

TIME-OF-DAY EFFECTS ON ENGAGEMENT WITH SOCIAL MEDIA CONTENT

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ABSTRACT OF THE DISSERTATION

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On Twitter, and other social media platforms, consumers are increasingly engaging with online information. The use of social media for networking is about to be overthrown by another motivation: seeking updates on recent events and news. While the marketing literature has paid attention to some types of content differences, there is little research on *which* content is better to release *when*. My dissertation aims to address this gap by examining two types of content that have not previously been studied in social media research—vice versus virtue content, and high-construal versus low-construal content—and showing that there is an asymmetry in how consumers engage in these types of content through the day.

In essay 1, I compare vice content, which promises immediate gratification (e.g., related to celebrities and scandals), to virtue content, which is beneficial in the long run (e.g., related to health and economy). I argue that vice and virtue information attract

differential levels of consumer engagement (e.g., number of likes on Twitter), depending on the time of day at which consumers are exposed to the information. My argument is based on the premise that people have high self-control early in the morning, which then prone to fail toward the evening. Consequently, virtue (vs. vice) content fits relatively better in the morning, with a trend toward the reverse as the day progresses. Seven studies—five experiments and two studies using large-scale Twitter datasets—demonstrate that as the day turns from morning to evening, there is a shift in engagement away from virtue content and toward vice content.

In essay 2, I focus on construal that arises due to geographical distance and examine its role in the context of engaging with information. I compare high-construal content (e.g., international news), to low-construal content (e.g., local news). I argue that high-construal content and low-construal content messages attract differential levels of consumer engagement (e.g., number of likes on Twitter), depending on the time of day at which consumers are exposed to the message. Consequently, high-construal (vs. low-construal) messages fit relatively better in the morning, with a trend toward the reverse as the day progresses. Two studies—a study using large-scale Twitter dataset and an experiment—demonstrate that as the day turns from morning to evening, there is a shift in engagement away from high-construal content and toward low-construal content.

These two essays afford implications for theory (e.g., vice vs. virtue, and high vs. low construal) because I present new insights into how these dichotomies influence engagement with social media during the day. Implications also arise for practice, as managers can better decide *which* content to post *when*, in order to maximize the engagement of their customers.

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TABLE OF CONTENTS

LIST OF TABLES	VIII
LIST OF FIGURES	IX
INTRODUCTION	1
ESSAY 1: TIME-OF-DAY EFFECTS ON ENGAGEMENT WITH VIRTUE VERSUS VICE SOCIAL MEDIA CONTENT	7
1.1 ABSTRACT	7
1.2 INTRODUCTION	8
1.3 SELF-CONTROL AND TIME OF DAY	11
1.4 ENGAGEMENT WITH VICE VERSUS VIRTUE CONTENT	13
1.5 OVERVIEW OF PREDICTIONS AND STUDIES	16
1.7 STUDY 1	20
1.8 STUDY 2	23
1.9 STUDY 3	26
1.10 STUDY 4	29
1.11 STUDY 5	40
1.12 STUDY 6	44
1.13 STUDY 7	52
1.14 GENERAL DISCUSSION	60
ESSAY 2: TIME-OF-DAY EFFECTS ON ENGAGEMENT WITH HIGH- CONSTRUAL VERSUS LOW-CONSTRUAL SOCIAL MEDIA CONTENT	67
2.1 ABSTRACT	67
2.2 INTRODUCTION	68

2.3 CONSTRUAL LEVEL THEORY: HIGH-LEVEL AND LOW-LEVEL THINKING	70
2.4 TIME-OF-DAY EFFECTS ON CONSTRUAL LEVELS: THE ROLE OF SELF-CONTROL	73
2.5 OVERVIEW OF PREDICTIONS AND STUDIES	74
2.6 STUDY 1	75
2.7 STUDY 2.....	79
2.8 GENERAL DISCUSSION.....	82
CONCLUSION.....	85
REFERENCES	103
APPENDIX A (ESSAY 1).....	116
APPENDIX B (ESSAY 1).....	117
APPENDIX C (ESSAY 1).....	118
APPENDIX D (ESSAY 1).....	119
APPENDIX E (ESSAY 1).....	122
APPENDIX F (ESSAY 1).....	126
APPENDIX G (ESSAY 1).....	127
APPENDIX H (ESSAY 1).....	128
APPENDIX J (ESSAY 2).....	129

LIST OF TABLES

Essay 1

Table 1: Study 6A Summary Statistics	87
Table 2: Study 6A Results	88
Table 3: Study 6B Results.....	89
Table 4: Study 7 Summary Statistics	90
Table 5: Study 7 Results	91

Essay2

Table 6: Study 1 Summary Statistics	92
Table 7: Study 1 Results	93

LIST OF FIGURES

Essay 1

Figure 1: Reading Likelihood as a Function of Time of Day and Magazine Type in Study 1 94

Figure 2: Reading Likelihood of Vice and Virtue Magazines by Time of Day in Study 2 95

Figure 3: Reading Likelihood of Vice and Virtue Websites by Time of Day in Study 3 96

Figure 4: Engagement for Vice and Virtue Tweets by Time of Day in Study 4 97

Figure 5: Liking Behavior for Vice and Virtue Magazines by Time of Day in Study 6A 98

Figure 6: Hourly Increase in Following Behavior for Vice and Virtue Magazines by Time of Day in Study 6B 99

Figure 7: Liking Behavior for Vice and Virtue Content by Time of Day in Study 6 (in Low versus High Temperature Conditions)..... 100

Essay 2

Figure 8: Engagement for International and Local Content by Time of Day in Study 1 101

Figure 9: Reading Likelihood of International and Local News Titles by Time of Day in Study 2 102

INTRODUCTION

The time consumers spent on social media keeps increasing year after year, with current estimates at 142 minutes per day (Bayindir and Kavanagh 2018). As consumers spend longer time on social media, this time is not spent just on social networking, as is commonly thought. In fact, a recent global consumer research survey (Bayindir and Kavanagh 2018) reveals that using social media for networking is about to be overthrown by another motivation: seeking updates on recent events and news from media companies, brands, and celebrities. More than half of all consumers follow news and media companies, brands, and celebrities.

Because “eyeballs” keep shifting to the digital world, digital advertising is soaring and headed toward \$129 billion this year, surpassing traditional advertising (eMarketer 2019), and headed to \$201 billion by 2023 (Enberg 2019). Companies may assume that their budget is well spent when they post a larger number of messages and advertisement on social media. However, this strategy may backfire because posting too much content is the main reason that consumers stop following brands on social media (Sprout Social 2016). So, companies better post content judiciously, which means that they better understand *which* content to post, and *when* to post it.

An extensive body of research has been focusing on how content plays a role in building higher engagement on social media. But little is known about how consumers engage with different types of content at different times of the day. My dissertation aims to address this gap by examining two types of content that have not previously been studied in social-media research—vice versus virtue content, and low-construal versus

high-construal content—and showing that there is an asymmetry in how consumers engage in these types of content through the day.

In essay 1, I compare vice content, which promises immediate gratification (e.g., related to celebrities and scandals), to virtue content, which is beneficial in the long run (e.g., related to health and economy). I argue that vice and virtue information attract differential consumer engagement (e.g., likes on Twitter), depending on the time of day at which consumers are exposed to the information. My argument is based on the premise that people have high self-control early in the morning, which then prone to fail toward the evening. Consequently, virtue (vs. vice) content fits relatively better in the morning, with a trend toward the reverse as the day progresses. Seven studies—five experiments and two studies using large-scale Twitter datasets—demonstrate that as the day turns from morning to evening, there is a shift in engagement away from virtue content and toward vice content. I consistently observe this vice-virtue asymmetry, and also find that this effect strengthens when day temperatures are higher, supporting the account of self-control failure.

In essay 2, I focus on construal that arises due to geographical distance and examine its role in the context of engaging with information. I compare high-construal content, such as messages that relate to events happening far away (e.g., international news), towards low-construal content, such as messages that relate to events happening nearby (e.g., local news). I argue that high-construal content and low-construal content messages attract differential consumer engagement (e.g., likes on Twitter), depending on the time of day at which consumers are exposed to the message. My argument is based on the premise that people have replenished self-control in the morning, which then likely to

fail by the evening. Consequently, high-construal (vs. low-construal) messages fit relatively better in the morning, with a trend toward the reverse as the day progresses. Two studies—a study using large-scale Twitter dataset and an experiment—demonstrate that as the day turns from morning to evening, there is a shift in engagement away from high-construal content and toward low-construal content.

These two essays afford implications for theory (e.g., vice vs. virtue, and high vs. low construal) because I present new insights into how these dichotomies influence engagement with social media during the day. Implications also arise for practice, as managers can better decide *which* content to post *when*, in order to maximize the engagement of their customers.

Previous Research on Social Media Engagement

A substantial body of research has examined the main drivers of social media engagement. While determining these drivers, the majority of prior work has focused on content related factors. From a consumer behavior perspective, this line of research explores the engagement with different types of content in terms of the size of the audience, the benefit of the message, and the emotional nature of the message (Barasch and Berger 2014; Berger and Milkman 2012; Toubia and Stephen 2013). From a managerial perspective, previous studies examine content engineering to build strategies for firms to improve engagement on social media platforms (Chiou and Tucker 2017; Kanuri, Chen, and Sridhar 2018; Lee, Hosanagar, and Nair 2018; Sismeiro and Mahmood 2018). Next, I summarize these major findings in the marketing literature.

One of the early works taking a consumer behavior stance demonstrates the importance of content positivity on content engagement (Berger and Milkman 2012). Measuring the engagement based on sharing behavior, Berger and Milkman (2012) show that news urging positive emotions hits the most emailed list. Their research, while not directly embedded in social media, had an influence in spawning other content engagement research on social media (Kanuri et al. 2018; Stephen, Sciandra, and Inman 2015).

Another highly discussed motivation of social media engagement is the content benefit and its trade-off with audience size. Examining intrinsic benefits (i.e., the benefits that come from self-satisfaction) and image-related benefits (i.e., the benefits that come from others' perception) of content, Toubia and Stephen (2013) find that image-related benefits drive engagement while communicating with a large audience. In a similar vein, another work shows that content engagement is driven by self-presentation concerns when communicating with a large audience, but it is driven by information helpfulness concerns when communicating with a small audience (Barasch and Berger 2014).

Regarding the informative value of content, prior research presents an unexpected negative influence of informative content on social media engagement in brand communications (De Vries, Gensler, and Leeflang 2012; Lee et al. 2018). On top of this finding, Lee and colleagues (2018) also document how merging informative content with brand personality turns this negative influence of informative content into a positive one. By doing this, the authors emphasize the importance of content engineering for managers.

Another stream of research also focuses on content engineering across different platforms instead of different contents (Chiou and Tucker 2017; Sismeiro and Mahmood

2018). This line of research demonstrates that as individuals engage with the content on social media, this engagement creates a spillover effect on the content's primary source, such as the website of the companies. Thereby, posting content on social media complements engagement on the company website.

As should be evident, prior literature has discussed multiple aspects of content and content engineering. But this line of research has neglected the time at which content engagement happens on social media, except for recent work by Kanuri et al. (2018). They examine content differences such as in message complexity and suggest an optimal posting time for companies to create maximum lifetime engagement, by relying on historical Facebook data from the previous year.

The Present Research

My dissertation complements findings of Kanuri et al. (2018) by examining two separate types of content that have not previously been studied in social-media research—vice versus virtue content, and high versus low construal content—and showing that there is an asymmetry in how consumers engage in these types of content through the day. Furthermore, instead of looking at historical data, I capture streaming data from Twitter, which allows me to examine real-time engagement. Even outside of time-of-day effects, several content types have been studied such as those related to valence and self-presentation (Barasch and Berger 2014; Berger and Milkman 2012). I complement these social-media results by revealing the effects of vice-virtue and high-

low construal dichotomies. Correspondingly, contributions also arise for the research on self-control and construal level theory.

All in all, my dissertation investigates time of day effects on social media engagement depending on two properties of content: vice versus virtue (essay 1) and high versus low construal (essay 2). I find that these properties of content interact with time of day and influence social media engagement. Each essay aims to contribute to theory and practice by establishing proposed effects and underlying processes.

