all and 9 = very much) how nostalgic they feel about that item (i.e., family, places, toys, the way people were, etc.) and how much they miss it for all items. All 20 item ratings were averaged together, with the higher scores indicate more nostalgia. The Batcho Nostalgia Inventory revealed good internal consistency ($\alpha = .87$). Lastly, the past positive items of the ZTPI measured “a warm and sentimental attitude toward the past” (Zimbardo & Boyd, 1999). The 9-item past positive subscale was in a Likert-type format (1 = very uncharacteristic to 5 = very characteristic). The ZTPI revealed good internal consistency ($\alpha = .83$). The reason for measuring nostalgia proneness through three different measures was because they capture somewhat different facets of nostalgia: the Batcho Nostalgia Inventory captures the more negative side, the Zimbardo Time Perspective Inventory Past Positive subscale captures the more positive side, whereas the Southampton Nostalgia Scale provides a general nostalgia proneness measure.

Loneliness. The UCLA Loneliness Scale – Version 3 (Russell, 1996) was selected to assess trait loneliness. The scale includes 20 items (1 = never to 4 = often) and nine of the items were reverse coded to total participants' general feelings of loneliness. The UCLA Loneliness Scale – Version 3 revealed good internal consistency ($\alpha = .93$).

Affect. The Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988) was selected to measure positive affect and negative affect with the 20 items rated in a Likert type format (1 = very slightly or not at all to 5 = extremely). The instructional language was adjusted when measuring trait affect (“you generally feel this way, how you feel on average”). The positive affect subscale ($\alpha = .85$) and negative affect subscale ($\alpha = .82$) both revealed good internal consistency.

Need to Belong. The Need to Belong Scale (Leary, Kelly, Cottrell, & Schreindorfer, 2005) was used to measure belongingness needs. Using a Likert scale format, participants responded to 10 items (1 = strongly disagree to 5 = strongly agree). The Need to Belong Scale revealed good internal consistency ($\alpha = .80$).

Empathy. The Interpersonal Reactivity Index (IRI; Davis, 1980) was used to measure empathy. The 28-item measure rates items (1 = Not at all like me to 4 = Very much like me) across 4 subscales: perspective taking, fantasy, empathic concern, and personal distress. The IRI revealed good internal consistency ($\alpha = .79$).

Meaning in Life. Meaning in Life Questionnaire (Steger & Frazier, 2005) was selected to assess presence of and searching for meaning across 10 items in a 7-point Likert-type format (1 = absolutely untrue to 7 = absolutely true). The presence of meaning subscale includes 5 of the 10 items, with one item reverse-coded. The searching for meaning subscale included the remaining 5 items. The presence subscale ($\alpha = .89$) and searching subscale ($\alpha = .87$) both revealed good internal consistency.

Self-Esteem. The Rosenberg Self-Esteem Scale (Rosenberg, 1965) was used to measure participants’ feelings of themselves. This 10-item scale in a Likert type format evaluated

individual self-esteem (1 = strongly disagree to 4 = strongly agree). The Rosenberg Self-Esteem Scale revealed good internal consistency ($\alpha = .86$).

Social Connectedness. The Social Connectedness Scale (Lee & Robbins, 1995) was used to measure feelings of closeness to others. The social connectedness scale was an 8-item measure in which participants rated each item on from 1 to 6 (1 = strongly agree to 6 = strongly disagree). Items on the social connectedness scale used negative language; higher scores indicating a greater sense of social connectedness and belonging. The Social Connectedness Scale revealed good internal consistency ($\alpha = .94$).

Perceived Stress. The Perceived Stress Scale (Cohen, Kamarck, & Mermeistein, 1983) was used to assess perception of stress and current levels of experienced stress in the past month in a Likert-type scale (1 = Never to 5 = Very Often). The 10 items, after reverse coding 4 items, were summed for a total perceived stress score. The Perceived Stress Scale revealed good internal consistency ($\alpha = .86$).

Well-Being. The Psychological Well-Being Scales (Ryff & Keyes, 1995) were selected to assess 6 aspects of psychological well-being: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance. The shorter 18-item version was measured across a 6-point Likert type scale (1 = strongly disagree to 6 = strongly agree). The Psychological Well-Being Scales revealed good internal consistency ($\alpha = .84$). The Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) was used to measure “global cognitive judgements of satisfaction with one’s life” (Diener, Emmons, Larsen, & Griffin, 1985). This short 5-item measure assesses subjective well-being in a Likert-type format (1 = strongly disagree to 7 = strongly agree). The SWLS revealed good internal consistency ($\alpha = .89$).

Basic Psychological Needs and Frustration. The Basic Psychological Needs and Frustration Scale (Chen et al., 2015) measured self-reported fulfillment of three basic psychological needs: social connectedness, competence, and autonomy. In addition, the scale measured frustration of these needs, or the extent to which participants feel these needs were not met. The scale included 24 items in a Likert-type format (1 = not true at all to 5 = completely true). The autonomy satisfaction subscale ($\alpha = .75$), the relatedness satisfaction subscale ($\alpha = .88$), and competence satisfaction subscale ($\alpha = .84$) all revealed good internal consistency.

Leisure Reading Measures

Leisure Activities. The 20-items used in Bergin (1992) leisure activities list was used for participants to select which activities they typically engage with in their everyday lives. Participants checked the activities they partake in to give a better indication of how they spend their leisure time.

Leisure Participation and Enjoyment. Participants indicated how frequently they engage in four different leisure activities: reading books, watching television/DVDS/videos, getting together with friends, and physical activities (Chen & Fu, 2008). Frequency was measured through 5 possible responses: (a) every day, (b) several times a week, (c) several times a month, (d) several times a year or less, and (e) never. Consistent with previous work, the responses were reverse coded to show higher numbers indicative of more frequency in leisure participation. Participants rated their enjoyment level of each of the four activities: (a) no enjoyment, (b) not much enjoyment, (c) some enjoyment, (d) a fair amount of enjoyment, (e) a great amount of enjoyment, and (f) did not participate in this kind of activity (Chen & Fu, 2008).

Reading Enjoyment. Items selected from a larger reading survey were adapted to capture frequency, barriers, impact, format, and enjoyment (Watson, 2016). Several items include

“During the past week, how much time have you spent reading books (in electronic or print format) for your own enjoyment? Please include all books you have read except those relating to your schoolwork,” “How many books have you read for your own enjoyment in the last month?,” “How many books have you read for your own enjoyment in the last six months?,” “In which format do you prefer to read books for your own enjoyment?,” “Do you feel like you have enough time to read as much as you want to?,” “What is the top reason that keeps you from reading as much as you want?,” and “Have you ever read a book which had a significant impact on you? If so, please give the title of the book and explain what effect it had.”

Leisure Motivation. The Leisure Motivation Scale (Beard & Ragheb, 1983) was selected to measure reasons why people participate in their leisure activity, specifically reading for pleasure. The 48-item scale includes 4 subscales: Intellectual, Social, Competency/Mastery, and Stimulus Avoidance. The instructions were tailored to have participants specifically respond to their motivation for reading on a 5-point Likert scale (1 = never true to 5 = always true).

Demographics. Relevant demographic information of age, gender, gender identity, race, and language were measured.

Results

Primary Goals

I conducted several bivariate correlational analyses to test for the primary and secondary aims to Study 1. There was some support between nostalgia at the trait level correlating with re-reading enjoyment, across two of the three trait nostalgia measures. There was a significant positive association between nostalgia proneness (SNS) and *enjoyment* of re-reading books, $r(251) = .23, p < .001, 95\% \text{ CI } [.11, .35]$. The Batcho nostalgia measure (BNI) and re-reading enjoyment were also significantly positively correlated, $r(251) = .20, p = .002, 95\% \text{ CI } [.07, .31]$.

People higher in trait nostalgia were more likely to enjoy re-reading books, supporting Hypothesis 1.

However, there were no significant correlations between *amount* of re-reading and nostalgia proneness, though the association between trait nostalgia (SNS) and frequency of re-reading was marginal, $r(249) = .12, p = .051, 95\% \text{ CI } [-.00, .24]$. In summary, support for Hypothesis 2 was largely absent. Overall, the people enjoy re-reading were more likely to report higher levels of nostalgia proneness, but higher levels of nostalgia do not appear to be associated with the amount of re-reading.

The results from Study 1 helped with the design of Study 2 based on the support for the first hypothesis. The link between trait nostalgia and enjoyment of re-reading, did support my hypothesizing and suggest that an experimental manipulation might be successful. If people enjoy reading their favorite book again as they indicated in Study 1, they may feel a sense of nostalgia. The lack of support for Hypothesis 2 is intriguing. It could be associated with affective forecasting inaccuracy (Green et al., 2013): individuals may not be fully aware of the nostalgic benefits of reading or not prioritize such nostalgic states. However, the correlation between nostalgia and reading enjoyment is the most relevant in considering whether re-reading a favorite book might elicit *state* nostalgia.

Table 1.

Correlations with re-reading frequency, re-reading enjoyment, and trait measures.

Measures	1	2	3	4	5	M	SD
1. ReReading Amount	-					7.00	8.02
2. ReReading Enjoyment	.581**	-				2.81	1.40
3. Southampton Nostalgia Scale	.123	.232**	-			4.48	1.21
4. Batcho Nostalgia Inventory	.047	.196**	.607**	-		3.34	.70
5. Zimbardo Past Positive nostalgia	-.065	.010	.380**	.359**	-	4.36	.85

** indicates a correlation significant at the .001 level

* indicates a correlation significant at the .05 level

Secondary Goals

There were no significant correlations to support Hypothesis 3. Reading enjoyment was not significantly correlated with trait loneliness, $r(243) = .06, p = .372$. Reading enjoyment was not significantly associated with subjective well-being and psychological well-being (see Table 2). Reading enjoyment and autonomy satisfaction were not significantly correlated, $r(255) = -.05, p = .408$. Reading enjoyment and competency satisfaction also were not significantly associated with each other, $r(255) = -.03, p = .666$. Overall, reading enjoyment was not significantly related to well-being or satisfaction of two psychological needs.

There were no significant correlations to support Hypothesis 4. Reading frequency was not associated with trait loneliness, $r(242) = .04, p = .502, 95\% \text{ CI } [-.08, .17]$. Reading frequency also was not correlated with either subjective well-being or psychological well-being (see Table 2). There was not a significant association between reading frequency and autonomy satisfaction, $r(231) = .07, p = .235, 95\% \text{ CI } [-.06, .20]$, or between reading frequency and competency satisfaction, $r(254) = .03, p = .611, 95\% \text{ CI } [-.09, .15]$. These findings were consistent across all measures of reading frequency, including times read per week, times read per month, and times read per six months. Therefore, reading frequency alone does not relate to these psychological constructs at the trait level.

Table 2.

Correlations with participation in reading, enjoyment in reading, and well-being (psychological well-being via six subscales and subjective well-being via Satisfaction with Life).

Measures	1	2	3	4	5	6	7	8	9
1. PartRead	-								
2. EnjoyRead	-.287**	-							
3. PWBAutonomy	.053	-.041	-						
4. PWBEnvironMast	-.001	.019	.342**	-					
5. PWBPersonGrow	-.027	-.072	.333**	.454**	-				
6. PWBPersonRelation	-.082	-.089	.228**	.361**	.393**	-			
7. PWBPersonGrow	.049	-.104	.240**	.290**	.463**	.249**	-		
8. PWBSelfAccept	-.038	-.092	.254**	.604*	.478**	.428**	.408**	-	

9. SWBSatLife	.097	-.084	.286**	.544**	.309**	.408**	.215**	.687**	-
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** indicates a correlation significant at the .001 level

* indicates a correlation significant at the .05 level

Discussion

My correlational investigation provided some support for the main Study 1 goal of connecting nostalgia with re-reading. Hypothesis 1 was supported: people who enjoyed reading books more than once were more likely to be higher in trait nostalgia. Hypothesis 2 regarding re-reading frequency and trait nostalgia was not supported (the correlation was marginal). This might have been because of faulty affective reflection regarding their frequency of re-reading books in their lives. Similarly, Hypotheses 3 and 4 regarding trait measures related to self-determination theory and reading frequency and enjoyment were not supported. However, it was important to note that non-significant findings at the trait level do not mean that experimentally manipulating reading or re-reading does not lead to different psychological outcomes. There are occasional disconnects between trait and state nostalgia outcomes, such as nostalgia increasing creativity at the state level but not the trait level (Ye, Ngan, & Hui, 2013). In spite of the lack of support for Hypotheses 3 and 4, I retained some well-being measures in Study 2 for these reasons. One limitation to Study 1 was that there were only frequency reports of reading, not the actual behavior of reading. Perhaps people experienced the nostalgic benefits of reading only when they were in the moment reading a book.

Study 2

In Study 2, I retained the same two research goals from Study 1. First, I tested whether people who read an old favorite book again would experience nostalgia and, in turn, its benefits, such increased social connectedness and meaning and reduced loneliness. Second, I tested whether reading books, regardless of if it was a new book or and old book, would elicit

additional positive psychological outcomes, specifically well-being and satisfaction of competency and autonomy psychological needs.

People often report that they read to escape their world, so perhaps when people read in the moment, they can forget about their worries temporarily and dive into a story with rich characters and interact in a narrative space that follows a plot that is largely removed from their reality. Study 2 tested whether people who interact with familiar fictional characters, plots, or reading style in their favorite book would experience nostalgia, which in turn could reduce loneliness and elevate meaning in life and social connectedness. As a secondary focus, perhaps the experience of reading itself, not just the estimated self-reported frequencies, affect the psychological outcomes in that reading state.

Hypotheses

Primary Goals

H1: I hypothesized that people who re-read a book would experience greater nostalgic feelings, compared to those who read a new book or a newspaper control. Re-reading a book that was familiar should elicit more feelings of nostalgia, adding to the other ways empirically determined to elicit nostalgia (e.g., music, scents, recalling particular memories).

H2a: I hypothesized that re-reading a novel would decrease *state loneliness* through narrative involvement and nostalgia. Those who re-read a favorite novel should experience greater transportation back into the familiar story, eliciting more nostalgic feelings, and, in turn, less loneliness.

H2b: I hypothesized that re-reading a novel would increase *meaning in life* through narrative involvement and nostalgia. Those who re-read a favorite novel should experience

greater transportation back into a familiar story, eliciting more nostalgic feelings, and, in turn, a greater sense of meaning in life.

H2c: I hypothesized that re-reading a novel would increase *social connectedness* through narrative involvement and nostalgia. Those who re-read a favorite novel would experience greater transportation back into the familiar story, eliciting more nostalgic feelings, and, in turn, a greater sense of feeling closeness to others.

Secondary Goals

Hypotheses 3a, 3b, and 3c refer to my secondary goal of examining the broader psychological benefits of reading. Thus, the relevant comparisons were different from the previous hypotheses, which compared reading a new book versus re-reading a familiar book. The following hypotheses refer to any sort of reading, so the relevant comparisons were both reading book conditions versus the newspaper article control on the self-determination theory satisfaction of psychological needs and well-being outcomes, using the Basic Psychological Needs and Frustration Scale (Chen et al., 2015) and measures psychological and subjective well-being.

Previous experimental designs used a newspaper as a suitable control condition because of the more distant and non-narrative nature of the articles, in which a process of “psychological numbing towards stories about large groups of people or objectified, or artistically presented facts is likely to occur” for newspaper reading but not narratives (Bal & Veltkamp, 2013, p. 3). Therefore, I argue that newspaper selections based on neutral topics act as an appropriate reading control group.

H3a: I hypothesized that re-reading and reading novel would increase *well-being*, compared to a newspaper article control condition.

H3b: I hypothesized that re-reading and reading novels would increase *autonomy*, compared to a newspaper article control condition.

H3c: I hypothesized that re-reading and reading novels would increase *competence*, compared to a newspaper article control condition.

Methods

Participants

In order to adequately power a study with several experimental conditions with a small to moderate expected effect size, 400 participants were recruited for this study. Although no studies have assessed the effects of reading (and re-reading) novels on social connectedness, I based the effect size on prior research that nostalgia inductions increase perceptions of social support ($r = .33$, Zhou, Sedikides, Wildschut, & Gao, 2008). It was likely that the effect of nostalgic reading (versus new reading) may be smaller than the induction used by Zhou et al. (2008), therefore I used an effect size half as large for our conservative power estimate. An a priori power analysis using G*Power indicated that a minimum of 261 participants (87 participants per condition) would be required to adequately detect a small effect size ($r = .17$, or $f^2 = .06$) with 95% power. Based on the a priori power analysis recommendation, a minimum of 87 participants per condition was needed to reach adequate power. I fell short of that goal due to issues with the sudden and unexpected conversion of Study 2 to an online version that had to be approved by the IRB to comply with the COVID-19 changes.

Participants were 70 undergraduate students (21 men, 47 women, and 2 non-binary) with a mean age of 19.61 ($SD = 2.43$). Of the 70 participants, 55 were in-lab sample and the remaining 15 were in the online-only sample. The race and ethnicity demographic characteristics included: white/Caucasian (25.7%), Asian (25.7%), black/African American (18.6%),

Hispanic/Latinx (12.9%), Middle Eastern (5.7%), and multiracial (8.6%), with 2 participants choosing not to respond. Most participants (81.4%) indicated that English was their native language. Participants were compensated through the course credit through the psychology department participant pool. They needed to either currently own, borrow, or acquire via library the instructed books before the study began.

Procedure

Participants completed an online survey of trait measures prior to entering the lab. Next, they identified two novels before their lab session: one they had not read before and one they had read at least once before and enjoyed a great deal. The online participants were asked in the study description the same set of instructions listed below so they would start the study when they had access to the two books as instructed.

Instructions: We are asking you to bring in two books for your lab session. Please bring into the lab a physical copy (or ebook version) of your favorite novel you have read in the past. This book should be one of your very favorite books, specifically one you have read at least once or twice. In addition, please bring a physical copy (or ebook version) of a new book you have not read before. This book you should be one you are hoping to read, but have not had a chance to start. Please refrain from selecting a book that was a required school assignment. These two books, the old favorite and the new interest books, should be the type of genre reading you enjoy in your free time. We encourage that your new book should be of similar length (i.e., number of pages) and the same or similar genre (i.e., fiction, narrative non-fiction, etc.) as your old book. Remember that you might find physical copies at a library. You may be reading one of these books during your session, or you may be provided other reading materials for the lab portion of this study.

The in-lab participants were asked to bring in both books so that the experimenter could ensure that they fulfilled the requirements of the book. Participants who did not bring in both books were politely asked to sign up for a future session with their books. The online-only participants were instructed to have the two books with them before they began the online survey. Consenting participants completed the initial trait measures in the questionnaire. The participants were randomly assigned to either reading their new novel, re-reading their old novel, or a control (neutral newspaper condition). Participants had 20 minutes to read their book in the lab or online. After the timed reading task, participants completed a nostalgia manipulation check, information about their reading (i.e., number of pages read and summary of content), and measures of state loneliness, nostalgia, affect, narrative involvement, well-being, and fulfillment of needs. Participants were debriefed and thanked, concluding the study.

Materials

Trait Measures

Nostalgia. Nostalgia proneness was measured using the Southampton Nostalgia Scale (SNS; Routledge et al., 2008), the Batcho Nostalgia Inventory (Batcho, 1995), and the Zimbardo & Boyd (1999) Time Perspective Inventory – Past Positive (ZTPI). For the SNS, participants were given the formal definition of nostalgia and then answered 6 items in a Likert scale format (1 = not at all to 7 = very much) to assess trait nostalgia. The higher summed scores indicated greater proneness to nostalgia. SNS revealed good internal consistency ($\alpha = .77$). The Batcho Nostalgia Inventory measured participants frequency and depth of feeling nostalgic. Participants rated from 1 to 9 (1 = not at all and 9 = very much) how nostalgic they feel about that item (i.e., family, places, toys, the way people were, etc.) and how much they miss it for all 18 items. All 20 item ratings were averaged together and the higher scores indicated more nostalgia. The

Batcho Nostalgia Inventory revealed good internal consistency ($\alpha = .88$). Lastly, the past positive items of the ZTPI measured “a warm and sentimental attitude toward the past” (Zimbardo & Boyd, 1999). The 9-item past positive subscale was in a Likert-type format (1 = very uncharacteristic to 5 = very characteristic). The ZTPI revealed poor internal consistency ($\alpha = .65$), which did not meet the .70 reliability requirement.

Loneliness. The UCLA Loneliness Scale – Version 3 (Russell, 1996) was selected to assess trait loneliness. The scale included 20 items (1 = never to 4 = often) and nine of the items were reverse coded to total participants’ general feelings of loneliness. The UCLA Loneliness Scale – Version 3 revealed good internal consistency ($\alpha = .92$).

Need to Belong. The Need to Belong Scale (Leary, Kelly, Cottrell, & Schreindorfer, 2005) was used to measure belongingness needs. Using a Likert scale format, participants responded to 10 items (1 = strongly disagree to 5 = strongly agree). The Need to Belong Scale revealed poor internal consistency ($\alpha = .54$), which did not meet the .70 reliability requirement.

Empathy. The Interpersonal Reactivity Index (Davis, 1980) was used to measure empathy. The 28-item measure rated items (1 = Not at all like me to 4 = Very much like me) across 4 subscales: perspective taking, fantasy, empathic concern, and personal distress. The Interpersonal Reactivity Index revealed good internal consistency ($\alpha = .71$).

Meaning in Life. Meaning in Life Questionnaire (Steger & Frazier, 2005) was selected to assess presence and searching of meaning across 10 items in a 7-point Likert-type format (1 = absolutely untrue to 7 = absolutely true). The Meaning in Life Questionnaire revealed good internal consistency ($\alpha = .71$).

Self-Esteem. The Rosenberg Self-Esteem Scale (Rosenberg, 1965) was used to measure participants’ feelings of themselves. This 10-item scale in a Likert type format evaluated

individual self-esteem (1 = strongly disagree to 4 = strongly agree), after reverse coding 5 items. The Rosenberg Self-Esteem Scale revealed good internal consistency ($\alpha = .88$).

Social Connectedness. The Social Connectedness Scale (Lee & Robbins, 1995) was used to measure feelings of closeness to others. The social connectedness scale was an 8-item measure in which participants rated each item on from 1 to 6 (1 = strongly agree to 6 = strongly disagree). Items on the social connectedness scale use negative language; higher scores indicated a greater sense of social connectedness and belonging. The Social Connectedness Scale revealed good internal consistency ($\alpha = .95$).

Nostalgia Induction via Reading

Reading Task. Participants were randomly assigned to either read their new novel, re-read their old novel, or read neutral newspaper articles. The participants rated their excitement for reading the assigned book or newspaper selections, on a 7-point Likert type scale (1 = not at all to 7 = very much) “to what extent are you looking forward to reading your selected text?” Participants had 20 minutes to read their book or newspaper selection in the lab or online. After 20 minutes, participants were asked to stop reading and complete a brief paragraph summary of their reading and how many pages they read.

State Nostalgia Measure. Three frequently-used items served as a nostalgia manipulation check following the reading task (Wildschut et al., 2006): “Right now I am feeling quite nostalgic,” “Right now I am having nostalgic feelings,” and “I feel nostalgic at the moment” on a Likert scale (1= strongly disagree and 6 = strongly agree). The nostalgia manipulation check revealed good internal consistency ($\alpha = .95$).

Narrative Involvement. As a measure of narrative transportation, the 12-item scale was selected (McDonald, Schumaker, Anderegg, & Quenette, 2010). Participants rated each item on

a Likert scale (1 = strongly disagree to 9 = strongly agree). The language of items was originally intended for watching a television show, so the items were adapted to relate specifically to reading. Example items include: “I felt like I was going through what the characters were going through,” “I could picture myself in some of the scenes in the book,” and “While I was reading the book, it was easy to imagine the events actually taking place.” The Narrative Involvement Scale revealed good internal consistency ($\alpha = .87$).

Outcome Measures

Social Connectedness. Four items were used in previous research (Hepper, Ritchie, Sedikides, & Wildschut, 2012), with adjusted language to adapt to the reading task: “Reading this text: makes me feel connected to loved ones,” “Reading this text: makes me feel protected,” “Reading this text: makes me feel loved,” and “Reading this text: makes me feel I can trust others” on a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree). The four social connectedness items revealed good internal consistency ($\alpha = .90$).

Meaning in Life. Four items were used in previous research (Hepper, Ritchie, Sedikides, & Wildschut, 2012) with adjusted language to adapt to the reading task: “Reading this text: makes me feel life is meaningful,” “Reading this text: makes me feel life has a purpose,” “Reading this text: makes me feel there is a greater purpose to life,” and “Reading this text: makes me feel that life is worth living” on a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree). The four meaning in life items revealed good internal consistency ($\alpha = .95$).