In what follows, I present essay 1 and essay 2. Essay 1 is structured as follows: First, I present a general overview of my research, my findings, and the implications of my research. Next, I review the literature on self-control and discuss the role of time of day on self-control failures. Then, I explain the distinction between vice and virtue content. Afterward, I build my hypothesis and document seven studies. I conclude essay 1 with a general discussion of my findings and the implications of these findings. Essay 2 is structured as follows: First, I introduce a general overview of my research, my findings, and the implications of my research. Next, I review the literature on construal level theory. Then, I discuss the link between time of day and construal levels relying on the self-control research. Afterward, I build my hypothesis and discuss two studies. I conclude essay 2 with a general discussion of my findings and the implications of these findings. Finally, I present an overall conclusion for my dissertation.

ESSAY 1: TIME-OF-DAY EFFECTS ON ENGAGEMENT WITH VIRTUE VERSUS VICE SOCIAL MEDIA CONTENT

1.1 ABSTRACT

On social media platforms such as Twitter, consumers are increasingly engaging with online information. Some of it is vice content that promises immediate gratification, and some of it is virtue content that is beneficial in the long run. This essay argues that vice and virtue content attract differential consumer engagement (e.g., likes on Twitter), depending on the time of day at which consumers are exposed to the content. Seven studies—five experiments and two studies using large-scale Twitter datasets—demonstrate that as the day shifts from morning to evening, the engagement of consumers shifts away from virtue content and toward vice content. I consistently observe this vice-virtue asymmetry, and also find that this effect strengthens when day temperatures are higher. These findings support a process of self-control failure but, given the inherent nature of the time of day construct, I acknowledge that self-control failure cannot be isolated from the numerous processes that may unfold as a day progresses. The results of this essay afford interesting implications for both theory and practice.

1.2 INTRODUCTION

Although consumers engage with information in many ways, social media platforms such as Facebook and Twitter are dominating such engagement. Digital advertising is soaring and headed toward \$129 billion in 2019, surpassing traditional advertising (eMarketer 2019). The reason is simply that “eyeballs” keep shifting to the digital world, with consumers now spending around 142 minutes per day engaging with social media (Bayindir and Kavanagh 2018). While in the early days of social media, engagement was with just frivolous information, social media is now a source of recent news for 68% of U.S. adults, with this number being even higher for Twitter (Matsa and Shearer 2018; Shearer and Gottfried 2017). So, a natural question to ask is how different types of content are driving engagement. In the current research, I focus on vice versus virtue content. Vice content (e.g., related to celebrities and scandals) promises immediate gratification, whereas virtue content (e.g., related to health and economy) promises long-term knowledge benefits. Seven studies—five experiments and two studies using large-scale Twitter datasets—demonstrate time-of-day effects that are asymmetric for vice versus virtue content. Specifically, as the day shifts from morning to evening, consumer engagement shifts away from virtue content and toward vice content.

The current research responds to a call for more research on social media (Lamberton and Stephen 2016), and on robust consumer-relevant effects (Inman et al. 2018). This research is high on consumer relevance because both consumers and practitioners are increasingly engaging with social media. Social media platforms such as Twitter are a particularly fruitful arena for deriving consumer-relevant insights because

of the availability of large-scale real-time data. While I experimentally demonstrate the effects of time of day in five experiments, I make more generalizable claims on time-of-day effects by gathering streaming Twitter data over several months. Capturing such engagement used to be much harder in the past. For instance, for a newspaper that arrived only in the morning, it was hard to track how a reader's engagement with different articles changed from morning to evening. But Twitter's real-time environment provides streaming news through the day, and the number of "likes" provides a sense of the consumers' engagement. The results have significant implications. Consumers and public policy makers may want to know how the time of day makes one more or less susceptible to different kinds of information. On the flip side, for a firm trying to engage consumers with its content, and then potentially leverage such engagement for advertising, it is critical to understand when to release which information in order to best capture consumers' attention.

The results of this essay add to the growing research on social media. Prior research reveals the effects of different kinds of content such as positive versus negative valence (Berger and Milkman 2012) and usefulness versus self-presentation (Barasch and Berger 2014). I believe that this essay is the first to assess engagement with vice versus virtue content on social media, and demonstrate asymmetric engagement with these two types of content during the course of a day.

By examining vice versus virtue content online, this research also contributes to research on self-control. Maintaining self-control requires the willpower to commit to long-term goals by resisting immediate desires (Hoch and Loewenstein 1991). But exerting self-control on one activity reduces available resources to exert self-control in a

subsequent activity (Muraven and Baumeister 2000). A telltale sign of such self-control failure is that people respond asymmetrically to vices and virtues, desisting from virtues and succumbing to vices. The results from experiments and Twitter data are consistent with such an asymmetry, thus supporting self-control failure. This self-control account is further supported by a moderating effect of day temperature. Because high temperatures are known to reinforce self-control failures (Cheema and Patrick 2012), they ought to exacerbate the vice-virtue asymmetry, and that is what I observe. To my knowledge, this research is the first to demonstrate self-control effects using large-scale social media datasets. But it is important to acknowledge that the focal independent variable, time of day, simply refers to a moment in time. Countless changes happen as individuals go from one moment to another, with self-control failure being just one of them. So, while the results are consistent with a process of self-control failure, the time of day construct limits this research's ability to establish direct process evidence.

Finally, this essay contributes to research on time-of-day effects. Kouchaki and Smith (2014) focus on how morality goes down during the course of a day (e.g., people lie more) due to self-control failure. What is specifically relevant here is one study (experiment 3) in which the authors use choice of want over should magazine as a manipulation check for self-control failure at two points during the day (with their eventual dependent variable being the degree of lying). Although just a manipulation check at two points in time, the greater choice of want magazines at the later point offers a good starting point for my thesis. In the context of social media, I hypothesize about the separate and distinct patterns that are likely to emerge for engagement with vice versus virtue content. Moreover, instead of just two points in time, I am able to examine real-

time engagement using data from Twitter that keeps streaming in through the day. The results help me establish a robust pattern that emerges in the context of social media. I should also mention other research on media, though not specifically social media, which points to higher engagement as the day progresses. Media engagement is known to be higher at nighttime (Cain and Gradisar 2010), as people “fail to resist the guilty pleasure of media use” (Exelmans and Van den Bulck 2017; p. 2). This finding is in line with the findings of Hoffman, Vohs, and Baumeister (2012) who, in the context of studying several desires, observe that desire for media is experienced more in the evening. Such findings would argue for an overall increase in social media engagement at the end of the day. However, I believe that these prior results are more pertinent to vice content, than to virtue content, which may show a weaker pattern, or even an opposite one. This essay also adds to time-of-day research by Kanuri, Chen, and Sridhar (2018), who examine content differences in message complexity using Facebook data from a past year. I complement these findings by examining a different content difference: vice versus virtue. Also, instead of looking at historical data, I capture streaming data from Twitter, which allows me to examine real-time engagement.

1.3 SELF-CONTROL AND TIME OF DAY

A substantial body of research demonstrates that individuals exert self-control to change their own actions, feelings, thoughts, and behaviors (Baumeister et al. 1998). Maintaining self-control requires willpower to commit to long-term goals by resisting immediate desires (Hoch and Loewenstein 1991). However, the capacity of self-control

depends not only on willpower but also on the availability of limited resources. Similar to how muscles are weakened after physical exercise, self-control weakens after subsequent efforts of control (Muraven and Baumeister 2000). Accordingly, exerting effort to monitor own actions reduces self-control and, consequently, curtails the performance in subsequent unrelated tasks.

The research on self-control mostly demonstrates self-control failure occurring in subsequent tasks by using a two-task procedure (Muraven, Tice, and Baumeister 1998)—after exerting control in an initial task, self-control decreases and leads individuals to forgo long-term concerns and favor pleasures of the present moment. The two-task paradigm has demonstrated that self-control failures reinforce reliance on automatic thinking processes (Pocheptsova et al. 2009), increased passivity (Danziger, Levav, and Avnaim-Pesso 2011; Vonasch et al. 2017), and impulsive behavior (Vohs and Faber 2007; Vohs and Heatherton 2000). But the two-task paradigm is not necessary to observe self-control failure, which may occur naturally during a day.

After rest during the sleep period, individuals wake up with self-control at full capacity. Then they face multiple self-control challenges through the day, such as trying to avoid activities and foods that are tempting, but not good for them in the long run. Monitoring one's own behavior, exerting self-control over and over again, and trying to make the right choices through the day is exhausting (Levav et al. 2010; Vohs et al. 2008). Consequently, individuals have high self-control during the early hours of a day, but self-control failures start emerging as the day progresses (Baumeister 2002). Self-control failures results in more automatic and impulsive responses, such as individuals

becoming more likely to disregard professionalism rules or engage in unethical behavior later in the day (Dai et al. 2015; Kouchaki and Smith 2014).

How self-control failure manifests for engagement with information is not fully understood. This essay's argument is that self-control failure may stimulate a desire for media in general. Indeed, that is the finding of Hofmann et al. (2012), who did an experience sampling study on several desires, including those pertaining to media. They did not examine social media, but a broad set of activities including TV watching and web surfing. Their results show the urge to engage in media activities becoming stronger toward the evening. These results are also in line with other research suggesting higher engagement of media at night time (Cain and Gradisar 2010), and consistent with general beliefs about people failing to resist the guilty pleasures of media at night (Exelmans and Van den Bulck 2017). I believe that prior research suggests a shift toward greater media use perhaps because of how web surfing and television are generally seen. For instance, the moniker "idiot box" for television suggests vice content. But, as noted earlier, Twitter and other social media platforms are vehicles for not just vice content, but also virtue content such as news about current affairs. Moreover, regardless of how dominant vice content may be over social media, there is no doubt that virtue content exists too. Hence, it is important to see if the shift toward more media in the evening is a general trend. I argue that the type of content matters—a vice pattern is different from a virtue pattern.

1.4 ENGAGEMENT WITH VICE VERSUS VIRTUE CONTENT

The distinction of seeking immediate gratification versus long-term benefits is captured well using the vice versus virtue dichotomy. A relative vice offers immediate pleasure at the moment of consumption, whereas a relative virtue may not be pleasurable at the moment but provides benefits in the long run (Khan and Dhar 2007; Khan, Dhar, and Wertenbroch 2005; Siddiqui, May, and Monga 2017; Wertenbroch 1998). Most of the research on vices versus virtues has been conducted in the domain of food. As an example of vices, eating a rich chocolate cake may provide immediate gratification but frequent consumption may lead to health issues. As an example of virtues, eating a bland salad may not provide much pleasure in the moment but the long-term benefits may be considerable. Even though individuals do acknowledge the long-lasting value of virtue options, they may succumb to vices when self-control is reduced. For example, individuals with reduced self-control prefer vices over virtues when making food and movie choices (Wang et al. 2010).

A vice-virtue dichotomy may apply to information as well. One purpose of consuming information is to satisfy curiosity, and derive pleasure from simply obtaining the information (Golman and Loewenstein 2015; Loewenstein 1994). However, as standard economic theories explain, another purpose is to acquire knowledge to make better decisions in the future (Stigler 1961). These distinctions map on to vices versus virtues. Thus, a celebrity's salacious gossip in *Cosmopolitan* could be considered vice information by many who are titillated by the instantaneous pleasure of obtaining the information, but know that there is no long-term benefit from it. By contrast, an article in *Forbes* on personal finance could be considered virtue information by many who don't

get tickled while reading the article but appreciate the long-term benefit of the knowledge that prepares them better for the future.

Although vice and virtue information has been considered in prior research, the terminology used is often different. Oster and Scott Morton (2005) referred to magazines that are fun to read as “leisure” and those that offer future benefits as “investment,” and showed that the ratio of subscription to newsstand prices varies between leisure and investment magazines. Similarly, Kouchaki and Smith (2015) consider impulsive “want” magazines versus future-oriented “should” magazines. Their focus was not on information engagement, but rather on unethical behavior such as lying and cheating through the day. However, in one of their studies (experiment 3), they did use choice between a want versus should magazine as a manipulation check for self-control failure (with degree of lying serving as the eventual outcome variable). The choice of want magazine was higher in the afternoon than in the morning. Though this manipulation-check result was only marginally significant ($p = .075$), that may have been because of the two specific points in time that they chose. This study is still encouraging given my research goal of studying time-of-day effects on social media. It suggests that unlike prior research suggesting generally higher media use in the evening (Cain and Gradisar 2010; Exelmans and Van den Bulck 2017; Hoffman et al. 2012), time-of-day effects may be different for vices versus virtues.

This essay complements the finding of Kouchaki and Smith (2015) by examining not only the choice between vice and virtue, but also separate patterns of engagement with vice and virtue content in social-media contexts. Additionally, in Twitter studies, I examine real-time engagement rather than just at two points in time, establishing a robust

pattern that emerges through the day. I argue that as the day progresses the reduced self-control is likely to shift focus of individuals from processing the *Forbes* article on personal finance towards succumbing to the immediate gratification from reading the *Cosmopolitan* article about a celebrity's salacious gossip. Thus, I expect that as the day wears on, engagement with vice content will be encouraged whereas, in a relative sense, engagement with virtue content will be discouraged.