Loneliness. The single item “I feel lonely” (1 = not at all to 5 = very much) in a Likert scale format was selected as a measure of state loneliness, which was consistent with previous work (van Roekel, Verhagen, Engels, Scholte, Cacioppo, & Cacioppo, 2016). Higher scores indicated greater current feelings of loneliness.

Self-esteem. Four items used in previous research were used to measure self-esteem (Hepper, Ritchie, Sedikides, & Wildschut, 2012): “makes me feel good about myself,” “makes me like myself better,” “makes me value myself more,” and “makes me feel I have many positive qualities” on a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree). The four self-esteem items revealed good internal consistency ($\alpha = .96$).

Affect. The Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1998) was selected to measure positive affect and negative affect using 20 items in a Likert type format (1 = very slightly or not at all to 5 = extremely). The instructional language was adjusted to measure state affect in the moment (“you feel this way right now, that is, at the present moment”) post-manipulation. The positive affect subscale ($\alpha = .89$) and negative affect ($\alpha = .86$) both revealed good internal consistency.

Well-Being. The Psychological Well-Being Scales (Ryff & Keyes, 1995) was selected to assess 6 aspects of psychological well-being: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance. The shorter 18-item version was measured on a 6-point Likert type scale (1 = strongly disagree to 6 = strongly agree). The Psychological Well-Being Scales revealed good internal consistency ($\alpha = .84$). The Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) was used to measure “global cognitive judgements of satisfaction with one’s life” (Diener, Emmons, Larsen, & Griffin, 1985). This short 5-item measure assessed subjective well-being in a Likert-type format (1 = strongly disagree to 7 = strongly agree). The instructional language was adjusted to measure in the moment (“you feel this way right now, that is, at the present moment”) post-manipulation for both measures of well-being. The Satisfaction with Life Scale revealed good internal consistency ($\alpha = .88$).

Basic Psychological Needs and Frustration. The Basic Psychological Needs and Frustration Scale (Chen et al., 2015) was selected to measure self-reported fulfillment of the following basic psychological needs: competence and autonomy. In addition, the scale measured frustration of these needs, or the extent to which participants feel these needs were not met. The scale included 24 items in a Likert-type format (1 = not true at all to 5 = completely true). The instructional language was adjusted to measure in the moment (“you feel this way right now, that is, at the present moment”) post-manipulation for the measures of need fulfillment. The autonomy satisfaction subscale ($\alpha = .70$) and competency satisfaction ($\alpha = .88$) both revealed good internal consistency.

Demographics. Relevant demographic information of age, gender, gender identity, race, and language were measured.

Results

Prior to the data collection, I conducted a pilot study ($N = 38$) to assess the neutrality of the newspaper selections as a control condition. There were four newspapers that were rated (1 – not at all to 5 = very much) as neutral ($M = 2.99$, $SD = 1.33$) from the raters that were included in the control condition.

I ran a series of assumption checks prior to data analysis to assess the normality of the data. Age of the participants was skewed (2.75) and kurtotic (7.92) as expected with the sample of undergraduate students. All other variables included in the following analyses remained within the ± 2.00 cutoff. All of the variables were standardized to assess univariate outliers. The Personal Growth subscale contained 1 outlier that exceeded the ± 3.25 range; therefore, the outlier was winsorized accordingly. No other variables contained any univariate outliers. Bivariate correlations were analyzed to assess multicollinearity. Self-esteem and social

connectedness ($r = .75, p < .001$) violated the assumption, as the variables exceeded the $\pm .70$ cutoff for assessing multicollinearity. The correlational matrix of the nostalgia manipulation check and the outcome variables for the primary hypotheses can be found in Table 3.

The in-lab reading task participants and the online reading task participants did not differ significantly on nostalgia $t(68) = 0.46, p = .648$ 95% CI (-.72, 1.16), indicating that the two samples were not different in terms of their nostalgic experience based on the different types of data collection. The number of pages read did not differ between the old book ($M = 28.64, SD = 24.51$) and the new book ($M = 25.08, SD = 20.60$) conditions for the 20-minute reading task, $t(47) = .55, p = .813, 95\% \text{ CI } (-9.48, 16.59)$.

Table 3.

Correlations among the three reading conditions on the outcome variables.

Variable	Group	Nostalgia	NarrInvolve	Loneliness	MeaningLife	SocialConnect	N
Nostalgia	OldBook	-					31
NarrInvolve	OldBook	.385	-				31
Loneliness	OldBook	.052	-.007	-			31
MeaningLife	OldBook	.531**	.635**	-.006	-		31
SocialConnect	OldBook	.589**	.472**	-.234	.649**	-	31
Nostalgia	NewBook	-					30
NarrInvolve	NewBook	.558**	-				30
Loneliness	NewBook	.380*	.252	-			30
MeaningLife	NewBook	.306	.489*	-.289	-		30
SocialConnect	NewBook	.414*	.521**	.051	.489**	-	30
Nostalgia	Control	-					9
NarrInvolve	Control	.588	-				9
Loneliness	Control	.273	.114	-			9
MeaningLife	Control	.643	.793	-.113	-		9
SocialConnect	Control	.481	-.205	-.458	.374	-	9

** indicates correlation is significant at the .01 level

* indicates correlation is significant at the .05 level

Primary Hypotheses

I conducted a One-Way Between-Subjects ANOVA to examine the effects of reading condition on current feelings of nostalgia. The overall test was significant, $F(2, 67) = 7.22, p =$

.001, $\eta^2 = .18$. A post-hoc Tukey test was used to see which groups differed significantly from one another. Re-reading an old book ($M = 4.30$, $SD = 1.53$) made people feel significantly more nostalgic than reading the new book ($M = 2.97$, $SD = 1.48$, $p = .002$) or reading the newspaper articles ($M = 2.89$, $SD = 1.61$, $p = .037$). The latter two groups did not differ significantly from each other ($p = .99$). People who re-read an old favorite book experienced greater nostalgic feelings than both the new book and the newspaper conditions, supporting Hypothesis 1 and revealed a new method for experiencing nostalgia. Reading a personally selected favorite novel again for a short period of time elicits nostalgia.

To examine whether there were group differences between the reading conditions on the outcome variables, I ran a multivariate analyses of variance (MANOVA). See Table 4 for means and standard deviations. Box's M test for homogeneity of the variance-covariance matrices across design cells was not significant, $\text{Box-M} = 17.86$, $F(12, 2578.315) = 1.34$, $p = .190$, providing support for the homogeneity of variance assumption. Additionally, two of the three Levene's tests were not significant, providing partial support for the homogeneity of variance assumption. A significant Bartlett's test of sphericity ($p < .001$) means that correlations were sufficiently large, so it was acceptable to proceed with MANOVA. The MANOVA did not reveal a statistically significant effect for reading condition, Pillai's Trace = .90, $F(6, 132) = .86$, $p = .527$, $\eta^2 = .04$. Nevertheless, I ran follow-up univariate analyses of variances (ANOVAs) for the sake of completeness. The overall test of reading condition on loneliness was not significant, $F(2, 67) = .54$, $p = .585$, $\eta^2 = .02$. The overall test of reading condition on meaning in life was not significant, $F(2, 67) = .68$, $p = .511$, $\eta^2 = .02$. The overall test of reading condition on social connectedness was not significant, $F(2, 67) = 2.25$, $p = .113$, $\eta^2 = .06$.

Next, I conducted separate independent groups t-tests to compare the old book and the new book conditions on loneliness, meaning in life, and social connectedness. The old book group ($M = 1.90, SD = .80$) and new book group ($M = 2.23, SD = 1.38$) did not differ significantly on loneliness, $t(58) = -1.14, p = .258, 95\% CI (-.92, .25)$. The old book group ($M = 4.25, SD = 1.58$) and new book group ($M = 3.89, SD = 1.52$) did not differ significantly on meaning in life, $t(58) = .90, p = .370, 95\% CI (-.44, 1.16)$. The old book group ($M = 3.43, SD = 1.52$) and new book group ($M = 2.79, SD = 1.46$) did not differ significantly on social connectedness, $t(58) = 1.65, p = .105, 95\% CI (-.14, 1.40)$.

Again, for completeness, I went ahead and ran the following tests to directly test my hypotheses, even though the omnibus MANOVA test was not significant. Loneliness was not highly correlated with meaning in life, $r(69) = -.18, p = .146$, or social connectedness, $r(69) = -.12, p = .335$. Meaning in life and social connectedness did positively correlate with each other, $r(69) = .56, p < .001$. None of these relations between the three outcome variables were extreme, so I decided to run the mediation analyses separately, although it is acceptable to run them simultaneously.

Table 4.

Means and Standard Deviations of Reading Condition on Loneliness, Meaning in Life, and Social Connectedness, as well as the two mediators: narrative involvement and nostalgia.

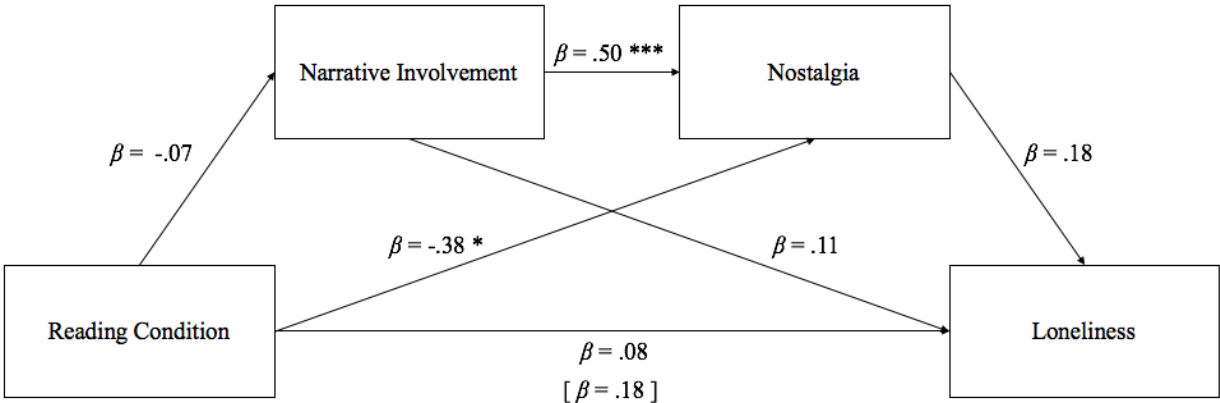
Variables		<i>M</i>	<i>SD</i>	<i>N</i>
Loneliness	Old Book	1.94	.81	31
	New Book	2.23	1.38	30
	Newspaper	2.07	1.23	9
Meaning in Life	Old Book	4.26	1.55	31
	New Book	3.89	1.52	30
	Newspaper	3.69	1.58	9
Social Connectedness	Old Book	3.45	1.51	31
	New Book	2.79	1.46	30
	Newspaper	2.53	1.17	9
Narrative Involvement	Old Book	2.75	.80	31
	New Book	3.21	.88	30

Nostalgia	Newspaper	3.28	.71	9
	Old Book	4.30	1.53	31
	New Book	2.97	1.48	30
	Newspaper	2.89	1.25	9

I conducted a series of serial-multiple mediations for Hypotheses H2a through H2c. The first of these analyses investigated whether narrative involvement and nostalgia mediated the relation between re-reading novels on state loneliness. I ran bootstrapping analysis to examine the indirect effect of reading condition on loneliness via narrative involvement and nostalgia using PROCESS version 3 model 6 (Hayes, 2012). This model, conducted with 5,000 bootstraps, yielded a mean bootstrap estimate of the indirect effect of -.16; however, the confidence interval included zero [-.37, .00], therefore narrative involvement and nostalgia did not mediate the effect of reading group on state loneliness (Hypothesis 2a). The full model is listed in Figure 1.

However, while the dual mediation was not supported for reading condition on loneliness, the model supports a significant effect of re-reading on nostalgia ($\beta = -.38, p = .014$). In addition, the effect of narrative involvement on nostalgia in the model ($\beta = .50, p < .001$) was promising for future research.

Figure 1. Serial-multiple mediation for reading condition on state loneliness.

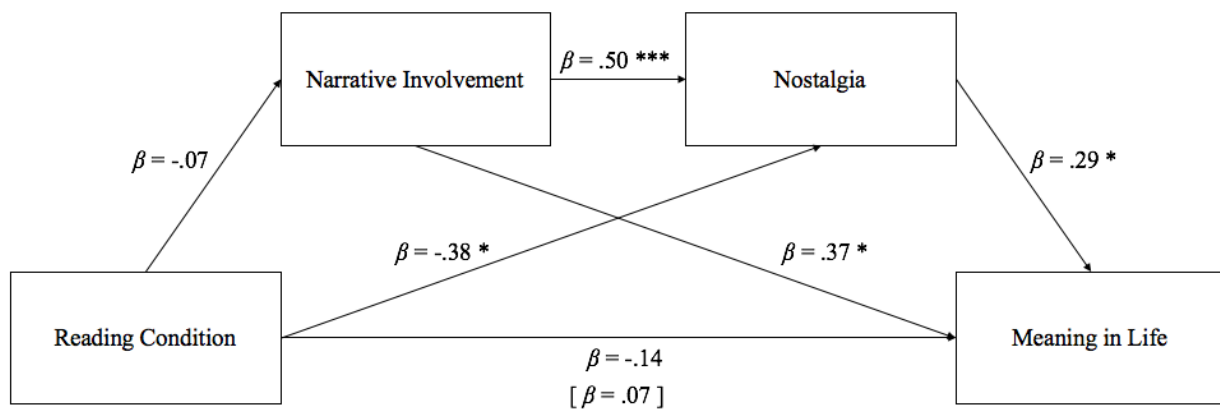


* indicates statistical significance at the .05 level

*** indicates statistical significance at the .01 level

The second serial-multiple mediation analysis examined whether narrative involvement and nostalgia mediated the relation between re-reading novels on meaning in life (Hypothesis 2b). I ran a bootstrapping analysis to see if there was an indirect effect of reading condition on meaning in life via narrative involvement and nostalgia using PROCESS version 3 (Hayes, 2012). This model, conducted with 5,000 bootstraps, yielded a mean bootstrap estimate of the indirect effect of -.45. The confidence interval did not include zero [-.82,-.16]; therefore, narrative involvement and nostalgia mediated the effect of reading group on meaning in life, which provided support for Hypothesis 2b. The full model is listed in Figure 2. Narrative involvement and nostalgia mediated the relation between reading conditions and having a sense of meaning in life, such that narrative involvement and nostalgic feelings were mechanisms through which reading condition affected meaning in life.

Figure 2. Serial-multiple mediation for reading condition on meaning in life.

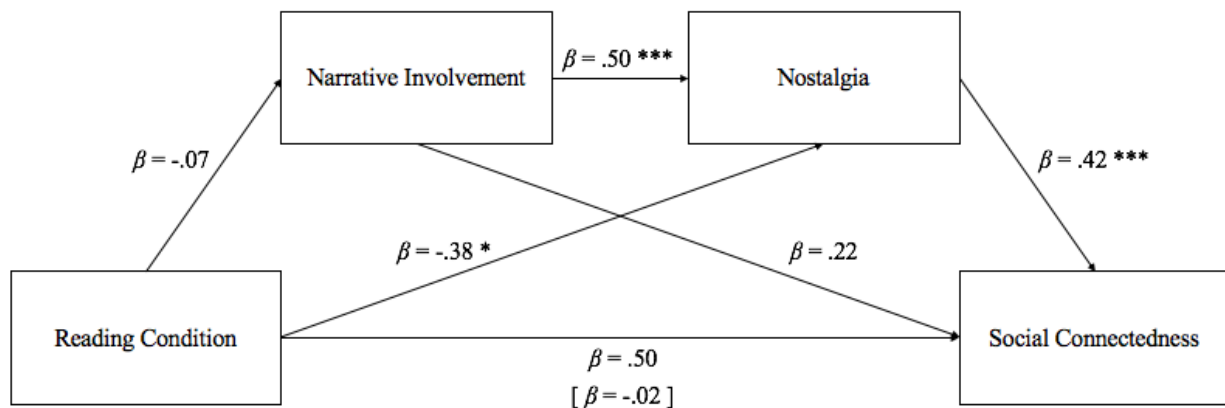


* indicates statistical significance at the .05 level
*** indicates statistical significance at the .01 level

The final serial-multiple mediation model investigated whether narrative involvement and nostalgia mediated the relation between re-reading novels on social connectedness. I ran

bootstrapping analysis to see if there was an indirect effect of reading condition on social connectedness through both narrative involvement and nostalgia using PROCESS version 3 (Hayes, 2012). This model, conducted with 5,000 bootstraps, yielded a mean bootstrap estimate of the indirect effect of -.46. The confidence interval did not include zero [-.82,-.17]; therefore, narrative involvement and nostalgia mediated the effect of reading condition on social connectedness, which provided support for Hypothesis 2c. The full model is listed in Figure 3. Narrative transportation and nostalgia were two mechanisms in which re-reading affects social connectedness.

Figure 3. Serial-multiple mediation for reading condition on social connectedness.



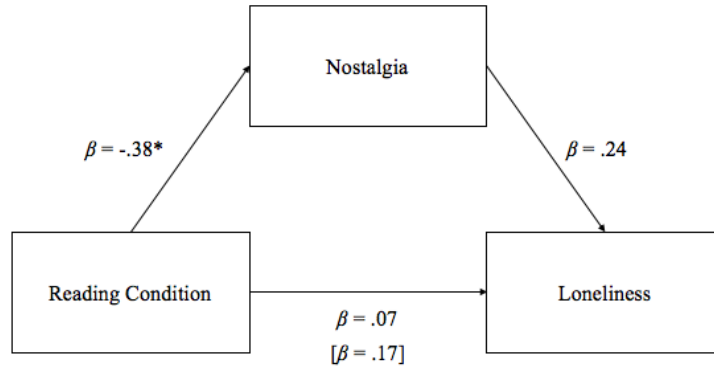
* indicates statistical significance at the .05 level
 *** indicates statistical significance at the .01 level

The important assumption, the a-path between reading condition and narrative involvement, was not met across these three mediation analyses. Therefore, I re-ran each of the three models without narrative involvement.

I ran bootstrapping analysis to see if there was an indirect effect of reading condition on loneliness through nostalgia using PROCESS version 3 model 4 (Hayes, 2012). This model, conducted with 5,000 bootstraps, yielded a mean bootstrap estimate of the indirect effect of -.15.

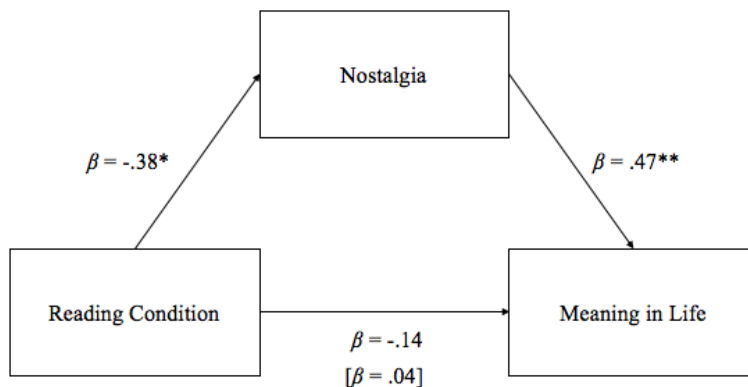
The confidence interval did not include zero [-.35, -.01]; therefore, nostalgia mediated the effect of reading condition on loneliness.

Figure 4. Nostalgia mediating the relation of reading condition and loneliness.



I ran bootstrapping analysis to see if there was an indirect effect of reading condition on meaning in life through nostalgia using PROCESS version 3 model 4 (Hayes, 2012). This model, conducted with 5,000 bootstraps, yielded a mean bootstrap estimate of the indirect effect of -.40. The confidence interval did not include zero [-.76, -.13]; therefore, nostalgia mediated the effect of reading condition on meaning in life.

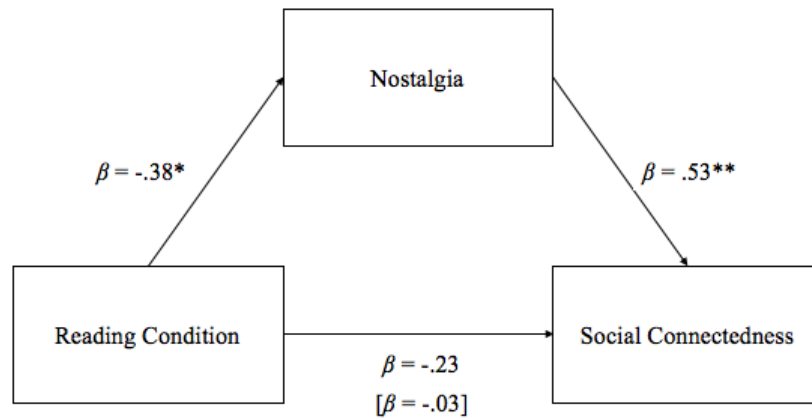
Figure 5. Nostalgia mediating the relation of reading condition and meaning in life.



I ran bootstrapping analysis to see if there was an indirect effect of reading condition on social connectedness through nostalgia using PROCESS version 3 model 4 (Hayes, 2012). This

model, conducted with 5,000 bootstraps, yielded a mean bootstrap estimate of the indirect effect of -.43. The confidence interval did not include zero [-.78, -.17]; therefore, nostalgia mediated the effect of reading condition on social connectedness.

Figure 6. Nostalgia mediating the relation of reading condition and social connectedness.



Overall, the three mediation analyses with nostalgia as the only mediator supplement explanation that nostalgia is an important mechanism for the relation of reading condition on the various outcomes.

Secondary Goals

To examine whether there were group differences between the reading conditions on the outcome variables for the ancillary goals of well-being and psychological needs met, I ran a multivariate analyses of variance (MANOVA). See Table 4 for means and standard deviations. Box’s M test for homogeneity of the variance-covariance matrices across design cells was significant, Box-M = 79.834, $F(45, 10646.886) = 1.474, p = .021$, providing lack of support for the homogeneity of variance assumption. Additionally, six of the nine Levene’s tests were not significant, providing partial support for the homogeneity of variance assumption. Significant Bartlett’s test of sphericity ($p < .001$) means correlations are sufficiently large, so it was acceptable to proceed with MANOVA. The MANOVA did not reveal a statistically

significant effect for reading condition, Pillai's Trace = .32, $F(18, 116) = 1.21$, $p = .261$, $\eta^2 = .16$.

I ran follow up univariate analyses of variances (ANOVAs) for completeness, even though the MANOVA was not significant.

I conducted One-Way Between-Subjects ANOVAs to test the effects of reading novels compared to a newspaper control on well-being, autonomy satisfaction, and competency satisfaction. The total number of participants was very low, with 31 in the old book condition, 30 in the new book condition, and only 9 in the newspaper control. (Data collection will continue, and analyses will be redone at the conclusion of the study. Using the weighted randomizer feature in Qualtrics, I plan to randomize participants using the 1:1:2 ratios for the conditions moving forward.) See Table 5 for the means and standard deviations for the secondary outcome measures.

Table 5.

Means and Standard Deviations of Reading Condition on Life Satisfaction, Psychological Well-Being, Autonomy, and Competency.

Dependent Variable		<i>M</i>	<i>SD</i>	<i>N</i>
Life Satisfaction	Old Book	20.77	5.38	31
	New Book	18.47	7.89	30
	Newspaper	22.56	7.32	9
Autonomy	Old Book	9.35	3.79	31
	New Book	8.73	3.40	30
	Newspaper	9.22	1.64	9
Environmental Mastery	Old Book	9.81	3.10	31
	New Book	9.38	3.49	30
	Newspaper	8.11	2.20	9
Personal Growth	Old Book	6.19	3.35	31
	New Book	4.87	2.53	30
	Newspaper	5.00	1.94	9
Positive Relations with Others	Old Book	9.23	4.00	31
	New Book	7.72	3.85	30
	Newspaper	8.11	2.93	9
Purpose in Life	Old Book	8.58	3.14	31
	New Book	8.55	3.98	30
	Newspaper	7.67	3.32	9
Self-Acceptance	Old Book	9.00	3.63	31

	New Book	7.93	4.09	30
	Newspaper	8.22	3.83	9
Autonomy Satisfaction	Old Book	15.03	2.61	31
	New Book	14.37	3.10	30
	Newspaper	15.22	1.10	9
Competency Satisfaction	Old Book	15.13	3.54	31
	New Book	15.53	3.48	30
	Newspaper	15.67	3.44	9

For the measure of well-being, I ran separate analyses for the measure of life satisfaction and each of the six psychological well-being subscales, to better articulate the multidimensional well-being measure (Ryff & Keyes, 1995). While it is also common practice to create a composite well-being score, I thought it would be best to assess reading across the six dimensions separately to examine the specific facets of well-being more thoroughly. Each of the overall tests was not significant. Reading condition did not significantly affect life satisfaction, $F(2, 69) = 1.60, p = .210, \eta^2 = .05$. In addition, the reading condition did not significantly influence autonomy, $F(2, 69) = .26, p = .772, \eta^2 = .01$, environmental mastery, $F(2, 68) = .99, p = .377, \eta^2 = .03$, personal growth, $F(2, 69) = 1.77, p = .179, \eta^2 = .05$, positive relations with others, $F(2, 68) = 1.20, p = .309, \eta^2 = .054$, purpose in life, $F(2, 68) = .25, p = .777, \eta^2 = .00$, and self-acceptance, $F(2, 68) = .59, p = .555, \eta^2 = .02$. Across the six subscales of psychological well-being and the measure of life satisfaction, the reading groups did not differ significantly from each other.