1.5 OVERVIEW OF PREDICTIONS AND STUDIES

I predict a time-of-day asymmetry in engagement with vice versus virtue content. Specifically, as the day shifts away from morning and toward evening, there will be a shift away from virtue and toward vice content. I observe such effects in seven studies. In the first three studies, I examine information engagement as reading likelihood of vice or virtue magazines. Study 1, I measure MTurk participants' reading likelihood in the morning and the evening, and find initial evidence of a shift from virtue to vice content. In study 2, I observe similar results when I measure the specific time at which student participants respond to a survey in a lab setting—the later the time, the more the trend toward vice rather than virtue content. In study 3, I ask student participants to consider several websites conveying vice versus virtue information, and replicate the results that I observe for magazines in studies 1 and 2. In study 4, I observe the same vice-virtue asymmetry for the tweets from CNN when I randomly assign participants to morning and evening time periods. Then, in study 5, I replicate this with the participation of the same group of individuals in the morning and evening sessions and provide evidence that self-

control failure drives the shift in engagement toward vice. In study 6, I investigate actual engagement on Twitter for several vice versus virtue magazines, and observe the asymmetry once again. Specifically, I examine how the time of day influences two behaviors that reflect engagement in information on Twitter: liking behavior (study 6A) and following behavior (study 6B). For the Twitter accounts of vice and virtue magazines, I observe a significant interaction between magazine type and time of day on liking and following behavior.

Finally, in study 7, I observe the asymmetry once again when I capture actual engagement on Twitter for vice versus virtue content of the same newspaper. This study also provided additional insights into the process. Although the vice-virtue asymmetry that I observe in all seven studies is a telltale sign of self-control effects, I sought more evidence using a moderation approach. I expect the vice-virtue asymmetry to be stronger when day temperatures are high (vs. low) because high temperatures are known to reduce individuals' self-control. Such reduced self-control has been shown in marketing contexts where high temperatures impede performance on effortful tasks, and decision short-cuts are used (Cheema and Patrick 2012). Sinha and Bagchi (2019) show that high temperatures increase willingness to pay in auctions because of higher discomfort and aggression. More generally, higher temperature is linked to decreased productivity, lower quantitative and qualitative output, and diminished human performance (Fine and Kobrick 1978; Seppänen, Fisk, and Lei 2006; Van de Vliert and Van Yperen 1996); and also leads to diminished self-control and more impulsive behavior (Ahn 2010; Anderson 1989; Anderson, Bushman, and Groom 1997; Reifman, Larrick, and Fein 1991). Thus, these results suggest that high (vs. low) temperatures

should intensify the self-control failure that arises during a day. If time-of-day divergence in engagement with vice versus virtue content is indeed due to self-control failure, then said divergence should exacerbate when day temperatures are high (vs. low). That is what I find. Study 7 reveals that the effect of time of day shifting information engagement away from virtue and toward vice content is stronger when the temperature is high (vs. low).

1.6 PILOT STUDIES

Prior to presenting the main studies, let me briefly describe two pilot studies that I conducted to verify two beliefs that I alluded to in the introduction. One relates to my use of Twitter: I believe that it is a suitable social-media platform to test the theory because it is a source of both vice and virtue content. The other relates to the idea that the results may be useful to managers: I presume that managers don't currently know about the vice-virtue asymmetry.

Regarding the suitability of Twitter, it is frequently thought of as a way to engage with frivolous information from celebrities and the like. However, it provides not only tempting information that offers short-term gratification, but also beneficial information that provides knowledge for the long term. In fact, a Pew Research report found that 72% of Twitter users get their news from this platform (Shearer and Gottfried 2017). To further confirm that Twitter engagement involves varied topics, and not just vice content, I conducted a pilot study with 113 undergraduate students ($M_{\text{age}} = 21$, 38% female). When I asked these participants about their average Twitter usage, 48% reported that they

used it at least once a week, attesting to its popularity. When I asked them to specify their reasons for using Twitter, the primary reasons were to spend spare time (60%), to monitor breaking news (60%), to monitor news (55%), to monitor trend topics (54%), to follow celebrities (42%), to share opinions (41%), to follow brands (37%), to network (34%), and then other reasons (13%). As is clear from the list, it is not that all topics are about frivolous topics that provide immediate gratification with no long-term benefits. While some do follow celebrities, there are others who follow news and other topics.

Regarding whether the results may be beneficial to managers, I wanted to check what managers currently do. Recall that the general belief is that media engagement goes up as morning turns to night (Cain and Gradisar 2010; Exelmans and Van den Bulck 2017; Hoffman et al. 2012). I wondered whether managers shared this general belief, and posted more content in the evening in general, or whether they posted differently based on the type of content. To find out, I conducted a pilot study in which I monitored the Twitter accounts of multiple magazines for a week to observe the specific time at which the managers post their content. I investigated posting behavior in the morning (i.e., from 6 am to 10 am) and the evening (i.e., from 4 pm to 8 pm) for a group of magazines that I adapted from Oster and Scott Morton (2005): three vice magazines (i.e., *Sports Illustrated*, *Allure*, and *US Weekly*) and three virtue magazines (i.e., *Fortune*, *Economist*, and *Adweek*). Using the number of tweets as a dependent variable, I performed a repeated measures ANOVA with time of day (morning vs. evening) as a within-subjects factor and magazine type (vice vs. virtue) as a between-subjects factor. The analysis revealed that the effect of magazine type ($F(1, 40) = 1.05, p = .31, \eta_p^2 = .03$) was not significant, and neither was the two-way interaction between time of day and magazine type ($F(1, 40) =$

.07, $p = .8$, $\eta_p^2 = .002$). The only significant effect was a main effect of time of day on tweets, such that the number of tweets was higher in the evening than in the morning ($M_{\text{Morning}} = 9.38$, $SD = 5.69$ vs. $M_{\text{Evening}} = 13.38$, $SD = 8.65$; ($F(1, 40) = 29.33$, $p < .001$, $\eta_p^2 = .4$). These results suggest that, regardless of content type, managers post more content in the evening, perhaps assuming that consumers are more likely to engage with all types of content in the evening than in the morning. However, as I will next show, consumers respond asymmetrically to vice versus virtue content.

1.7 STUDY 1

The purpose of study 1 is to test whether reading likelihood of vice (vs. virtue) information increases more from morning to evening. I utilize a list of magazines adapted from Oster and Scott Morton (2005), who used the classification of leisure magazines that provide immediate fun (i.e., vice), versus investment magazines that provide benefits in the future (i.e., virtue). Accordingly, I picked *Cosmopolitan*, *Entertainment Weekly*, *People*, and *Vanity Fair* as vice magazines and *Forbes*, *Health*, *The New Yorker*, and *The Atlantic* as virtue magazines. Participants randomly saw the names of either vice magazines or virtue magazines. Then, they indicated their likelihood of reading these magazine's articles when tweeted in the morning and the evening. I predicted that reading likelihood will be higher for vice (vs. virtue) magazines in the evening than the morning.

1.7.1 Pretest

I used two separate pretests to confirm that the magazines are different in terms of their vice-virtue perceptions. In the first pretest, a total of 113 undergraduate students ($M_{age} = 21$, 38% female) completed the study as partial fulfillment of course credit. Following Oster and Scott Morton (2005), I described time-inconsistent benefits as the following: “Some magazines can be thought of as pleasures of the moment, while others teach us something important for the future. Consider for each magazine how much of the benefit of reading that magazine comes now versus in the future.” Following this definition, participants rated the vice group of magazines (*Cosmopolitan*, *Entertainment Weekly*, *People*, and *Vanity Fair*) as well as the virtue group (*Forbes*, *Health*, *The New Yorker*, *The Atlantic*) on a scale from 0 to 100 (benefit comes now = 0; benefit comes later = 100). Relative to the vice group, participants rated the virtue group magazines significantly higher on benefits later rather than now ($M_{Vice} = 28.60$, $SD = 18.16$, $M_{Virtue} = 62.00$, $SD = 15.42$; $t(112) = -13.84$, $p < .001$, $d = -1.98$).

I also conducted a second pretest in which I used a slightly different measure of vice and virtue: “A vice is something tempting that may have fewer benefits later on. A virtue is something that is not very tempting now but may be more beneficial later on.” (Khan and Dhar 2007; Siddiqui et al. 2017). In this pretest, 172 undergraduate students ($M_{age} = 21$, 42% female) rated either vice magazines or virtue magazines on a scale from 0 to 100 (vice = 0; virtue = 100). Confirming the manipulation, participants rated the vice (vs. virtue) group of magazines as more vice (vs. virtue) on the 100-point scale ($M_{Vice} = 43.92$, $SD = 19.85$, $M_{Virtue} = 61.68$, $SD = 17.10$; $F(1, 170) = 39.48$, $p < .001$, $\eta_p^2 = .2$).

1.7.2 Method

A total of 298 respondents ($M_{\text{age}} = 36$, 49% female) from MTurk successfully completed the study in exchange for a small payment (eleven responses were excluded because participants incorrectly answered two attention-filter questions). Participants were randomly assigned to either the vice or the virtue condition—they saw a list of either the vice magazines or the virtue magazines (see appendix A). I asked participants to write down their thoughts about the magazines (in order to encourage participants to think about them) and then asked them to imagine the following scenario:

Imagine that you have a Twitter account and you are actively using Twitter. You are following the Twitter accounts of a list of magazines that you saw on the previous page. By following these magazines, you can reach a stream of contents released by these magazines on your Twitter homepage.

Following this scenario, in two separate questions about reading likelihood in the morning versus evening, I asked participants “How likely are you to read the articles tweeted by these magazines in the morning between 6 am and 10 am?” and “How likely are you to read the articles tweeted by these magazines in the evening between 4 pm and 8 pm?” (1 = Very unlikely, 7 = Very likely).

1.7.3 Results and Discussion

I performed repeated measures analysis of variance (ANOVA) with time of day (morning vs. evening) as a within-subjects factor and magazine type (vice vs. virtue) as a between-subjects factor. The analysis revealed a main effect of time of day ($F(1, 296) =$

28.88, $p < .001$, $\eta_p^2 = .09$) and magazine type ($F(1, 296) = 16.14$, $p < .001$, $\eta_p^2 = .05$) on reading likelihood. Importantly, results revealed a significant two-way interaction ($F(1, 296) = 4.31$, $p = .04$, $\eta_p^2 = .01$; see figure 1). Planned contrasts revealed what was driving the two-way interaction. Specifically, participants' reading likelihood in the evening (vs. morning) increased more for vice magazines, such that the difference (i.e., evening – morning) was greater for vice ($M_{\text{diff.}} = 1.37$; $F(1, 296) = 28.92$, $p < .001$, $\eta_p^2 = .09$), compared to virtue magazines ($M_{\text{diff.}} = .61$; $F(1, 296) = 5.23$, $p < .05$, $\eta_p^2 = .02$). Viewed from another perspective, in the morning, the reading likelihood was significantly lower for vice magazines than virtue magazines ($M_{\text{Vice}} = 2.77$, $SD = 1.88$ vs. $M_{\text{Virtue}} = 3.60$, $SD = 1.98$; $F(1, 296) = 13.91$, $p < .001$, $\eta_p^2 = .05$). However, in the evening, the reading likelihood for vice magazines was comparable to that of virtue magazines ($M_{\text{Vice}} = 4.14$, $SD = 1.87$ vs. $M_{\text{Virtue}} = 4.21$, $SD = 1.71$; $F(1, 296) = .11$, $p = .7$, $\eta_p^2 = .00$). Thus, as predicted, there is a shift toward engagement with vice content as morning turns to evening.

1.8 STUDY 2

Study 1 reveals the predicted shift toward vice content, and I now add to this result in two ways. First, I ask participants to provide a rating for each magazine instead of providing an overall response that takes all magazines into account. Second, study 1 asked participants to indicate their reading likelihood in the morning versus evening. Both questions were asked at the same point in time. I now ask such questions when it is actually morning versus evening. That is, I ask participants about their reading likelihood

at the time that they are doing the survey, while myself noting the time at which the survey is completed. I expect a shift in reading likelihood from virtue to vice content as the day progresses.