There was no support for autonomy and competency, two of the basic psychological needs, from the reading novel conditions compared to the newspaper control. I ran One-Way Between Subjects ANOVAs for Hypotheses 3b and 3c as well, but they were not supported. The overall test for the relation between reading conditions on satisfying autonomy needs was not significant, $F(2, 69) = .52, p = .598, \eta^2 = .02$. In addition, the overall test for reading conditions

satisfying the need for competency was not significant, $F(2, 69) = .14, p = .870, \eta^2 = .00$. The lack of support for these secondary goals may be because of several important factors, including underpowered analyses and unequal groups.

Discussion

The experimental Study 2 tested a new approach to manipulating nostalgia and assessing psychological outcomes through re-reading. This manipulation using old favorite books has not been explored prior to this research. Re-reading a favorite book successfully evoked nostalgic feelings, compared to both reading a new book of interest and a newspaper control condition. Reading an old favorite novel again, even for a short 20-minute time period, may increase feelings of nostalgia. Reading an old favorite book can be another potential source of nostalgia, in addition to previously validated ways (e.g., recalling a particular memory, smells; Wildschut et al., 2006; Reid, Green, Wildschut, & Sedikides, 2015; Barrett et al., 2010; Hepper et al., 2012; Vess, Arndt, Routledge, Sedikides, & Wildschut, 2012; Van Tilburg et al., 2013; Fraley et al., 2000).

The primary goals of the study were to determine whether reading a familiar favorite book again would trigger nostalgic feelings, as well as whether those elicited nostalgic feelings would influence loneliness, meaning in life, and social connectedness. Hypothesis 1 was supported, indicating that re-reading is an effective way to induce nostalgia. The psychological effects of loneliness, meaning, and social connectedness were important in understanding the benefits of re-reading books. There were no significant differences in reading conditions on the outcome variables, indicating that people reported similar feelings of loneliness, meaning, and social connectedness after re-reading an old favorite, reading a new book of interest, and reading a neutral newspaper selection (though the sample size was small). Two of the second set of

hypotheses were supported (Hypotheses 2b and 2c), suggesting that meaning in life and social connectedness after reading were influenced by the immersion into the story and feeling nostalgic. The manipulated reading condition variable has a potentially causal effect on the outcome variables as modeled in Figures 1 through 6; however, it is important to know that the mediators were not manipulated, therefore, the link remains correlational between the mediator and the outcome variable, even though we can still have a significant indirect effect. I took the MacArthur approach to clarify the relations further. This approach treated the indirect effect as only potentially causal, where we get closer to causality, but further complex models will be needed to address a manipulated mediator to establish the causal mechanisms (Agler & Boeck, 2017). Therefore, for hypotheses 2b and 2c, the manipulated reading groups related to increased meaning in life and social connectedness experienced a significant indirect effect of nostalgia.

The mediation results for the second set of hypotheses revealed interesting insights for future work. The simplified analyses containing the nostalgia-only mediator better articulated the relation between reading conditions on the three outcomes. Specifically, nostalgia mediated the effect of reading group on loneliness, meaning in life, and social connectedness. While the relation between narrative involvement and nostalgia was interesting, particularly for future work looking at personal familiarity with the story, nostalgia seems to better explain how re-reading decreases feelings of loneliness and increases feelings of meaning in life and social connectedness.

The ancillary goals examined whether reading books increase well-being and psychological needs relative to a neutral newspaper control. These goals were not supported in this current set of analyses (Hypotheses 3a, 3b, and 3c). The study was underpowered, and more data collection is needed. That being said, these results were promising, particularly with the re-

reading book manipulation. Lastly, it could also be the case that there might not be an effect of reading in general on well-being and basic psychological needs. However, until data collection is truly complete with equal groups and adequate power, I will not know if the hypotheses are supported or not. The theoretical justification suggests that the reading behavior would elicit positive psychological effects. This method gave participants the opportunity to select books that they wanted to read. After full data collection, there will be enough evidence to support or not the hypothesis 3 for the secondary goals of the study.

General Discussion

Study 1 revealed some support for the primary goal of exploring the association between nostalgia and re-reading. Nostalgic people were more likely to enjoy re-reading books. However, nostalgic people were not likely to also re-read books more frequently. There were some limitations to the correlational approach of Study 1. The actual reading frequencies and duration was not recorded in a daily format, as they were estimating the amount in Study 1. This correlational design also limited the degree to which reading frequency and basic psychological needs were not supported. Future work could examine whether reading over time (e.g., via a longitudinal design) satisfies the basic psychological needs, using the self-determination theoretical framework.

Study 2 took a step further by using an experimental approach to examine the psychological effects of re-reading books. The design of Study 2 included three conditions: old book, new book, and control (newspaper articles). The primary goal of Study 2 was to look at whether re-reading an old favorite novel that the participants themselves chose to read would evoke nostalgia, relative to reading a new book. Primary hypotheses also proposed that nostalgia elicited by re-reading a favorite book would reduce loneliness and increase meaning and

belonging. Nostalgia was successfully evoked from re-reading. In addition, re-reading decreased loneliness and increased both meaning in life and social connectedness through the nostalgic reading experience. Future work could look at moderators that may be influential in the mediation models, including trait nostalgia, affect, and self-esteem; the moderating roles of various traits may explain who may experience exacerbated levels of well-being after reading. There was an error in matching participant randomized ID numbers to link pre-lab trait measures and in-lab measures together, so I was not able to run moderation analyses. Additional moderators could be enjoyment of re-reading, pulling from the results of Study 1, to see if people who enjoy re-reading books again would also see differences in various psychological outcomes, compared to those who do not enjoy re-reading.

Nostalgia is often triggered from negative affect, social interactions, scents, music, movies, and writing about a nostalgic event (Wildschut et al., 2006; Reid, Green, Wildschut, & Sedikides, 2015; Barrett et al., 2010; Hepper et al., 2012; Wildschut et al., 2006; Vess, Arndt, Routledge, Sedikides, & Wildschut, 2012; Van Tilburg et al., 2013; Fraley et al., 2000). The serial-mediation models provide more causal evidence for the experimental reading manipulation on various outcomes through narrative transportation and nostalgia. Interacting with familiar fictional characters through an old favorite book with subsequent beneficial psychological effects provides more support for the transportation theory. The short 20-minute reading task evoked nostalgia; future work could examine the potential long-term benefits of reading entire novels and other psychological effects. Specifically, future avenues analyzing reading entire favorite books again during times of negative states might be beneficial for expanding upon the restorative functioning of nostalgia.

In addition, other modes of narration, such as podcasts and film, may be important avenues to explore for going through a familiar story. While this work provides mixed evidence for narrative involvement as an mechanism, more thorough investigations are necessary. It would be important to distinguish between the author's writing style, the parasocial relationship with the protagonist, and the physical book itself. Future research could question whether nostalgia occurs through re-reading because of where the person was in life when they first read the book, why it is considered the favorite book, and evaluating the other past experiences. Overall, reading people's favorite novels again becomes a new avenue for triggering nostalgia, and in turn, experience greater meaning in life and social connectedness from re-reading.

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Appendix I

Southampton Nostalgia Scale

According to the Oxford Dictionary, 'nostalgia' is defined as a 'sentimental longing for the past.'

1 2 3 4 5 6 7
Not at all Very much

1. How valuable is nostalgia for you?
2. How important is it for you to bring to mind nostalgic experiences?
3. How significant is it for you to feel nostalgic?
4. How prone are you to feeling nostalgic?
5. How often do you experience nostalgia?
6. Generally speaking, how often do you bring to mind nostalgic experiences?
7. Specifically, how often do you bring to mind nostalgic experiences? (Please check one.)

- At least once a day
- Three to four times a week
- Approximately twice a week
- Approximately once a week
- Once or twice a month
- Once every couple of months
- Once or twice a year

Batcho Nostalgia Inventory

*Instructions: Using the following scale, select a number to indicate **what you miss about when you were younger and how much you miss it.***

1 = Not at all to 9 = Very Much

Family
Heroes or Heroines
Not having to worry
Places
Music
Someone you loved
Friends
Things you did
Toys
The way people were

Feelings you had
 TV shows, movies
 School
 Having someone to depend on
 Holidays
 The way society was
 Pet or pets
 Not knowing sad or evil things
 Church or Temple, etc.
 Your house

Zimbardo Time Perspective Inventory – Past Positive

It gives me pleasure to think about my past.
 I get nostalgic about my childhood.
 Happy memories of good times spring readily to mind.
 On balance, there is much more good to recall than bad in my past.
 I enjoy stories about how things used to be in the “good old times”.
 Familiar childhood sights, sounds, and smells often bring back a flood of wonderful memories.
 I like family rituals and traditions that are regularly repeated.
 I find myself tuning out when family members talk about the way things used to be.
 The past has too many unpleasant memories that I prefer not to think about.

UCLA Loneliness Scale – Version 3

INSTRUCTIONS: Indicate how often each of the statements below is descriptive of you.

Statement	Never	Rarely	Sometimes	Often
1. How often do you feel that you are "in tune" with the people around you?	1	2	3	4
2. How often do you feel that you lack companionship?	1	2	3	4
3. How often do you feel that there is no one you can turn to?	1	2	3	4
4. How often do you feel alone?	1	2	3	4
5. How often do you feel part of a group of friends?	1	2	3	4
6. How often do you feel that you have a lot in common with the people around you?	1	2	3	4
7. How often do you feel that you are no longer close to anyone?	1	2	3	4
8. How often do you feel that your interests and ideas are not shared by those around you?	1	2	3	4
9. How often do you feel outgoing and friendly?	1	2	3	4
10. How often do you feel close to people?	1	2	3	4
11. How often do you feel left out?	1	2	3	4

12. How often do you feel that your relationships with others are not meaningful?	1	2	3	4
13. How often do you feel that no one really knows you well?	1	2	3	4
14. How often do you feel isolated from others?	1	2	3	4
15. How often do you feel you can find companionship when you want it?	1	2	3	4
16. How often do you feel that there are people who really understand you?	1	2	3	4
17. How often do you feel shy?	1	2	3	4
18. How often do you feel that people are around you but not with you?	1	2	3	4
19. How often do you feel that there are people you can talk to?	1	2	3	4
20. How often do you feel that there are people you can turn to?	1	2	3	4

Positive and Negative Affect Schedule

*This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate **to what extent you generally feel this way**, that is, how you feel on the average. Use the following scale to record your answers.*

	1	2	3	4	5
	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
_____ Interested					
_____ Distressed					
_____ Excited					
_____ Upset					
_____ Strong					
_____ Guilty					
_____ Scared					
_____ Hostile					
_____ Enthusiastic					
_____ Proud					
_____ Irritable					
_____ Alert					
_____ Ashamed					
_____ Inspired					
_____ Nervous					
_____ Determined					
_____ Attentive					
_____ Jittery					

- _____ Active
- _____ Afraid

Need to Belong Scale

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

- 1 = Strongly disagree
- 2 = Moderately disagree
- 3 = Neither agree nor disagree
- 4 = Moderately agree
- 5 = 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

Interpersonal Reactivity Index (IRI)

Instructions: The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate number on the scale at the top of the page. When you have decided on your answer, fill in the letter next to the item number. READ EACH ITEM CAREFULLY BEFORE RESPONDING. Answer as honestly as you can. Thank you.

1	2	3	4	5
Does not describe me very well	Does not describe me well	Somewhat describes me well	Describes me well	Describes me very well

- 1. I daydream and fantasize, with some regularity, about things that might happen to me.
- 2. I often have tender, concerned feelings for people less fortunate than me.
- 3. I sometimes find it difficult to see things from the "other guy's" point of view.
- 4. Sometimes I don't feel very sorry for other people when they are having problems.
- 5. I really get involved with the feelings of the characters in a novel.
- 6. In emergency situations, I feel apprehensive and ill-at-ease.
- 7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it.
- 8. I try to look at everybody's side of a disagreement before I make a decision.
- 9. When I see someone being taken advantage of, I feel kind of protective towards them.
- 10. I sometimes feel helpless when I am in the middle of a very emotional situation.
- 11. I sometimes try to understand my friends better by imagining how things look from their perspective.
- 12. Becoming extremely involved in a good book or movie is somewhat rare for me.
- 13. When I see someone get hurt, I tend to remain calm.

14. Other people's misfortunes do not usually disturb me a great deal.
15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.
16. After seeing a play or movie, I have felt as though I were one of the characters.
17. 17. Being in a tense emotional situation scares me.
18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.
19. I am usually pretty effective in dealing with emergencies.
20. I am often quite touched by things that I see happen.
21. I believe that there are two sides to every question and try to look at them both.
22. I would describe myself as a pretty soft-hearted person.
23. When I watch a good movie, I can very easily put myself in the place of a leading character.
24. I tend to lose control during emergencies.
25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while.
26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.
27. When I see someone who badly needs help in an emergency, I go to pieces.
28. Before criticizing somebody, I try to imagine how I would feel if I were in their place.

Meaning in Life Questionnaire (MLQ)

Please take a moment to think about what makes your life feel important to you. Please respond to the following statements as truthfully and accurately as you can, and also please remember that these are very subjective questions and that there are no right or wrong answers. Please answer according to the scale below:

1	2	3	4	5	6	7
Absolutely Untrue	Mostly Untrue	Somewhat Untrue	Can't Say Absolutely True or False	Somewhat True	Mostly True	Absolutely True

1. I understand my life's meaning.
2. I am looking for something that makes my life feel meaningful.
3. I am always looking to find my life's purpose.
4. My life has a clear sense of purpose.
5. I have a good sense of what makes my life meaningful.
6. I have discovered a satisfying life purpose.
7. I am always searching for something that makes my life feel significant.
8. I am seeking a purpose or mission for my life.
9. My life has no clear purpose.
10. I am searching for meaning in my life.

Rosenberg Self-Esteem Scale

Instructions: Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement.

1	2	3	4
Strongly Agree	Agree	Disagree	Strongly Disagree

1. On the whole, I am satisfied with myself.
2. At times I think I am no good at all.

3. I feel that I have a number of good qualities
4. I am able to do things as well as most other people.
5. I feel I do not have much to be proud of.
6. I certainly feel useless at times.
7. I feel that I'm a person of worth, at least on an equal plane with others.
8. I wish I could have more respect for myself.
9. All in all, I am inclined to feel that I am a failure.
10. I take a positive attitude toward myself.

Social Connectedness Scale

Please indicate the degree to which you agree or disagree with each statement, marking one box for each statement.

Statement	1 Strongly Agree	2	3	4	5	6 Strongly Disagree
I feel disconnected from the world around me.						
Even around people I know, I don't feel that I really belong.						
I feel so distant from people.						
I have no sense of togetherness with my peers.						
I don't feel related to anyone.						
I catch myself losing all sense of connectedness with society.						
Even among my friends, there is no sense of brother/sisterhood.						
I don't feel that I participate with anyone or any group.						

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

1	2	3	4	5
Never	Almost Never	Sometimes	Fairly Often	Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and "stressed"?

4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your way?
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt that you were on top of things?
9. In the last month, how often have you been angered because of things that were outside of your control?
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Psychological Well-Being Scales – 18-item version (PWB)

Instructions: Select one response below each statement to indicate how much you agree or disagree.

1. “I like most parts of my personality.”

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
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2. “When I look at the story of my life, I am pleased with how things have turned out so far.”

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
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3. “Some people wander aimlessly through life, but I am not one of them.”

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
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4. “The demands of everyday life often get me down.”

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
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5. “In many ways I feel disappointed about my achievements in life.”

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
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6. “Maintaining close relationships has been difficult and frustrating for me.”

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
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7. “I live life one day at a time and don't really think about the future.”

	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
8. "In general, I feel I am in charge of the situation in which I live."	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
9. "I am good at managing the responsibilities of daily life."	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
10. "I sometimes feel as if I've done all there is to do in life."	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
11. "For me, life has been a continuous process of learning, changing, and growth."	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
12. "I think it is important to have new experiences that challenge how I think about myself and the world."	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
13. "People would describe me as a giving person, willing to share my time with others."	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
14. "I gave up trying to make big improvements or changes in my life a long time ago"	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
15. "I tend to be influenced by people with strong opinions"	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
16. "I have not experienced many warm and trusting relationships with others."	Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree

17. "I have confidence in my own opinions, even if they are different from the way most other people think."

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
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18. "I judge myself by what I think is important, not by the values of what others think is important."

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
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Satisfaction with Life Scale

Below are five statements that you may agree or disagree with. Using the 1 - 7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

- ___ In most ways my life is close to my ideal.
- ___ The conditions of my life are excellent.
- ___ I am satisfied with my life.
- ___ So far I have gotten the important things I want in life.
- ___ If I could live my life over, I would change almost nothing.

Basic Psychological Needs and Frustrations Scale - General

Below, we ask you about the kind of experiences you actually have in your life. Please read each of the following items carefully. You can choose from 1 to 5 to indicate the degree to which the statement is true for you at this point in your life.

1 (Not true at all) 2 3 4 5 (Completely true)

- 1. I feel a sense of choice and freedom in the things I undertake. **1 2 3 4 5**
- 2. Most of the things I do feel like "I have to". **1 2 3 4 5**
- 3. I feel that the people I care about also care about me. **1 2 3 4 5**
- 4. I feel excluded from the group I want to belong to. **1 2 3 4 5**
- 5. I feel confident that I can do things well. **1 2 3 4 5**
- 6. I have serious doubts about whether I can do things well. **1 2 3 4 5**
- 7. I feel that my decisions reflect what I really want. **1 2 3 4 5**
- 8. I feel forced to do many things I wouldn't choose to do. **1 2 3 4 5**
- 9. I feel connected with people who care for me, and for whom I care. **1 2 3 4 5**
- 10. I feel that people who are important to me are cold and distant towards me. **1 2 3 4 5**
- 11. I feel capable at what I do. **1 2 3 4 5**
- 12. I feel disappointed with many of my performances. **1 2 3 4 5**
- 13. I feel my choices express who I really am. **1 2 3 4 5**
- 14. I feel pressured to do too many things. **1 2 3 4 5**

- 15. I feel close and connected with other people who are important to me. **1 2 3 4 5**
- 16. I have the impression that people I spend time with dislike me. **1 2 3 4 5**
- 17. I feel competent to achieve my goals. **1 2 3 4 5**
- 18. I feel insecure about my abilities. **1 2 3 4 5**
- 19. I feel I have been doing what really interests me. **1 2 3 4 5**
- 20. My daily activities feel like a chain of obligations. **1 2 3 4 5**
- 21. I experience a warm feeling with the people I spend time with. **1 2 3 4 5**
- 22. I feel the relationships I have are just superficial. **1 2 3 4 5**
- 23. I feel I can successfully complete difficult tasks. **1 2 3 4 5**
- 24. I feel like a failure because of the mistakes I make. **1 2 3 4 5**

Leisure Activities List

Please check all of the leisure activities listed that you typically engage with in your daily life:

- | | |
|--------------------------------------|--|
| <input type="checkbox"/> Sports | <input type="checkbox"/> Car/motorcycle mechanics |
| <input type="checkbox"/> Fishing | <input type="checkbox"/> Woodworking |
| <input type="checkbox"/> Music | <input type="checkbox"/> Fixing things |
| <input type="checkbox"/> Drama | <input type="checkbox"/> Collecting |
| <input type="checkbox"/> Photography | <input type="checkbox"/> Computer programming |
| <input type="checkbox"/> Writing | <input type="checkbox"/> Being with friends |
| <input type="checkbox"/> Cooking | <input type="checkbox"/> Dancing |
| <input type="checkbox"/> Childcare | <input type="checkbox"/> Reading |
| <input type="checkbox"/> Movies | <input type="checkbox"/> Learning about current events |
| <input type="checkbox"/> Television | <input type="checkbox"/> Other: _____ |

Leisure Participation and Enjoyment

Please report how often you engage in the four activities in your free time by checking the box below:

1. Reading Books
 - Everyday
 - Several times a week
 - Several times a month
 - Several times a year or less
 - Never

2. Watching TV/DVDS/Videos
 - Everyday
 - Several times a week
 - Several times a month
 - Several times a year or less
 - Never

3. Getting together with friends

- Everyday
- Several times a week
- Several times a month
- Several times a year or less
- Never

4. Engaging in physical activities

- Everyday
- Several times a week
- Several times a month
- Several times a year or less
- Never

Please report the level of enjoyment you experience from each of the four activities in your free time by checking the box below:

1. Reading Books

- No enjoyment
- Not much enjoyment
- Some enjoyment
- A fair amount of enjoyment
- A great amount of enjoyment
- Did not participate in this kind of activity in my free time

2. Watching TV/DVDS/Videos

- No enjoyment
- Not much enjoyment
- Some enjoyment
- A fair amount of enjoyment
- A great amount of enjoyment
- Did not participate in this kind of activity in my free time

3. Getting together with friends

- No enjoyment
- Not much enjoyment
- Some enjoyment
- A fair amount of enjoyment
- A great amount of enjoyment
- Did not participate in this kind of activity in my free time

4. Engaging in physical activities

- No enjoyment
- Not much enjoyment
- Some enjoyment
- A fair amount of enjoyment

- _____ A great amount of enjoyment
 _____ Did not participate in this kind of activity in my free time

Reading Enjoyment

1. During the past week, how much time have you spent reading books (in electronic or print format) for your own enjoyment? Please include all books you have read except those relating to your schoolwork. _____
2. How many books have you read for your own enjoyment in the last month? _____
3. How many books have you read for your own enjoyment in the last six months? _____
4. In which format do you prefer to read books for your own enjoyment? _____
5. If you would like to spend more time reading for enjoyment, what keeps you from doing so?

6. Have you ever read a book which had a significant impact on you? If so, please give the title of the book and explain what effect it had. _____

Indicate the percentage of enjoyment you feel towards fiction and non-fiction books below:

Fiction % of enjoyment = _____
 Non-fiction % of enjoyment = _____

Leisure Motivation Scale

Instructions: The following items ask about different motivations for reading for fun. Respond the items by completing the following statement:

" I read..."

1. To expand my interests
2. To seek stimulation
3. To make things more meaningful for me
4. To learn about things around me
5. To satisfy my curiosity
6. To explore new ideas
7. To learn about myself
8. To expand my knowledge
9. To discover new things
10. To be creative
11. To be original
12. To use my imagination
13. To be with others
14. To build friendships with others
15. To interact with others
16. To develop close friendships
17. To meet new and different people
18. To help others
19. So others would think well of me doing it
20. To reveal my thoughts, feelings, or physical skills to others
21. To influence others
22. To be socially competent and skillful
23. To gain a feeling of belonging
24. To gain other's respect

- 25. To get a feeling of achievement
- 26. To see what my abilities are
- 27. To challenge my abilities
- 28. Because I enjoy mastering things
- 29. To be good in doing them
- 30. To improve my skill and ability in doing them
- 31. To compete against others
- 37. To be in a calm atmosphere
- 38. To avoid crowded areas
- 39. To slow down
- 40. Because I like to be alone
- 41. To relax physically
- 42. To relax mentally
- 43. To avoid the hustle and bustle of daily activities
- 44. To rest
- 45. To relieve stress and tension
- 46. To do something simple and easy
- 47. To unstructure my time
- 48. To get away from the responsibilities of everyday life

Reading and Re-Reading Items

What is the title and author (if known) of your favorite fiction novel?

Title:

Author:

How many times have you read this book?

How many books have you re-read books before?

Do you find enjoyment in re-reading books?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Instructions for those who have only read their favorite fiction book once:

Think about your favorite fiction book that you've read. If you were to read this book again...

Would it make you feel nostalgic?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Would it make you feel connected to the characters?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Would you want to talk about it with others?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Would you *savor* reading the book?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Would you read it with a different perspective?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Would knowing what happens in the end of the book change your enjoyment of the book?

1	2	3
Made me like it less	Did not change my enjoyment	Made me like it more

To what extent would you make time in your day to read it again?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

To what extent would you recommend others to re-read their favorite books?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Do you currently have a copy or could you be able to access a copy of it (ebook or actual books, etc.)?

1	2
No	Yes

Instructions for those who have only read their favorite fiction book more than once:

Think about your favorite fiction book that you've re-read before. When you re-read that book again...