1.8.1 Method

A total of 246 undergraduate students ($M_{\text{age}} = 22$, 49% female) participated in this study to earn partial course credit (9 responses were excluded because participants incorrectly answered the three attention-filter questions). Participants answered the survey between 10 am and 6 pm in the behavioral lab, and I noted the time at which the participants answered the survey. As in study 1, magazine type was manipulated between subjects and participants were randomly assigned to either the vice or virtue condition. I asked participants about their likelihood of reading the articles tweeted by the given magazines at that moment in time (“How likely are you to read the articles tweeted by [magazine name] at this moment in time?” 1 = Very Unlikely, 7 = Very Likely). For both vice and virtue conditions, participants rated each magazine separately. As the ratings were highly correlated, I computed an average rating for vice (Cronbach’s $\alpha = .87$) and virtue magazines (Cronbach’s $\alpha = .70$).

1.8.2 Results and Discussion

The purpose was to test whether reading likelihood changed differently for vice versus virtue magazines through the day. Accordingly, using the dependent variable of

reading likelihood, I investigated the two-way interaction between magazine type (virtue = -1, vice = 1), and time of day spread across nine hours of data collection (10 am = 0, 6 pm = 8) using the PROCESS SPSS macro (Model 1; Hayes 2013).

The results were not significant for the influence of time of day on reading likelihood ($b = .004$, $SE = .04$, $z = .10$, 95% CI (-.08, .09), $p = .9$), but reading likelihood was significantly higher for virtue than for vice magazines ($b = -.92$, $SE = .18$, $z = -5.24$, 95% CI (-1.27, -.58), $p < .001$). Importantly, the results revealed a significant two-way interaction between time of day and magazine type ($b = .12$, $SE = .04$, $z = 2.78$, 95% CI (.03, .20), $p < .01$, $R^2 = .14$). Further analysis clarified the asymmetry. For the vice magazines, the slope of time of day was positive, indicating that the reading likelihood was increasing for the vice magazines as the day progressed ($b = .12$, $SE = .06$, $z = 2.03$, 95% CI (.004, .24), $p < .05$; see figure 2). In contrast, for the virtue magazines, the slope of time of day was negative, indicating that the reading likelihood was decreasing for the virtue magazines as the day progressed ($b = -.11$, $SE = .06$, $z = -1.91$, 95% CI (-.23, .004), $p = .06$). In other words, the reading likelihood shifted away from virtues and towards vices as the day progressed.

Furthermore, I applied the Johnson–Neyman floodlight analysis technique (Johnson and Neyman 1936; Spiller et al. 2013) to specify significant regions of the effect of magazine type across different levels of time of day. I find a significant effect of magazine type on reading likelihood for the values of time of day at and below 5.69 which, given a 9-point measure, corresponds to a time of 3:41 pm ($b = -.25$, $SE = .13$, $z = -1.97$, 95% CI (-.51, .00), $p = .05$). Accordingly, the shift toward vices and away from

virtues was such that, after 3:41 pm, there was no longer any difference in reading likelihood between virtue and vice magazines.

1.9 STUDY 3

Studies 1 and 2 focused on the eight magazines as the source of vice and virtue information. In the current study, I concentrate on six different websites for vice and virtue information. In reality, these websites operate under the same parent company and publish different types of news. The vice websites (and the content that they publish) were as follows (see appendix B for more details): *Deadspin* (sports), *Jezebel* (celebrities and fashion), and *The A.V. Club* (films, music, and television). The virtue websites were as follows: *Gizmodo* (technology and science), *Jalopnik* (cars and automotive), and *Splinter* (politics). To confirm that vice-virtue perceptions differ across these websites, I conducted a pretest with 85 undergraduate students ($M_{\text{age}} = 20$, 43% female). The participants read the brief description of the website as well as vice-virtue definitions and then rated either vice or virtue websites using the scale described in study 1 (with lower scores indicating more vice perception and higher indicating more virtue perception). The results confirmed that the group of vice (vs. virtue) websites received lower (i.e., more vice) scores on the vice-virtue scale ($M_{\text{Vice}} = 32.09$, $SD = 21.26$; $M_{\text{Virtue}} = 62.43$, $SD = 22.80$, $F(83,1) = 40.22$, $p < .001$, $\eta_p^2 = .3$). Furthermore, I tested for any mood effects, to verify that mood in the morning versus evening does not influence the predicted asymmetry.

1.9.1 Method

A total of 158 undergraduate students ($M_{\text{age}} = 23$, 56% female) participated in this study to earn partial course credit (9 responses were excluded because participants incorrectly answered attention-filter questions). Participants answered the survey between 10 am and 6 pm for three days in the behavioral lab, and I noted the time at which the participants answered the survey. Website type was manipulated between subjects and participants were randomly assigned to either the vice or virtue condition. For every website, I initially provided a brief description (“[website name] is a website that mostly publishes articles about [content type]”) and then asked participants about their likelihood of reading the articles published by the given website at that moment in time (1 = Very Unlikely, 7 = Very Likely). Then, I asked participants to complete the Positive Affect Negative Affect Scale (PANAS; see appendix C for scale items; Watson, Clark, and Tellegen 1988). Finally, I asked participants standard demographic questions.

1.9.2 Results and Discussion

I investigated how reading likelihood changed for vice versus virtue websites as the day progressed. I tested the effect of two-way interaction between time of day (10 am = 0, 6 pm = 8) and website type (virtue = -1, vice = 1) on the reading likelihood.

The results were not significant for the influence of time of day on reading likelihood ($b = -.08$, $SE = .05$, $z = -1.51$, 95% CI (-.18, .02), $p = .13$), but reading likelihood was significantly higher for virtue than for vice websites ($b = -.75$, $SE = .21$, z

= -3.58, 95% CI (-1.17, -.34), $p < .001$). Importantly, the two-way interaction was significant ($b = .16$, $SE = .05$, $z = 3.07$, 95% CI (.06, .26), $p < .01$, $R^2 = .09$). Further analysis specified the asymmetry in reading likelihood for vice versus virtue websites. For the vice websites, the reading likelihood increased as the day progressed ($b = .08$, $SE = .07$, $z = 1.11$, 95% CI (-.06, .22), $p = .2$; see figure 3). In contrast, for the virtue websites, the reading likelihood decreased as the day progressed ($b = -.24$, $SE = .07$, $z = -3.22$, 95% CI (-.38, -.09), $p < .01$). Furthermore, I examined significant regions of this effect by conducting the Johnson–Neyman floodlight analysis. I found two significant regions. The effect of website type on reading likelihood was significant for the values of time of day at and below 3.38 as well as at and above 7.84. Given a scale of 0 to 8, these values correspond to a time of 1:23 pm ($b = -.21$, $SE = .11$, $z = -1.98$, 95% CI (-.43, .00), $p = .05$) and 5:50 pm ($b = .50$, $SE = .25$, $z = 1.98$, 95% CI (.00, .99), $p = .05$). Thus, the reading likelihood for virtue (vs. vice) content was higher before 1:23 pm, and the reverse was true after 5:50 pm, with no difference in reading likelihood in between these times.

I wanted to confirm that mood does not influence the specific asymmetry that I observe. Therefore, I included the measures of positive affect (PA) and negative affect (NA) from the PANAS scale into the model. The two-way interaction between time of day and website type still held ($p < .01$). Additionally, I conducted two separate mediation analysis with PA and NA measures, neither of which revealed a significant mediating effect. Thus, mood doesn't account for the interactive effect of time of day and content type on reading likelihood.

1.10 STUDY 4

Study 4 contributes to the previous studies in four ways. First, the previous studies concentrated on magazines and websites as the source of vice and virtue content. In the current study, I focus on one news channel, CNN, and picked three vice and three virtue tweets from the Twitter account of CNN in October 2019 (see appendix D for visuals). Second, the earlier studies measured time by asking participants for their engagement with information at different times, and by measuring the time simultaneously while participants were answering the survey at different points in a day. Different than these methods, I now randomly assign participants to time periods either in the morning or evening. Third, while the earlier experimental designs focus on reading likelihood as social media engagement, this study measures engagement by relying on two engagement actions on social media: the likelihood of liking the tweet and the likelihood of clicking on the link to read the full article. Finally, in the current study, I test for possible alternative explanations. Overall, I expect that engagement, which is measured as the average of liking and clicking likelihood, would be higher for vice (vs. virtue) tweets in the evening than the morning.

Before the main study, I conducted a pretest with 98 MTurk participants ($M_{\text{age}} = 35.8$, 38.8% female) to confirm that vice-virtue perceptions differ across six tweets. Similar to the earlier studies, the participants read the definitions of vice and virtue, and then provided a rating for each tweet (vice = 0; virtue = 100). The results confirmed that the group of vice tweets received lower (i.e., more vice) scores than virtue tweets ($M_{\text{Vice}} = 38.38$, $SD = 27.59$ vs. $M_{\text{Virtue}} = 74.60$, $SD = 16.25$ $t(97) = -10.11$, $p < .001$, $d = -1.60$).

1.10.1 Method

I conducted the main study in two days to employ random assignment to time periods. For the first day, the main goal was to randomly assign participants to morning and evening conditions for the next day. Then, in the second day, I observed how engagement changes for vice and virtue tweets in the morning and the evening. I tested for possible alternative explanations on both days.

In the first day, a total of 297 MTurk participants ($M_{\text{age}} = 37.9$, 52% female) who reside in Pacific Standard Time (PST) zone successfully completed¹ the study in exchange for a small payment. First, participants answered Composite Scale of Morningness (CSM; see appendix E for details; Smith, Reilly, and Midkiff 1989), and 18-item Need for Cognition scale (NFC; see appendix F for details; Cacioppo, Petty, and Kao 1984) on the 7-point scale (1 = Rarely would describe me; 7 = Usually would describe me) as well as standard demographic questions. The responses for these two scales served me to observe possible alternative explanations. Then, I randomly assigned them to either the morning or the evening condition for the next day. Accordingly, participants stated whether they were willing to attend the morning study between 6 am and 10 am or the evening study between 6 pm and 10 pm in their local time. 285 (96%) of them agreed to attend the study on the next day.

¹ In the first day, I launched the study on MTurk by asking California-US as location qualification in the worker requirements. 261 participants (88%) self-reported that they reside in one of the states in PST zone (i.e., California, Washington, Oregon, and Nevada).

In the second day, a total of 115 respondents ($M_{age} = 39$, 51% female) returned² for the study in exchange for a small payment. I excluded 16 responses that included incorrectly answering attention-filter questions (raising lack of attention to the task), reporting different age and gender during the two waves of the survey (raising questions about the veracity of responses), and reporting that they had been awake for 6 or more hours in the morning condition (suggesting that they may not have slept through the night). This last point was used as an exclusion condition because my focus in the morning condition is on those who have just woken up with refreshed self-control, and not those whose self-control may be reduced simply because they have not slept (Ghumman and Barnes 2013, Wagner et al. 2012).

I employed time (morning vs. evening) as a between-subject factor and tweet type (vice vs. virtue) as a within-subject factor. Accordingly, participants answered the survey either in the morning (6 am and 10 am in PST) or the evening (6 pm and 10 pm in PST). Participants saw three vice and three virtue tweets of CNN in a randomized order. For each tweet, I measured engagement by asking participants to indicate their likelihood of liking the tweet and clicking on the link to see the full article. Specifically, they indicated the extent to which they agree with the following statements: “I would press ‘like’ for this tweet” and “I would click on the link to read the full article” (1 = Strongly disagree, 7 = Strongly agree). After this main task, participants stated the number of hours that they have been awake, which provided an exclusion criterion. Then, participants responded to PANAS items similar to study 3. Finally, participants provided their level of boredom

² In the second day, as I launched the morning and evening sessions in PST, most of the participants from other time zones self-eliminated. Overall, 106 participants (92%) self-reported that they reside in one of the states in PST zone.

and needing a break by indicating their agreement with the following statements: “I feel bored at this moment in time” and “I need a break from work at this moment in time.” (1 = Strongly disagree, 7 = Strongly agree).