Did it make you feel nostalgic at the time you were re-reading it?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Did it make you feel connected to the characters?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Did you want to talk about it with others?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Did you *savor* reading the book?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Did you read it with a different perspective?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

How did knowing what happened in the end of the book change your enjoyment of the book?

1	2	3
Made me like it less	Did not change my enjoyment	Made me like it more

To what extent would you make time in your day to read it again?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

To what extent would you recommend others to re-read their favorite books?

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

Do you currently have a copy or could you be able to access a copy of it (ebook or actual books, etc.)?

1	2
No	Yes

Demographics Questionnaire

Please respond to the following:

1. What is your age in years? _____
2. What is your gender? Female Male Other gender (specify below)
3. If other gender, what do you identify as? _____
4. What race do you most strongly identify as? _____
5. Is English your native language? Yes No
6. If no, what is your native language? _____

Study 2 Pre-Reading Task Question:

To what extent are you looking forward to reading your selected text?

(1 = not at all to 5 = very much)

Study 2 Reading Instructions following Reading Task (re-read old book, read new book, read newspaper control):

Please take the time to think about the book you just read over the last 20 minutes.

Nostalgia Check

The following statements refer to how you feel right now. Please indicate your agreement or disagreement by placing a number in the blank space preceding each statement. The number should be anywhere from 1 to 6, according to the following scale.

1	2	3	4	5	6
Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree

- ___ Right now, I am feeling quite nostalgic.
- ___ Right now, I am having nostalgic feelings
- ___ I feel nostalgic at the moment.

Please indicate how much of the book you were able to read (number of pages read): _____

Please provide a summary of the reading:

Please provide a brief description of your favorite part of the reading (if you have read the text prior, you may discuss your favorite part even if you did not read it in the allotted time today):

For the re-reading condition only:

How long ago (in years) did you read this book for the first time? _____

How many times have you read this book before today? _____

When is the last time you read this book before today? _____

How familiar is this reading to you?

1 (not at all) to 5 (very much)

How personally relevant is this reading to you?

1 (not at all) to 5 (very much)

In a few sentences, explain why you consider this book to be your favorite?

Narrative Involvement Scale

Instructions: Using the 1 to 9 scale, with 1 = strongly disagree, and 9 = strongly agree with the statement, please tell us how much you agree with the following statements about your experience with the book you just read.

1. I felt like I was going through what the characters were going through.
2. I could picture myself in some of the scenes in the book.
3. It felt like the events were happening to me.
4. While reading, I was thinking of things I could have been doing instead of reading.
5. I imagined what it would be like to be in a character's situation.
6. I thought about parts of my life that were related to what was happening in the story.
7. While I was reading the book, it was easy to imagine the events actually taking place.
8. The book affected me emotionally.
9. I understood what the characters were going through.
10. I found the story moving.
11. Several times while reading the book, I was thinking about other things.
12. I have felt the emotions the characters were experiencing.

Outcomes (Social Connectedness, Meaning in Life, and Self-Esteem)

Please use the following scale to record your answer:

1	2	3	4	5	6
Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree

Reading this text ...

- ___ makes me feel connected to loved ones
- ___ makes me feel protected
- ___ makes me feel loved
- ___ makes me feel I can trust others
- ___ makes me feel life is meaningful
- ___ makes me feel life has a purpose
- ___ makes me feel there is a greater purpose to life
- ___ makes me feel that life is worth living
- ___ makes me feel good about myself
- ___ makes me like myself better
- ___ makes me value myself more
- ___ makes me feel I have many positive qualities

Loneliness – Single Item (state measure)

Please respond to the following statement below about how you are currently feeling on the scale by circling the number:

“I feel lonely.”

1	2	3	4	5
Not at all	A little	Moderately	Quite a bit	Very much

Psychological Well-Being Scales – 18-item version (PWB) – State Measure (Adapted)

Instructions: *Select one response below each statement to indicate how much you agree or disagree with how you feel right now in the present moment.*

1. “Right now, I like most parts of my personality.”

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
-------------------	-------------------	-------------------	-------------------------------	----------------------	----------------------	----------------------

2. “When I look at the story of my life, I am pleased with how things have turned out so far right now.”

Strongly agree	Somewhat agree	A little agree	Neither agree nor disagree	A little disagree	Somewhat disagree	Strongly disagree
-------------------	-------------------	-------------------	-------------------------------	----------------------	----------------------	----------------------

3. "Some people wander aimlessly through life, but I am not one of them right now."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
4. "In the present moment, the demands of everyday life get me down."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
5. "In many ways I feel disappointed about my achievements in life right now."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
6. "Maintaining close relationships has been difficult and frustrating for me in the present moment."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
7. "Right now, I live life one day at a time and don't really think about the future."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
8. "In the present moment, I feel I am in charge of the situation in which I live."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
9. "I am good at managing the responsibilities of daily life in the present moment."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
10. "I sometimes feel as if I've done all there is to do in life right now."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
11. "For me, life has been a continuous process of learning, changing, and growth right now."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
12. "In the present moment, I think it is important to have new experiences that challenge how I think about myself and the world."

- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
13. "In the present moment, people would describe me as a giving person, willing to share my time with others."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
14. "I gave up trying to make big improvements or changes in my life in the present moment."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
15. "Right now, I tend to be influenced by people with strong opinions"
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
16. "In the present moment, I have not experienced many warm and trusting relationships with others."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
17. "Right now, I have confidence in my own opinions, even if they are different from the way most other people think."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
18. "In the present moment, I judge myself by what I think is important, not by the values of what others think is important."
- | | | | | | | |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|
| Strongly agree | Somewhat agree | A little agree | Neither agree nor disagree | A little disagree | Somewhat disagree | Strongly disagree |
|----------------|----------------|----------------|----------------------------|-------------------|-------------------|-------------------|

Satisfaction with Life Scale – State Measure (Adapted)

Below are five statements that you may agree or disagree with as you feel right now in the present moment. Using the 1 - 7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

- ____ Right now I feel that in most ways my life is close to my ideal.
- ____ The conditions of my life are excellent right now.
- ____ I am satisfied with my life in the present moment.

____ So far I have gotten the important things I want in life right now.
____ If I could live my life over, I would change almost nothing right now.

Basic Psychological Needs and Frustrations Scale – State (Adapted)

Below, we ask you about the kind of experiences you actually have in your life. Please read each of the following items carefully. You can choose from 1 to 5 to indicate the degree to which the statement is true for you at this point in your life, that is, in the present moment.

1 (Not true at all) 2 3 4 5 (Completely true)

1. I feel a sense of choice and freedom in the things I undertake right now. **1 2 3 4 5**
2. In the present moment, most of the things I do feel like “I have to”. **1 2 3 4 5**
3. I feel that the people I care about also care about me right now. **1 2 3 4 5**
4. I feel excluded from the group I want to belong to in the present moment. **1 2 3 4 5**
5. I feel confident that I can do things well right now. **1 2 3 4 5**
6. Right now, I have serious doubts about whether I can do things well. **1 2 3 4 5**
7. I feel that my decisions reflect what I really want. **1 2 3 4 5**
8. I feel forced to do many things I wouldn’t choose to do right now. **1 2 3 4 5**
9. In the current moment, I feel connected with people who care for me, and for whom I care. **1 2 3 4 5**
10. Right now, I feel that people who are important to me are cold and distant towards me. **1 2 3 4 5**
11. I feel capable at what I do in the present moment. **1 2 3 4 5**
12. Right now, I feel disappointed with many of my performances. **1 2 3 4 5**
13. I feel my choices express who I really am right now. **1 2 3 4 5**
14. In the present moment, I feel pressured to do too many things. **1 2 3 4 5**
15. I feel close and connected with other people who are important to me right now. **1 2 3 4 5**
16. In the present moment, I have the impression that people I spend time with dislike me. **1 2 3 4 5**
17. I feel competent to achieve my goals in the current moment. **1 2 3 4 5**
18. I feel insecure about my abilities right now. **1 2 3 4 5**
19. I feel I have been doing what really interests me in the present moment. **1 2 3 4 5**
20. In the current moment, my daily activities feel like a chain of obligations. **1 2 3 4 5**
21. Right now, I experience a warm feeling with the people I spend time with. **1 2 3 4 5**
22. I feel the relationships I have are just superficial right now. **1 2 3 4 5**
23. I feel I can successfully complete difficult tasks right now. **1 2 3 4 5**
24. In the present moment, I feel like a failure because of the mistakes I make. **1 2 3 4 5**

Newspaper Articles

Like Magneto? Microcrystals give magnets superpower over living cells

New iron-rich protein crystals could help researchers better understand the nerve cells that control movement and sensation. All they need are magnets.

Imagine if you could control someone by using a magnet. It would be a bit like Magneto, the supervillain in X-Men. He can control anything magnetic. Even the iron inside someone's body.

Controlling people with magnets sounds a little, well, wacky. But scientists have now done something close to that. They have engineered cells to make long, needle-like crystals rich in iron. Researchers can then use magnets to control cells containing these crystals.

Video recordings show these iron-rich crystals moving toward a strong magnet. The crystals pull the entire cell along with them.

"It's almost alien," says Bianxiao Cui. She's a chemist at Stanford University in California. Cui and her colleagues didn't set out to give scientists superpowers like Magneto's. Instead, their new protein crystals were designed to help scientists study which neurons control an animal's movements and senses. The crystals provide something inside a cell that magnets can attract. This innovation fills a gap in the budding field of magnetogenetics (Mag-NEE-toh-jeh-NET-iks).

Scientists in this field genetically engineer cells so that they will respond to magnetic fields. Now researchers can remotely control specific neurons in the body using magnets. Those neurons could be ones that control how hungry an animal gets. Or they could be neurons that control leg muscles so a mouse starts running when a magnet is nearby.

Gaining magnetic control

A magnetic field can turn on neurons that contain proteins rich in iron. The field does this by heating or giving a mechanical push to those proteins.

Researchers had already been able to control neurons with light. That process is called optogenetics. To use it, scientists insert light-sensitive molecules into the neurons of living animals. The researchers can then turn the neurons on or off simply by shining a light on them. With this technique, neuroscientists have done some incredible things. They've made mice run in circles. They've even restored movement to an animal's paralyzed leg.

But optogenetics has its downsides. Light, for example, can't penetrate deeply into the body. There's just too much bone, muscle and other tissue in the way. So researchers may implant optical fibers into the animal to deliver light to deep neurons. That makes the method cumbersome and even potentially dangerous.

The whole idea behind magnetogenetics is that you don't have to implant anything, explains Jacob Robinson, who was not involved in the study. He's a neuroengineer who works at Rice University in Houston, Texas.

Cells deep inside the body could be switched on with just a magnetic field. No fibers or surgery would be needed.

But there's a snag. The only protein found naturally inside animal cells that's even remotely magnetic is ferritin (FAIR-ih-tin). Each molecule can have as many as 4,500 atoms of iron. That may sound like a lot, but it's not. The force that a magnet acting on ferritin generated would be only a billionth as strong as would be needed to turn on a neuron. So Cui's team developed protein crystals that could carry enough iron to make their cells responsive to magnets.

Giant crystals with an iron heart

The team first extracted the gene to make ferritin from a microbe. They then made a circular piece of DNA that contained two human genes. Those genes make long, hollow crystals called inka-PAK4 (short for Inkabox-PAK4cat). The team introduced these circular pieces of DNA into human kidney cells that were growing in a petri dish. A day later, the first crystals appeared.

“When I first saw those crystals assemble in the cells by themselves, it was just amazing,” Cui recalls.

The crystals grew for three days until they were 45 millionths of a meter long. That's about half the average thickness of a human hair. They're the largest iron-containing protein crystals ever made in the lab — or in nature, Cui says. They were even longer than the cells they grew in. But the cells in which they formed never ripped. They just stretched to accommodate the crystals.

The researchers pried open the cells and removed the crystals. Then they loaded these with iron. The team estimates that it packed some 8 billion iron atoms into each crystal before inserting those crystals into human cells growing in a dish. Now they exposed the cells to a magnetic field and waited to see what would happen.

And the cells moved.

“The first time I actually saw [the cells] move toward the magnet, I was like, ‘Wow!’” Cui says. Crystals started collecting close to the magnet. And the crystals pulled their cells with them. The team described this online September 25 in *Nano Letters*.

Robinson expressed excitement over this. “It's an excellent step,” he said, “toward engineering cells to create their own magnetic nanoparticles.”

Scientists aren't sure what will happen to the crystals afterward. But the cells have the genes for the crystals. So every cell reproduced from the original cells should be able to make the crystals, Cui says.

Iron not included

As promising as the results are, both Cui and Robinson emphasized that this isn't the end.