1.10.2 Results and Discussion

The purpose was to test whether online engagement changed differently for vice versus virtue tweets from morning to evening. Accordingly, I measured engagement by taking the average of the two dependent variables: likelihood of liking the tweet, and clicking on the link to see the full article (Cronbach’s $\alpha = .8$). Then, using this dependent variable of engagement, I performed repeated measures analysis of variance (ANOVA) with time of day (morning vs. evening) as a between-subject factor and tweet type (vice vs. virtue) as a within-subject factor. The analysis revealed a main effect tweet type ($F(1, 113) = 55.12, p < .001, \eta_p^2 = .33$) on engagement but the main effect of time of day was not significant ($F(1, 113) = 2.81, p = .1, \eta_p^2 = .02$). Importantly, results revealed a significant two-way interaction ($F(1,113) = 8.37, p < .01, \eta_p^2 = .07$). Planned contrasts revealed what was driving the two-way interaction. Specifically, engagement in the evening (vs. morning) increased significantly for vice tweets (see figure 4), such that the difference (i.e., evening – morning) was significant for vice ($M_{\text{diff.}} = .83; F(1, 113) = 8.39, p < .01, \eta_p^2 = .07$), but not for virtue ($M_{\text{diff.}} = -.18; F(1, 113) = .004, p = .9, \eta_p^2 = .0$). Viewed from another perspective, in the morning, engagement was significantly lower for vice tweets than virtue tweets ($M_{\text{Vice}} = 2.79, SD = 1.50$ vs. $M_{\text{Virtue}} = 4.30, SD = 1.67; F(1, 113) = 55.64, p < .001, \eta_p^2 = .33$). In the evening, engagement was still lower

for vice than virtue tweets but the averages become closer ($M_{Vice} = 3.62$, $SD = 1.57$ vs. $M_{Virtue} = 4.28$, $SD = 1.29$; $F(1, 113) = 9.84$, $p < .01$, $\eta_p^2 = .08$). Overall, these results confirmed that engagement shifts away from virtue toward vice content as morning turns to evening.

As robustness checks, I conducted additional analyses for two measures that I employed to calculate engagement (i.e., the likelihood of liking tweets, and the likelihood of clicking on the link to see the full article). I used these measures as dependent variables in two separate analyses to confirm that the observed effects held.

First, I performed repeated measures analysis of variance (ANOVA) with time of day (morning vs. evening) as a between-subject factor and tweet type (vice vs. virtue) as a within-subject factor by using the likelihood of liking tweets as the dependent variable. The analysis demonstrated a main effect tweet type ($F(1, 113) = 39.65$, $p < .001$, $\eta_p^2 = .26$) on likelihood of liking a tweet but the main effect of time of day was not significant ($F(1, 113) = 1.84$, $p = .2$, $\eta_p^2 = .02$). Moreover, results showed a similar significant two-way interaction ($F(1,113) = 12.07$, $p < .01$, $\eta_p^2 = .1$). Planned contrasts demonstrated that the likelihood of liking a tweet in the evening (vs. morning) increased significantly for vice tweets, such that the difference (i.e., evening – morning) was significant for vice ($M_{diff.} = .87$; $F(1, 113) = 8.03$, $p < .01$, $\eta_p^2 = .07$), but not for virtue ($M_{diff.} = -.13$; $F(1, 113) = .17$, $p = .7$, $\eta_p^2 = .001$). In the morning, the likelihood of liking a tweet was significantly lower for vice tweets than virtue tweets ($M_{Vice} = 2.66$, $SD = 1.59$ vs. $M_{Virtue} = 4.07$, $SD = 1.75$; $F(1, 113) = 49.91$, $p < .001$, $\eta_p^2 = .3$). But, in the evening, the likelihood of liking a tweet for vice tweets was comparable to that of virtue tweets ($M_{Vice} = 3.53$, $SD = 1.71$ vs. $M_{Virtue} = 3.94$, $SD = 1.58$; $F(1, 113) = 3.8$, $p = .05$, $\eta_p^2 = .03$).

Second, I performed repeated measures analysis of variance (ANOVA) with time of day (morning vs. evening) as a between-subject factor and tweet type (vice vs. virtue) as a within-subject factor by using the likelihood of clicking on the link to see the full article as dependent variable. The analysis showed a significant main effect tweet type ($F(1, 113) = 55.92, p < .001, \eta_p^2 = .33$) and marginally significant main effect of time of day ($F(1, 113) = 3.24, p = .08, \eta_p^2 = .03$) on likelihood of clicking on the link to see the full article. Results also revealed a significant two-way interaction ($F(1, 113) = 4.2, p < .05, \eta_p^2 = .04$). Planned contrasts demonstrated that the likelihood of clicking on the link in the evening (vs. morning) increased significantly for vice tweets, such that the difference (i.e., evening – morning) was significant for vice ($M_{\text{diff.}} = .79; F(1, 113) = 7.26, p < .01, \eta_p^2 = .06$), but not for virtue ($M_{\text{diff.}} = .09; F(1, 113) = .09, p = .8, \eta_p^2 = .001$). In the morning, the likelihood of clicking on the link was significantly lower for vice tweets than virtue tweets ($M_{\text{Vice}} = 2.92, SD = 1.58$ vs. $M_{\text{Virtue}} = 4.54, SD = 1.82; F(1, 113) = 47.44, p < .001, \eta_p^2 = .3$). In the evening, the likelihood of clicking on the link was still significantly lower for vice tweets than virtue tweets ($M_{\text{Vice}} = 3.71, SD = 1.71$ vs. $M_{\text{Virtue}} = 4.63, SD = 1.37; F(1, 113) = 14.12, p < .001, \eta_p^2 = .11$).

In a separate additional study, I employed the same study design but examined tweet type (vice vs. virtue) as a between-subject factor instead of a within-subject factor. A total of 292 respondents ($M_{\text{age}} = 35.9, 42\%$ female) completed this study in exchange for a small payment. I replicated the results for all three dependent variables including, likelihood of liking tweets, likelihood of clicking on the link to see the full article, and engagement, which was measured as the average of like and click (Cronbach's $\alpha = .8$). First, I used the dependent variable of engagement and examined the two-way interaction

between tweet type (virtue = -1, vice = 1), and time of day (morning = -1, evening = 1) using the PROCESS SPSS macro (Model 1; Hayes 2013). The results were not significant for the influence of time of day on engagement ($b = .08$, $SE = .09$, $t = .87$, 95% CI (-.10, .45), $p = .4$), but engagement was significantly higher for virtue than for vice tweets ($b = -.43$, $SE = .09$, $t = -4.88$, 95% CI (-.61, -.26), $p < .001$). Importantly, the results revealed a significant two-way interaction between time of day and tweet type ($b = .18$, $SE = .09$, $t = 2.07$, 95% CI (.01, .36), $p = .04$, $R^2 = .09$). Further analysis clarified the asymmetry. For the vice tweets, the slope of time of day was positive, indicating that the engagement was increasing for the vice tweets from morning to evening ($b = .26$, $SE = .13$, $t = 2.07$, 95% CI (.01, .51), $p = .04$). In contrast, for the virtue tweets, the slope of time of day was negative, but not significant, indicating that the engagement was decreasing for the virtue tweets from morning to evening ($b = -.11$, $SE = .13$, $t = -.85$, 95% CI (-.35, .14), $p = .4$). In other words, the engagement shifted away from virtues and towards vices as the day progressed. Viewed from another perspective, the slope of tweet type was negative both in the morning ($b = -.62$, $SE = .12$, $t = -5.00$, 95% CI (-.86, -.38), $p < .001$) and the evening ($b = -.25$, $SE = .13$, $t = -1.95$, 95% CI (-.5, .00), $p = .05$) indicating that the engagement was lower for the vice than virtue tweets both in the morning and evening.

Second, I focused on likelihood of liking tweets as the dependent variable and conducted a similar examination as engagement. The results of regression were not significant for the influence of time of day on likelihood of liking a tweet ($b = .04$, $SE = .10$, $t = .41$, 95% CI (-.16, .24), $p = .7$), but likelihood of liking was significantly higher for virtue than for vice tweets ($b = -.42$, $SE = .10$, $t = -4.09$, 95% CI (-.62, -.22), $p <$

.001). The results revealed a significant two-way interaction between time of day and tweet type ($b = .21$, $SE = .10$, $t = 2.01$, 95% CI (.004, .41), $p = .045$, $R^2 = .07$). Further analysis showed that for the vice tweets, the slope of time of day was positive, indicating that the likelihood of liking was increasing for the vice tweets from morning to evening ($b = .25$, $SE = .15$, $t = 1.71$, 95% CI (-.04, .53), $p = .09$). In contrast, for the virtue tweets, the slope of time of day was negative, but not significant, indicating that the likelihood of liking was decreasing for the virtue tweets from morning to evening ($b = -.17$, $SE = .14$, $t = -1.13$, 95% CI (-.45, .12), $p = .3$).

Third, I examined the dependent variable of likelihood of clicking on the link. The results of regression were not significant for the influence of time of day on likelihood of clicking on the link to see the full article ($b = .11$, $SE = .09$, $t = 1.23$, 95% CI (-.07, .29), $p = .2$), but likelihood of clicking was significantly higher for virtue than for vice tweets ($b = -.45$, $SE = .09$, $t = -4.91$, 95% CI (-.63, -.26), $p < .001$). The results revealed a marginally significant two-way interaction between time of day and tweet type ($b = .16$, $SE = .09$, $t = 1.78$, 95% CI (-.02, .34), $p = .08$, $R^2 = .09$). Further analysis showed that for the vice tweets, the slope of time of day was positive, indicating that the likelihood of clicking was increasing for the vice tweets from morning to evening ($b = .28$, $SE = .13$, $t = 2.13$, 95% CI (.02, .53), $p = .03$). In contrast, for the virtue tweets, the slope of time of day was negative, but not significant, indicating that the likelihood of clicking was decreasing for the virtue tweets from morning to evening ($b = -.05$, $SE = .13$, $t = -.39$, 95% CI (-.31, .20), $p = .7$).

In this study, I also examined some potential alternative explanations, such as CSM and NFC, which I measured in the first day study, as well as boredom and needing

a break from work, which I measured in the second day of the study. First, I focused on CSM to examine whether engagement with content changes depending on their circadian preferences. Circadian preferences emphasize the different sleep-wake patterns such that morning type people prefer waking up early and feel energized in the morning whereas evening type people prefer waking up late and feel energized in the evening (Gullo et al. 2019; Smith et al. 1989). Thus, I wanted to confirm that circadian preferences do not moderate the effect that I observe. I treated CSM as a categorical variable in which a score over 43 reflects a morning type, a score below 23 reflects an evening type, and a score in between these values reflects an intermediate type, following the descriptions of Smith and colleagues (1989). In this study, most of the participants scored as an intermediate type (67.8%), then followed by morning type (29.6), and few participants scored as an evening type (2.6%). I examined three-way interaction by performing repeated measures analysis of variance (ANOVA) with time of day (morning vs. evening) and CSM (morning vs. evening vs. intermediate type) as a between-subject factor and tweet type (vice vs. virtue) as a within-subject factor. The analysis showed a significant main effect tweet type ($F(1, 109) = 17.09, p < .001, \eta_p^2 = .14$) on engagement. However, there was no significant effect of time of day ($F(1, 109) = .06, p = .8, \eta_p^2 = .001$) and CSM ($F(1, 109) = .67, p = .5, \eta_p^2 = .012$). Two-way interaction between time of day and tweet type was marginally significant ($F(1, 109) = 2.99, p = .09, \eta_p^2 = .03$). Importantly, three-way interaction between time of day, tweet type, and CSM was not significant ($F(1, 109) = .19, p = .8, \eta_p^2 = .004$). Moreover, there were no significant two-way interaction between time of day and CSM ($F(1, 109) = .16, p = .9, \eta_p^2 = .003$) as well as between tweet type and CSM ($F(1, 109) = .59, p = .6, \eta_p^2 = .01$). These results

confirmed that circadian preferences do not influence the interactive effect of time of day and content type on engagement.

Second, I used NFC to confirm that individual differences in motivation to expend effort for thoughtful processing does not influence engagement with vice and virtue content during a day. According to NFC research, individuals high in NFC are more motivated to exert effort for acquiring knowledge compared to individuals low in NFC (Cacioppo et al. 1996). As this difference in individuals would not fluctuate from morning to evening, I do not expect it to moderate the asymmetric engagement that I observe. In this study, I measured NFC by taking the average for all items. Then, I examined three-way interaction by performing repeated measures analysis of variance (ANOVA) with time of day (morning vs. evening) and NFC (1 SD above the mean vs. 1 SD below the mean vs. intermediate) as a between-subject factor and tweet type (vice vs. virtue) as a within-subject factor. The analysis demonstrated a significant main effect tweet type ($F(1, 109) = 38.85, p < .001, \eta_p^2 = .26$) on engagement. Yet, there was no significant effect of time of day ($F(1, 109) = 2.35, p = .1, \eta_p^2 = .02$) and NFC ($F(1, 109) = .12, p = .9, \eta_p^2 = .002$). Two-way interaction between time of day and tweet type was marginally significant ($F(1, 109) = 2.96, p = .09, \eta_p^2 = .03$). Importantly, three-way interaction between time of day, tweet type, and NFC was not significant ($F(1, 109) = .004, p = .9, \eta_p^2 = .00$). Additionally, two-way interaction between tweet type and NFC was marginally significant ($F(1, 109) = 2.83, p = .06, \eta_p^2 = .05$) and there was no significant two-way interaction between time of day and NFC ($F(1, 109) = .59, p = .6, \eta_p^2 = .01$). Consequently, these results confirmed that neither NFC does not account for the engagement shifting away from virtue toward vice content throughout the day.

Third, considering the possibility that mood changes during the day may influence choice of vice during the day, I examined mood by using PANAS items, which yielded two separate scores for positive affect (PA) and negative affect (NA). I observed a significant difference in positive affect between morning and evening conditions. The results of independent samples t-test showed that participants in the evening condition reported lower positive affect than participants in the morning condition ($M_{\text{Evening}} = 3.8$, $SD = 1.08$ vs. $M_{\text{Morning}} = 4.26$, $SD = 1.39$; $t(113) = -1.98$, $p = .05$, $d = -.37$). However, there was no difference for negative affect across evening and morning conditions ($M_{\text{Evening}} = 1.52$, $SD = .97$ vs. $M_{\text{Morning}} = 1.49$, $SD = .85$; $t(113) = .16$, $p = .9$, $d = .03$). Overall, these directions that I observed for positive and negative affect was consistent with previous literature (Golder and Macy 2011). One may suggest that individuals struggling with decreased positive affect through the evening may engage with vice information for recovery. Considering this possibility, I conducted a mediation analysis. However, there was neither a significant direct effect of positive affect on the engagement for “vice – virtue difference” nor a significant mediation through positive affect.

Finally, I examined boredom and needing a break as possible alternative explanations. One may argue that after a long day at work individuals may have an increased sense of boredom and needing a break in the evening, and these feelings may drive the shift in engagement toward vice content. Considering this possibility, I conducted separate analysis for these two measures. The results demonstrated that there was no difference in boredom across evening and morning conditions ($M_{\text{Evening}} = 2.38$ vs. $M_{\text{Morning}} = 2.15$; $t(113) = .91$, $p = .4$ $d = .17$). However, participants in the evening

condition reported a higher score for needing a break than participants in the morning condition ($M_{\text{Evening}} = 3.35$, $SD = 1.91$ vs. $M_{\text{Morning}} = 2.18$, $SD = 1.71$; $t(113) = 3.44$, $p < .01$, $d = .65$). Thus, I further examined a mediation through needing a break, but the results did not yield a significant mediation or a significant direct effect on the engagement. These results demonstrated that neither boredom nor needing a break drive the effect that engagement shifting toward vice content from morning to evening.

1.11 STUDY 5

In this study, I utilize a Twitter alike experience for the participants by using the tweets of CNN as the source of information as similar to previous study. Yet, different than the previous study I asked participants to click a tweet of their choice to read the full article. By using tweet choice as the dependent variable, I aim to observe *click-through* behavior in an experimental design instead of measuring self-reported engagement measures. Moreover, different than the previous studies, I use time of day as within-subjects factors to observe engagement behavior for the same group of participants both in the morning and the evening. Finally, in this study, I seek evidence for the influence of reduced self-control on the engagement shift towards vice content by the evening. I expect that engagement would be higher for vice (vs. virtue) tweets in the evening than the morning and reduced self-control would drive this shift in engagement. Additionally, I test for possible alternative explanations.

1.11.1 Method

In study 5, I employed both time (morning vs. evening) and tweet type (vice vs. virtue) as within-subjects factor. Accordingly, I conducted a study in the morning and another in the evening.

In this study, I employed both time (morning vs. evening) and tweet type (vice vs. virtue) as within-subjects factor. Accordingly, I conducted a study in the morning and another in the evening. In the morning, 155 respondents ($M_{\text{age}} = 37.3$, 47% female) from MTurk successfully completed the study in exchange for a small monetary payment. At the end of the survey, I asked participants whether they were willing attend evening study between 6 pm and 10 pm. Among them 139 (89.68%) participants agreed to attend the evening study. However, in the evening, 58 participants ($M_{\text{age}} = 40.9$, 40% female) returned for the study (41.73% return rate) and completed the study in exchange for additional monetary payment.

Both in the morning and the evening conditions, participants first responded to 25-item self-control questions on a scale from 1 to 7, with higher scores indicating a more severe self-control failure (State Self-Control Capacity Scale; see appendix G for scale items; Christian and Ellis 2011; Ciarocco et al. 2007; Twenge, Muraven, and Tice 2004). Then, I provided vice and virtue tweets in a randomized order and asked participants to pick one of these tweets to read the full article (see appendices D and H for visuals). Importantly, I used different sets of two vice and two virtue tweets in the morning and the evening conditions. Additionally, participants responded to a manipulation check where they rated their vice and virtue perception for two things: the tweet that they choose, and the full article that they read after choosing the tweet. Finally, before participants

answering to standard demographic questions, I tested for possible alternative explanations. Accordingly, they completed PANAS items, and provided their level of boredom and needing a break similar to the previous study.

1.11.2 Results and Discussion

A paired samples t-test showed a marginally significant difference for the choice of vice tweet in the evening and the morning ($M_{\text{Evening}} = .40$, $SD = .49$ vs. $M_{\text{Morning}} = .29$, $SD = .46$; $t(57) = 1.52$, $p = .1$, $d = .23$). I conducted another paired samples t-test to observe the change in self-control from morning to evening. Since higher scores indicate higher self-control failure, self-control failure was significantly more severe in the evening ($M_{\text{Evening}} = 3.29$, $SD = 1.13$) than the morning ($M_{\text{Morning}} = 2.85$, $SD = 1.07$; $t(57) = 2.92$, $p < .01$). I further examined whether this severe self-control failure from morning to evening drives the choice of vice rather than virtue. Remember that participants picked a vice or virtue article both in the morning and the evening. These two choices may seem as one of three different categories: virtue – vice (i.e., switching to vice in the evening), vice – virtue (i.e., switching to virtue in the evening), virtue – virtue and vice – vice (i.e., not switching). Thus, I analyzed the effect of self-control failure on categories of choices by using multinomial logistic regression with not switching as the reference category. Self-control failure significantly increased the switch from virtue to vice choice from morning to evening ($b = 1.06$, $SE = .41$, Wald's $X^2 = 6.56$, $p = .01$). However, self-control failure had no significant effect on the switch from vice to virtue choice ($b = -.50$,

SE = .47, Wald's $X^2 = 1.11, p = .3$). These results demonstrated that increased self-control failure from morning to evening drives the engagement with vice content.

Considering the possibility that participants might perceive their choice of tweet or the article, which they read after choosing the tweet, as vice (vs. virtue) at varying levels, I conducted manipulation checks. The results confirmed that participants perceive their choice of vice (vs. virtue) tweets as more vice (vs. virtue) both in the morning ($M_{Vice} = 38.12, SD = 29.24$ vs. $M_{Virtue} = 81.56, SD = 21.96; t(56) = -6.21, p < .001, d = -1.79$) and in the evening ($M_{Vice} = 30, SD = 27.07$ vs. $M_{Virtue} = 76.46, SD = 26; t(56) = -6.55, p < .001, d = -1.74$). Importantly, participants perceived vice (vs. virtue) full articles, which they read after picking the tweet, as more vice (vs. virtue) both in the morning ($M_{Vice} = 37.53, SD = 28.53$ vs. $M_{Virtue} = 82.95, SD = 24.55; t(56) = -6.12, p < .001, d = -1.76$) and in the evening ($M_{Vice} = 32.96, SD = 29.57$ vs. $M_{Virtue} = 80.86, SD = 22.99; t(56) = -6.92, p < .001, d = -1.76$).

Similar to study 4, I investigated mood by using positive affect (PA) and negative affect (NA) as two separate scores from PANAS. First, I examined the change in PA and NA during the day. A paired samples t-test indicated that participants had a lower positive affect in the evening compared to the morning ($M_{Evening} = 3.81, SD = 1.30$ vs. $M_{Morning} = 4.30, SD = 1.30; t(57) = -3.87, p < .001, d = -.38$). Contrarily, they had a higher negative affect in the evening compared to the morning ($M_{Evening} = 1.76, SD = 1.13$ vs. $M_{Morning} = 1.59, SD = 1.08; t(57) = 2.06, p < .05, d = .15$). Overall, these changes that I observed for PA and NA during the day was consistent with previous literature (Golder and Macy 2011). I, then, investigated whether the changes in PA and NA during the day is predicting the tweet choice. The results of a repeated measures logistic

regression analysis demonstrated that neither positive affect ($b = -.04$, Wald's $X^2 = .07$, $p = .8$) nor negative affect ($b = .22$, Wald's $X^2 = 1.13$, $p = .3$) had an influence on article choice.

Again, similar to study 4, I tested boredom and needing a break as possible alternative explanations. A paired samples t-test indicated that boredom did not change between the evening ($M_{\text{Evening}} = 2.53$, $SD = 1.55$) and the morning ($M_{\text{Morning}} = 2.43$, $SD = 1.43$; $t(57) = .56$, $p = .6$, $d = .07$). However, needing a break was higher in the evening ($M_{\text{Evening}} = 3.14$, $SD = 1.78$) than the morning ($M_{\text{Morning}} = 2.34$, $SD = 1.53$; $t(57) = 3.11$, $p < .01$, $d = .48$). Thus, I conducted additional analysis for needing a break to observe whether it has an effect on article choice. The results of a repeated measures logistic regression analysis demonstrated that needing a break had no effect on article choice ($b = .20$, $SE = .12$, $p = .1$). Consequently, these results demonstrated that boredom or needing a break did not drive the engagement shift toward vice content from morning to evening.

1.12 STUDY 6

The empirical evidence from the first five studies documents that individuals' engagement shifts toward vices and away from virtues as morning turns to evening. I now investigate actual behavior on Twitter. Specifically, I focus on two engagement metrics: number of likes, and number of followers. First, I examine the number of "likes" because that suggests active engagement with content (study 6A). Second, I investigate the number of "followers" because choosing to become a follower of a company's social

media account is an indication that one is inclined to engage more with that type of content (study 6B).

1.12.1 Data Description

I collected 6,944,210 observations from the Twitter accounts of the same eight magazines that I used in studies 1 and 2. I gathered these data between September 17, 2017, and October 1, 2018³ by utilizing Application Programming Interface (API) through Python coding. I used Twitter's Streaming API to record real-time updates from the magazine accounts. I repeated the data collection every 30 minutes to record the most recently posted tweets by each magazine and the associated consumer engagement. Importantly, I used real-time streaming data because it is critical to apprehend consumers' engagement with content at a specific time of day for the purposes of this research, rather than historical data (Kanuri et al. 2018). Although historical data has its advantages, it may exaggerate consumers' activities by recording cumulative information, without capturing consumers' actual reactions at a given time. Therefore, I use streaming data to examine how consumer engagement level varies over time in a day. I also collected critical information related to tweets (i.e., content of the tweets, number of likes, release time and date of tweets, hashtags, and mentions in the text of tweets,

³ Due to technological malfunctioning, the data collection was interrupted on multiple days (from October 27, 2017 to November 5, 2017; November 29, 2017; December 23-24, 2017; January 11, 2018; May 20, 2018; June 8, 2018). I have manually collected the number of tweets posted during this time. Comparing the daily average number of tweets in the observed data and the omitted data, I find no significance difference.

media included in tweets, etc.) as well as the updates for magazine accounts (i.e., number of followers that each magazine has).

In study 6A, I investigated the number of likes for each tweet posted by the magazines. I focused on the original tweets posted by the focal magazines and disregarded those that originated from another Twitter account and were re-posted by the focal magazine account. There were 176,390 unique tweets from eight magazines in the final data for study 6A. Since I examined the number of likes for each tweet, the unit of analysis was at the tweet level. Further, I used time of day as the tweet post time⁴ at which a magazine account posts an original tweet. Here, I measured the accumulation of the number of likes for an hour after each original tweet is posted since it has been shown that half of the content engagement occurs within an hour from the tweet post time (Kwak et al. 2010). I also confirmed the appropriateness of one hour in the data, given the acceleration rate for “likes.” While the number of likes expectedly increases with the age of the tweet, the rate of this increase is the highest in the first hour and then slows down, such that 63% of the likes accumulate in the first hour. Thus, the 1-hour cutoff helps me capture a majority of the likes, while providing me real-time liking behavior, and maintaining uniformity by imposing a fixed time duration for assessing tweet engagement.