“We still haven’t reached the goal,” Cui says.

Ideally, researchers would not need to first remove newly grown crystals to pack them full of the metal atoms. Instead, cells would enrich the crystals with iron as it built them. In fact, Cui’s group tried three different ways to get iron into its cells. They even drenched the cells in an iron-rich solution. Nothing worked.

Cells typically keep their iron levels low, Cui’s team notes. It’s estimated that cells naturally contain only 3 percent as much iron as the crystals would need to be effective.

We probably need to alter the cell’s outer membranes, Cui suspects. Then, he says, they might be able to transport more iron into a cell. Still, these magnetic crystals are a major leap forward in the young field of magnetogenetics. And the researchers are confident additional studies will overcome this iron-enrichment obstacle.

Cool Job: One green chemist is mining zoo dung for biological helpers

Her goal is to convert farm-field wastes into useful fuels and chemicals

You might call this group of lab members a poop patrol. Sometimes, they hang out at the Santa Barbara Zoo waiting for certain goats and sheep to do their business. But they’re not there just as a cleanup crew. To them, these droppings are more than waste. They’re the source of microbes that might one day become the route to greener fuels and chemicals.

Michelle O’Malley, 37, leads this group. She’s a chemical and biological engineer at the University of California campus across town. Her team is hunting for fungi that live in the digestive tract of plant-eating animals, such as sheep, goats, cows, giraffes and elephants. As anaerobes (AN-uh-roabs), those fungi can only live in the absence of oxygen. Together with some anaerobic bacteria, these fungi can break down grass and other plants. Along the way, they release sugars and other nutrients.

These particular microbial helpers do not usually show up in the human gut. That’s why much of the fibrous parts of plants that we eat goes undigested. It passes through our guts, largely unaltered, exiting as wastes out the other end.

Here at the zoo, the researchers are focusing on San Clemente Island goats and Navajo-Churro sheep. “It can be hard to tell the difference between goat and sheep poop,” notes O’Malley. So it helps to “watch the donation take place.”

Once collected, their pellets go to the lab. There, team members coax out the fungi that enable these animals to digest certain plants.

O’Malley had to learn what she calls “very old-school technology” to grow the finicky fungi in her lab. Then she turned to tracking down the distinctive plant-degrading enzymes that these fungi make. Her big-picture plan is to help society move away from fossil fuels, such as

petroleum. In their place, she hopes to find more sustainable ways to make chemicals and fuels. Her raw materials could be agricultural leftovers — such as corn stover and wheat straw, for example. In the past, such leftover plant materials have often been viewed as waste because people can't eat them.

Fungi point to helpful enzymes

The fibrous parts of plants are made of lignocellulose (Lig-no-SEL-yu-loas). That chemical, in turn, is made from smaller compounds. Among them are two sugars: cellulose and hemicellulose. And those sugars are rich in carbon. Carbon is also a major ingredient in most fuels and many other chemicals and drugs.

O'Malley's team would like to mine lignocellulose for its carbon. The problem is that the fibrous parts of plants also contain lignin. It's a structural material that serves "to keep microbes and their enzymes out" of plant cell walls, O'Malley explains. So lignin makes it difficult to get to the sugars in lignocellulose.

Industrial chemists have found ways to chemically or physically remove lignin. But those processes often are costly, toxic and wasteful (as lignin itself contains valuable chemicals).

Some fungi have a better approach. And that's what drew O'Malley's attention to plant-eating animals and their poop. It turns out, O'Malley says, that certain anaerobic fungi found in the guts of these animals could give industry a greener way to break down cellulose, hemicellulose — and even lignin.

After a goat's grassy lunch, certain anaerobic fungi burrow into the plant cell walls. There they release enzymes that break down lignocellulose — lignin and all. These challenging fungi have a 10-syllable name: *Neocallimastigomycota*.

O'Malley studied under chemical engineer Anne Robinson. That was back when she was in graduate school at Carnegie Mellon University in Pittsburgh, Pa. Robinson isn't surprised her former student is working with such a challenging microbe. She recalls her student as being "very unafraid to tackle problems" and "able to recognize the interesting or unusual result."

One fungus: Many, many digestive enzymes

After graduate school, O'Malley contacted scientists who had worked with anaerobic fungi. Most had abandoned those studies. The microbes just proved too difficult to work with. Then Michael Theodorou invited her to work with him. He had pioneered research on such microbes. Today he works at Harper Adams University in Newport, England. Back then, though, Theodorou was in Wales. And there he taught O'Malley how to isolate and grow these fungi.

Their challenge was feeding the fungi what they needed to grow, all the while keeping oxygen out.

Her team now begins with roll tubes. Think of them as 3-D petri dishes that can support growth across their inner walls, all in an oxygen-free environment. Carbon dioxide and a food source with digestive fluids are added to the closed tubes. Next, her team rolls the tubes to get an even coat on the internal walls. After adding a fungi-rich poop slurry, they roll the tubes again. If the process works, fungal colonies grow.

“All of this requires a lot of careful, coordinated, quick movements,” O’Malley says. It’s “a lost art.”

In her UC Santa Barbara lab, O’Malley has been isolating fungi from zoo samples and studying their enzymes. Until now, “nobody really knew their true power,” she says. Those fungi (with a mouthful of a name) turn out to have genes to make the largest number of biomass-degrading enzymes known. That’s something her team reported in *Science* three years ago.

The researchers have now partnered these anaerobic fungi with brewers’ yeast (*Saccharomyces cerevisiae*). That yeast is a mainstay of the biochemical industry.

O’Malley’s group showed that the fungi efficiently broke down lignocellulose in reed canary grass. That freed the sugars to be converted to other products by the yeast. O’Malley and colleagues shared their findings, last year, in *Biotechnology and Bioengineering*.

With the goal of unleashing these powers for the biotechnology industry, O’Malley and her group are exploring whether it makes sense to harvest the enzymes from the fungi. Maybe they should just insert fungal DNA into yeast and bacteria. That could turn them into enzyme-making machines.

Figuring out the ideal way to break down lignocellulose “has been a really [unsolvable] problem for a long time,” says Michael Betenbaugh. This biochemical engineer works at Johns Hopkins University in Baltimore, Md. O’Malley “kind of forged out on her own,” he says. Her trick, he adds, was “looking for these unusual microbes that have been doing [it] for millennia.”

This robot catches jellyfish with a gentle ‘hug’

Silicone fingers swell with water to trap jellyfish without squishing them

Jellyfish seem made for their watery world. These gelatinous creatures, with tentacles that dangle from umbrella-shaped bodies, are 95 percent water. But their fragile bodies have made it hard for scientists to safely catch them for study. Until now. A new soft robot that mimics a human hand can gently catch and clasp jellyfish without harm.

“Jellyfish and other gelatinous animals ... have a huge amount of potential to teach us things,” notes Nina Sinatra. She and her colleagues designed and built their new robot to make it easier to study those jellies. Sinatra is a mechanical engineer. That’s someone who uses physics and materials science to design gadgets with moving parts. She worked on the project while at Harvard University in Cambridge, Mass.

Her team described its new device August 28 in Science Robotics. Resembling a robotic hand, its six soft fingers can cradle a flopsy and fragile jellyfish.

“If we aren’t able to safely hold and handle these animals without damaging them,” says Hannah Stuart, “then it makes it really hard to study them.” Stuart is a mechanical engineer at the University of California, Berkeley, who did not take part making the robot. The new robot’s fingers are so soft and flexible that they might not be able to hold themselves up when outside of the water, she notes. But, she adds, the dangly strips work well when they are submerged.

The fingers clip onto a 3-D printed “palm.” It looks like a rectangular box. The scientists made the fingers out of layers of soft and rubbery silicone. One surface has a stiffer layer embedded with tiny nanofibers. The scientists made this layer tougher and less bendy.

Inside each finger is a channel through which water can flow. When directed to grab a jelly, the robot uses a pump to fill the channel with water from around the robot. This makes the fingers curl toward the stiffer side and close in around the jelly.

At first, the scientists designed the hand with four fingers, two each on opposite sides of the palm. But jellyfish easily wriggled out. “As we were trying to go in and give them a little soft hug, they would just exit stage left,” Sinatra quips. The scientists solved the problem by adding a finger to the top and bottom of the palm.

“[The fingers] have a gentle grasping force,” Stuart says. “It’s really the first time that somebody has demonstrated this [approach to handling such soft objects].” The amount of force the fingers exert is less than one newton. Stuart likens that force to the weight of an apple in someone’s hand. But to see if the robot can help biologists study jellies in the ocean, the team should test it in the field, she says. That might require attaching the hand to a deep sea submersible. The new robot should survive that. Its materials can withstand the pressure of the deep sea. Sea water won’t corrode them either.

This project aims to help scientists safely gather information on soft critters, Sinatra says. Her team is also thinking up ways to modify the hand so that it collects other information below the waves. The robot might someday include sensors, samplers that can grab a bit of DNA or cameras that take photos. Getting data on the creatures’ features in the ocean might mean scientists won’t even need retrieve the animal to study it.

The robotic hand also demonstrates how robots can take on all sorts of shapes and sizes, Sinatra says. “[A robot] doesn’t necessarily have to be C-3PO from Star Wars or a big assembly-line robot in a car-manufacturing plant,” she says. “Robots can be made of squishy things. They can be made of foam. They can be kind of whatever you imagine them to be.”

Chemists have created a ring-shaped form of carbon

Called cyclocarbon, this molecule is the latest lab-made form of the universal element

A highly anticipated new form of carbon has finally arrived on the scene.

Called cyclocarbon, this molecule consists of a ring of 18 carbon atoms. Scientists described it online August 15 in *Science*. It offers a new face to one of chemistry's most celebrated elements.

"It's not every day that you make a new form of carbon," says chemist Rik Tykwinski. He works in Canada at the University of Alberta in Edmonton. Chemists had been trying to create cyclocarbon for a long time. So long that Tykwinski — who wasn't involved with the new research — had placed a bet about whether it was even possible. He won, he says.

Cyclocarbon joins other molecular forms of the adaptable element, from diamond and graphite to the thin sheets called graphene. There are also tiny spheres known as buckyballs and nano-scale cylinders called carbon nanotubes.

Chemists thought it should be possible to create ring-shaped carbon molecules. But until now, nobody knew what their properties would be, notes physicist Katharina Kaiser. She's at IBM Research in Zurich, Switzerland. "It's really amazing that we found it," she says, "and it's absolutely great that we could characterize it."

Kaiser's team started with molecules of cyclocarbon oxide. These are made of carbon and other atoms. They included groups of carbon monoxide (pairs of carbon and oxygen atoms). Removing the carbon monoxide was a necessary step to create the new ring form of carbon. But that was no easy task. Carbon monoxide helped to stabilize the starting molecule. The researchers managed to pluck off the carbon monoxide groups by zapping the molecule with electricity. They used a specialized tool called an atomic force microscope.

Once the researchers had a bare ring of carbon, they wanted to capture an image of its structure. Again, they used the atomic force microscope. Cyclocarbon reacts easily with other substances — but not table salt. So the team created the new carbon molecule on a salty surface.

Previous research had found hints of cyclocarbon molecules in a gas. But it wasn't possible to make an image of those molecules. So scientists couldn't identify the bonds holding the molecule together. Scientists wanted to know if all the bonds were the same length.

The new study resolved that question. It showed that the carbon atoms are held together by alternating long and short bonds.

That should now help scientists refine the computer calculations used to predict the structures of unknown molecules. "There's still a big question whether many of these ... calculations give the right answer," says Yves Rubin. "So it's very important to confirm by experiment." Rubin is a chemist at the University of California, Los Angeles, who also was not involved with the study.

Previous work on new forms of carbon caused great excitement among scientists. The discovery in the 1980s of buckyballs (and the family of molecules that includes them, called fullerenes)

won a Nobel Prize. Likewise, the 2004 discovery of graphene won a Nobel. Investigations into its many potential uses in electronics and elsewhere have continued.

But because cyclocarbon isn't stable, it can't be bottled up for further study. So, for now, it's not clear how wide-ranging this new molecule's impact will be.

Vita

Margaret Kneuer was born on November 6, 1996, in Buffalo, New York, and is an American citizen. She graduated from Pittsford Mendon High School in 2014. She received her Bachelor of Arts in Psychology from Mercyhurst University in Erie, Pennsylvania in 2018. She worked for AmeriCorps in the Rocky Mountain Youth Corps program in 2016. She has taught nine classes as a lab instructor for PSYC 214 Applications of Statistics at Virginia Commonwealth University.