In study 6B, I conducted the analysis based on the change in the number of followers for each magazine through the day. Therefore, the unit of analysis was at the

⁴ It is important to note that the Twitter API reports time in Coordinated Universal Time. I converted this reported time to Eastern Standard Time because the headquarters of all the focal magazines are located in the Eastern Time Zone. Thus, the release time of tweets matched the time zones of the magazines.

magazine level. I collected the number of followers every hour from Twitter. There were 139,151 unique observations from eight magazines in the final dataset for study 6B.

1.12.2 Study 6A

Method. In this study, I examined whether liking behavior changed differently for vice versus virtue magazines through the day. As previously mentioned, the dependent variable, liking behavior, refers to the number of likes accumulated during the one-hour period after a tweet is posted. When I investigated the distribution of this variable, I observed extreme outliers on the right tail. Therefore, I winsorized the number of likes at the 99% level to reduce the impact of outliers⁵ (Meyvis and Van Osselaer 2018). Given that the dependent variable (i.e., number of likes) is a count variable that is zero or a strictly positive integer, Poisson or negative binomial regressions would be preferred over OLS regression (Coxe, West, and Aiken 2009). However, one of the assumptions of Poisson regression was violated, as the data suggested overdispersion—the variance of likes (3064.72) was greater than the mean of likes (47.26, see table 1 for summary statistics). Hence, I used a negative binomial regression.

In the model, I used magazine type (virtue = -1, vice = 1), time of day (6 am = 0, 5 am = 23), and their interaction as the main predictors. I controlled for other factors that may have an influence on consumers' liking behavior. Specifically, I used the one-hour-lagged number of tweets to acknowledge the level of tweet posting behavior for each

⁵ As a robustness check, I ran the model before winsorizing at 99% level. The directions and significance of the estimates are consistent. Given the value of zero at the 1% level, the data is winsorized only at the 99% level.

magazine in the most recent past. I further accounted for the tweet posting frequency by adding the minutes elapsed (i.e., duration) between two consecutive tweets. Considering that the magazines I focused on have audiences of different size, the number of followers was also included. Furthermore, given that magazines may post the same content on different days, I controlled for the number of repeated tweets. To account for message differences, I examined whether the following are included in each tweet: a media file (e.g. photograph or video), a Uniform Resource Locator (URL) link to actual content on a magazine's website, hashtag related to content, and mention of other accounts. Whether the tweet is posted as a reply to another account was also accounted for. Finally, given that the focus was on changes within a single day, I included day-of-month and month-of-year fixed effects to control for any day-to-day and month-to-month differences.

Results and Discussion. I find that liking behavior increased through the day ($b = .001$, $SE = .0004$, $z = 2.29$, 95% CI (.0001, .002), $p < .05$), and was higher for virtue than for vice magazines ($b = -.06$, $SE = .01$, $z = -14.08$, 95% CI (-.07, -.06), $p < .001$). Importantly, the results uncovered a significant two-way interaction of time of day and magazine type ($b = .01$, $SE = .0004$, $z = 12.65$, 95% CI (.004, .01), $p < .001$, see model 1 in table 2). There was an asymmetry of liking behavior for vice and virtue. For the vice magazines, a positive slope for time of day indicated that liking behavior increased for vice magazines over the course of the day ($b = .27$, $SE = .03$, $z = 10.52$, 95% CI (.22, .33), $p < .001$; figure 5). In contrast, for virtue magazines, a negative slope for time of day indicated that liking behavior decreased over the course of the day ($b = -.20$, $SE =$

.03, $z = -7.34$, 95% CI (-.25, -.14), $p < .001$). These results confirmed that liking behavior shifted toward vices rather than virtues as the day progressed.

Looking at the results in a different way, the Johnson–Neyman floodlight analysis technique pointed out significance regions of the effect of magazine type across different levels of time of day. This analysis revealed that there was a significant negative effect of magazine type on liking behavior for the values of time of day at and below 12.08 on a scale of 0 to 23, which corresponded to 6:05 pm on a day, ($b_{JN} = -.26$, $SE = .13$, $z = -1.96$, 95% CI (-.52, .00), $p = .05$). In contrast, there was a significant positive effect of magazine type on liking behavior for the values of time of day at and above 14.45, which corresponded to 8:27 pm on a day, ($b_{JN} = .30$, $SE = .15$, $z = 1.96$, 95% CI (.00, .60), $p = .05$). These results suggest that liking was lower for vice magazines than virtues before 6:05 pm, but liking was higher for vice magazines than virtues after 8:27 pm, with no vice-virtue difference in between these two times.

As noted earlier, I had included various variables to control for other factors that may influence consumers' liking behavior. While somewhat peripheral to the focal research question, these variables provide some interesting insights. The recent level of tweet posting behavior was positively associated with the number of likes. In a similar vein, the smaller duration between two consecutive tweets was associated with a higher number of likes. This suggests that when magazines post new content more frequently, the more recent tweets would receive a higher number of likes. However, there was a negative relationship between the number of repeated tweets and the number of likes. Therefore, magazines would do better to post new content instead of repeating old content. The results also show that contents with a URL link were associated with a lower

number of likes, which is consistent with prior research (Lee, Hosanagar, and Nair 2018). Including a media file and mentioning other accounts in a tweet led to a lower number of likes. To reiterate, the results were robust to changes in the control factors.

As a robustness check, I examined whether the results are driven only by weekdays. For instance, individuals may want to be updated on virtue (vs. vice) content in the morning, as they that may be useful for their jobs, with this trend dissipating as evening draws near. But if the results are driven more by self-control failure, then the results should emerge for the weekend as well. After all, weekends involve their own challenges of fighting impulses (attempts to not overeat, avoid spending money on shopping, get up to do household chores, etc.). Such unstructured self-control challenges may be as, or even more, exhausting than the set routines of workdays. The results indicate that the results don't weaken over the weekend but are, in fact, a bit stronger ($b = .004$, $SE = .001$, $z = 8.96$, 95% CI (.003, .01), $p < .01$; see model 2 in table 2). More important, the patterns are similar. On weekdays, the slope of vice magazines is significantly positive during the day ($b = .08$, $SE = .03$, $z = 3.2$, 95% CI (.03, .13), $p < .01$) but the slope of virtue magazines is significantly negative ($b = -.16$, $SE = .03$, $z = -5.4$, 95% CI (-.22, -.10), $p < .001$). Analogously, on weekends, the slope of vice magazines is significantly positive ($b = 1.11$, $SE = .10$, $z = 11.03$, 95% CI (.92, 1.31), $p < .001$) but the slope of virtue magazines is significantly negative ($b = -.38$, $SE = .06$, $z = -6.57$, 95% CI (-.49, -.27), $p < .001$). These similar patterns confirm that the results are not driven by work considerations specific to workdays.

1.12.3 Study 6B

Method. I investigated whether consumers' following behavior differed across vice and virtue magazines as the day progresses. The dependent variable, which reflects the difference in number of followers for a magazine, was measured as the change in the number of followers every hour. Since I observed extreme outliers on both the left and the right tails, I winsorized the difference in followers at 1% and 99% levels⁶. Then, I regressed the difference in followers on the magazine type (virtue = -1, vice = 1), time of day (continuous; 6 am = 0, 5 am = 23), and their interaction. I used the one-hour-lagged number of tweets posted by the magazines as a control variable to account for the level of tweeting for each magazine. I also accounted for the popularity of a magazine's tweets by including the number of likes in the previous hour.

Results and Discussion. The number of followers did increase through the day regardless of magazine type. But the growth in follower numbers was high in the morning and slowed down by the evening ($b = -.33$, $SE = .02$, $z = -19.74$, 95% CI $(-.36, -.30)$, $p < .001$). Furthermore, the follower numbers changed less for vice magazines compared to virtue magazines ($b = -15.43$, $SE = .22$, $z = -69.53$, 95% CI $(-15.87, -15.00)$, $p < .001$). Importantly, a significant two-way interaction emerged between the type of magazine and time of day ($b = .22$, $p < .001$, table 3), such that the hourly growth of number of followers for virtue magazines was significantly lower ($b = -.55$, $SE = .02$, $z =$

⁶ Twitter cancelled millions of accounts on June 12, 2018. Since the observation period included this date, I winsorized the outliers.

-24.01, 95% CI (-.59, -.50), $p < .001$) than for vice magazines ($b = -.12$, $SE = .02$, $z = -4.7$, 95% CI (-.16, -.07), $p < .001$; see Table 3 and figure 6).

In sum, as the day progressed, the rate at which followers were added declined more sharply for virtues than for vices. While both sets of magazines were attracting relatively fewer followers as morning turned to evening, this decline was stronger for virtue than for vice magazines. Additionally, after controlling for the one hour lagged number of tweets and lagged number of likes, the results remained unchanged in terms of direction and significance. Taking studies 6A and 6B together, as the day shifts from morning to evening, the Twitter likes of current followers, and accrual of new followers, reveal a shift away from virtue and toward vice content.

1.13 STUDY 7

Having observed the information engagement for both intentions and actual behavior, in this final study, I provide additional empirical evidence in three ways. First, while the documented vice-virtue asymmetry suggests that self-control failure is likely at play, I seek further evidence for this account through moderation. As explained earlier, high temperature reduces self-control (Cheema and Patrick 2012) and, more broadly, restricts performance during the day as a function of exposure duration to heat (Fine and Kobrick 1978). Therefore, I predict that relatively high temperature strengthens the influence of time of day on the asymmetry of information engagement. That is, I expect the shift toward vices and away from virtues to become stronger when the temperature is relatively high (vs. low). To see such a shift, however, it is important that day

temperatures actually do have an influence on consumers. This is less likely to occur in developed economies where air conditioning ensures temperature control all year around. And it is more likely to occur in developing economies. In particular, I focus on India for this study, where the penetration of air conditioning is only 5% (Statista 2019), making it more likely that day temperatures will have an influence.

Second, in the previous study, I utilized Twitter accounts of multiple magazines as the source of vice and virtue content. However, the audience of these accounts may differ in their magazine preferences. Therefore, I now concentrate on one Twitter account to observe the information engagement preferences of one audience. I chose the account of *The Times of India* newspaper, which is the largest English newspaper in India. The Twitter page of the newspaper has more than 11.5 million followers, which is almost twice as large compared to the next most followed English newspaper in India, *Hindustan Times*. Furthermore, because the main audience of the newspaper resides in India, I accurately observe the time of information engagement. Finally, considering that vice and virtue perceptions may vary across news articles within the magazines, I now focus on specific topics as the source of vice and virtue content.

1.13.1 Data Description

I gathered 515,370 observations from the Twitter account of *The Times of India* newspaper between April 24, 2018, and November 24, 2018. Following a similar data collection process as in study 4, I used Twitter API via Python coding to gather the data

with repetition of the collection every 30 minutes, also recording updates on the account and information about every tweet.

I examined the number of likes for each tweet by focusing only on the original tweets and disregarding tweets originating from another Twitter account. In the final data, there were 45,468 unique tweets. Time of day was the time at which the account posts an original tweet. Similar to study 4, I examined the number of likes accumulated for an hour from the tweet post time. Since Twitter API reports time in Coordinated Universal Time (UTC), I converted it to Indian Standard Time (IST) to understand the information engagement pattern in local time.

I categorized various topics as either vice and virtue content. To identify which category a tweet fell into, I employed URL tags (i.e., web addresses) that are available in the text of tweets. Since the characters are limited in tweets, the newspaper incorporates URLs in tweets to provide full content of an article to the audience. Thereby, a user may click on the URL to read the related article from the website of the newspaper. It is important to note that Twitter automatically shortens URLs; therefore URLs look like a random combination of letters and numbers. While connecting to the website of the newspaper, the short URLs become hierarchical URLs on the users' web browser. Hierarchical URLs usually provide a clear path of the website. This path looks like segments separated by slashes. For example, the hierarchical URLs of the newspaper reveal the hostname of the webpage at the beginning and reveal news topics after the slash (e.g., [https://timesofindia.indiatimes.com/business/...](https://timesofindia.indiatimes.com/business/)).

To identify topics, I collected the hierarchical URL information from the short URLs by using Python coding. I obtained hierarchical URLs for 71.3% of the tweets, and

were unable to get this information for other tweets due to two reasons: (a) the URL was missing for some tweets—it did not link to content on the newspapers’ website, and (b) the URL was broken for some tweets—the newspaper had removed the content from its website. For tweets that had URL information, I classified the topics as vice or virtue. For such classification, I pretested vice-virtue perceptions for an inclusive list of topics with the participation of 157 undergraduate students ($M_{\text{age}} = 20$, 29% female). Similar to the measure used in earlier studies, I defined a vice as something tempting that may not offer many benefits, and a virtue as being not tempting but offering benefits later on (vice = 0; virtue = 100). In a relative sense, participants rated topics related to *beauty, celebrity, entertainment, fashion, humor, and sports* as more vice (Cronbach’s $\alpha = .79$, $M = 30.15$, $SD = 20.48$), but rated topics related to *automotive industry, business, environment, health, local matters, politics, science, technology, world, and opinion column* as more virtue (Cronbach’s $\alpha = .74$, $M = 65.42$, $SD = 14.43$, $t(120) = 16.43$, $p < .001$).

Finally, using publicly available temperatures from AccuWeather, I obtained daily temperatures for three metropolitan cities—Bengaluru, Mumbai, and New Delhi—where *The Times of India* is the most read (The Times of India 2018). I also validated this on Google Trends. During the observation period in the data (i.e., between April 24, 2018, and November 24, 2018), people in Bengaluru, Mumbai, and New Delhi were the ones who most frequently searched for *The Times of India* to get news. I computed the average temperatures based on the daily highest temperatures, as these would capture the high temperatures on a given day that may exacerbate self-control failures. The observed temperatures ranged from 83°F to 98°F ($M = 90$, $SD = 3.47$), which is similar to the

ranges considered in prior temperature studies in real-world settings (Fine and Kobrick 1978; Van de Vliert and Van Yperen 1996).

1.13.2 Method

I employed the number of likes as the dependent variable. Similar to study 6A, the variance of likes (Var = 454.97; SD = 21.33) was greater than the mean of likes (25.37, see table 4); therefore, I used a negative binomial regression, rather than Poisson regression. I analyzed the three-way interaction between the content (virtue = -1, vice = 1), time of day (continuous; 6 am = 0, 5 am = 23), and temperature. I also mean-centered temperature to alleviate multicollinearity, and controlled for the various variables as I did in study 6A. However, I eliminated some of the control variables that would not be appropriate for the current study. Thus, I excluded the variable controlling for available URL in the text of the tweet because I used this very variable to create vice and virtue categories. Also, considering that month of year is associated with temperature, I excluded this variable from the model.

1.13.3 Results and Discussion

In line with previous results, I observed a significant two-way interaction of content type and time of day ($b = .01$, $SE = .001$, $z = 8.53$, 95% CI (.006, .01), $p < .001$, table 5). More importantly, a significant three-way interaction emerged between time of day, content type, and temperature ($b = .001$, $SE = .0003$, $z = 2.21$, 95% CI (.0001, .001),

$p < .05$), confirming that the predicted two-way interaction between content type and time of day was stronger for higher temperatures (see figure 7). But attesting to the robustness of the results, the two-way interaction remained statistically significant even when temperatures were low. At low temperature (i.e., 1 SD below the mean), the two-way interaction between time of day and topic type was significant ($b = .13$, $SE = .03$, $z = 4.39$, 95% CI (.07, .19), $p < .001$); as the day progressed, the number of likes increased for vice ($b = .24$, $SE = .06$, $z = 4.17$, 95% CI (.12, .35), $p < .001$), but decreased for virtue ($b = -.04$, $SE = .03$, $z = -1.42$, 95% CI (-.09, .01), $p = .1$). The pattern for high temperature (i.e., 1 SD above the mean) was similar, but stronger. The two-way interaction was significant ($b = .26$, $SE = .04$, $z = 7.22$, 95% CI (.19, .33), $p < .001$); as the day progressed, the number of likes increased for vice ($b = .37$, $SE = .07$, $z = 5.25$, 95% CI (.23, .51), $p < .001$), but decreased for virtue ($b = -.16$, $SE = .03$, $z = -6.11$, 95% CI (-.22, -.11), $p < .001$).

Furthermore, in two separate floodlight analyses, I observed significance of regions for the two-way interaction within relatively high and low temperature conditions. These analyses reveal that when temperatures are higher, the engagement advantage of virtue (vs. vice) content dissipates earlier in the morning, and the engagement advantage of vice (vs. virtue) content emerges earlier in the evening. Specifically, I first examined the interaction between time of day and topic type in relatively high temperature. For this interaction, I observed two significant regions. The results showed that liking of vice topics was significantly lower than virtues for the values of time of day at and below the point 3.24 on a scale of 0 to 23, which corresponded to 9:14 am on a day, ($b_{JN} = -.58$, $SE = .29$, $z = -1.96$, 95% CI (-1.16, .00), p

= .05). However, liking of vice topics was significantly higher than virtues for the values of time of day at and above the point 6.95 on a scale of 0 to 23, which corresponded to 12:57 pm on a day, ($b_{JN} = .40$, $SE = .20$, $z = 1.96$, 95% CI (.00, .80), $p = .05$). Second, I explored the interaction between time of day and topic type in relatively low temperature. Again, I observed two significant regions. Accordingly, liking of vice topics was significantly lower than virtues for the values of time of day at and below the point 4.96 on a scale of 0 to 23, which corresponded to 10:58 am on a day, ($b_{JN} = -.41$, $SE = .21$, $z = -1.96$, 95% CI (-.82, .00), $p = .05$). In contrast, liking of vice topics was significantly higher than virtues for the values of time of day at and above the point 10.19 on a scale of 0 to 23, which corresponded to 4:11 pm on a day, ($b_{JN} = .30$, $SE = .16$, $z = 1.96$, 95% CI (.00, .61), $p = .05$).

In sum, while the advantage of virtue (vs. vice) content persisted until 10:58 am in low temperatures, it dissipated earlier, at 9:14 am, in high temperatures that made people desist from virtue engagement earlier. Similarly, while the advantage of vice (vs. virtue) content emerged at 4:11 pm in low temperatures, it emerged much earlier, at 12:57 pm, in high temperatures that made people succumb to vice engagement earlier. Thus, the effects of self-control failure emerged earlier in higher temperatures, resulting in a stronger vice-virtue asymmetry.

Overall, the results replicated the earlier findings. The information engagement shifted away from virtues towards vices as the day progressed. Furthermore, consistent with self-control literature, the influence of time of day on the shift in engagement was stronger in relatively high (vs. low) temperatures. Also, because high temperature

increases self-control failures earlier during the day, the engagement shift occurs earlier in time on hotter days.

I also conducted robustness checks on the data. First, as in study 4, I verified the effect of weekday versus weekend. Including this variable into the model, the higher-order interaction was not significant ($b = -.0002$, $SE = .0004$, $z = -.47$, 95% CI $(-.0008, .0005)$, $p = .6$), attesting to the robustness of temperature moderation; the 3-way pattern for weekday was statistically similar to that for the weekend. Second, for the analysis, I could categorize only 71.3% of the available data in the observed period. To increase the sample, I utilized hashtags and mentions to categorize the rest of the observations. The Twitter account of *The Times of India* includes hashtags (e.g., #TimesOfIndia) and mentions (e.g., @TimesOfIndia) in the text of tweets. Although categorizing these tags introduces some subjectivity in choosing the category, it did help me increase the categorized sample size from 71.3% to 87.1% (the newly categorized data was not skewed toward either vices or virtues and, just like the original sample, was a mix of the two). The results were robust to this larger sample; the directions and significance of the estimates were consistent across models. Furthermore, recruiting automatized techniques, I attempted to categorize the tweets by using unsupervised (i.e., Latent Dirichlet Allocation) and supervised (i.e., Naïve Bayes) machine-learning methods. But because the words in the text of tweets are limited, these methods were inadequate to achieve accurate results. Therefore, I categorized the tweets relying on mentions by using a combination of two algorithms, k-means clustering and document as a vector (doc2vec). As mentions were missing in some of the tweets, I was able to categorize just 36.3% of the observations as vice and virtue. Disregarding observations with missing categories,

the vice-virtue categories that I obtained from the machine-learning algorithm matched with the focal categories of study 7 (i.e., defined based on URL tags) at a very high level: 97%. In short, when I explored the data using different methods, I did not encounter any conflicting results—the results were robust to different approaches.

1.14 GENERAL DISCUSSION

1.14.1 Summary

Social-media platforms are dominating consumers' engagement with information. The one at the center of this research, Twitter, is among the most well-known for the diffusion of information. It started as a simple micro-blogging site where individuals would express their personal thoughts in 140 characters or less. Since then, the limit of characters has doubled to 280, the number of tweets has exploded to over 500 million tweets each day, and it has become so critical to business that it is now worth around \$30 billion. A key reason for such a high valuation is the ability to reach highly engaged customers. Twitter is used by marketers to strengthen brands via messages and advertisements, provide customer service, promote new products, and even distribute new products such as app downloads. But, at the end of the day, a tweet is nothing more than informational content that consumers engage with. And the same is true for posts on Facebook or any other social media platform. So, it is critical to know how consumers' engagement varies with the type of informational content.

One key distinction in information content is whether it is a vice, which promises immediate gratification, or whether it is a virtue, which promises long-term knowledge benefits. I predict time-of-day effects that are asymmetric for vice versus virtue content. Specifically, as the day shifts from morning to evening, consumer engagement should shift away from virtue content and toward vice content. Support for this prediction comes from seven studies—five experiments and two studies using large-scale Twitter datasets. In study 1 with MTurk participants who are asked about reading likelihood of vice versus virtue magazines in the morning versus evening, I find initial evidence of engagement shifting as the day progresses—away from virtues and toward vices. This result replicates in study 2 with student participants in a lab setting, when I do not mention the time of day, but simply measure the time at which participants complete the survey. Study 3 also shows the same vice-virtue asymmetry when I consider vice versus virtue websites. Study 4 depicts that vice-virtue asymmetry also exists for the tweets of CNN in a design that I randomly assign participants to morning and evening time periods. Then, Study 5 replicates this with the participation of same group of individuals in the morning and evening periods and provide evidence that self-control failure drives the shift in engagement toward vices. This asymmetry is also evident in study 6 when I measure actual engagement for several magazines on Twitter as measured via likes (Study 6A) and followers (Study 6B). Finally, in study 7, I use vice versus virtue content from the same newspaper and measure actual engagement in terms of likes. Here again, I observe the same vice-virtue asymmetry that emerged in earlier studies. In addition, I observed that this asymmetry becomes stronger when day temperatures get higher.

These results respond to a call for more research on social media (Lamberton and Stephen 2016), and on robust, consumer-relevant effects (Inman et al. 2018). The results are highly relevant to both consumers and marketers. They are also robust in that they generalize across different types of data (experiments vs. Twitter datasets), different participants (MTurkers, students, and regular users of Twitter), different operationalizations of vice versus virtue content (different magazines, websites, individual tweets, and newspaper topics), and different operationalizations of time of day (asking participants how they engage with content at different times, asking for engagement responses while measuring the time myself, randomly assigning participants to morning and evening conditions, and getting a time stamp from Twitter datasets). Across such variation, what consistently emerged was an asymmetric engagement with vice versus virtue content through the day.

1.14.2 Limitations

While the results are robust, one limitation is that I cannot make an unambiguous claim on the process. After all, by its very nature, time of day is simply a moment in time. As those moments change, many things happen simultaneously, and it is hard to isolate one specific process underlying the time-of-day effect. That said, I believe that the chief culprit is self-control failure. I build the theory of this essay around this process because it has been shown that self-control failure occurs as the day progresses. One wakes up with full reserves of self-control, which then reduces as people make successive self-control decisions, such as refraining from a tempting food or activity, or pushing oneself

toward food or activity that is beneficial for the long term (Levav et al. 2010; Vohs et al. 2008). As self-control weakens through the day, people engage in vices such as unethical behavior and disregard virtues such as professionalism (Dai et al. 2015; Kouchaki and Smith 2014). Thus, a telltale sign of self-control failure is an asymmetry for vices versus virtues, and that is what I observed. If the results had simply been about a main effect through the day, such as an increase in engagement with social media, it would have been hard to make this claim. But given the interaction I demonstrate, the more parsimonious case to make for the vice-virtue asymmetry is self-control failure rather than any other process.

I should also note that circadian rhythms (Gullo et al. 2019; Hornik and Miniario 2009; Kanuri et al. 2018; Warner 1988) cannot account for the results of this research. Such rhythms cannot explain the documented vice-virtue asymmetry, which I observed as a systematic trend through the day, and not as a circadian non-linear trend (dip from the morning to the afternoon and then a rise as evening nears). Finally, I should note that the moderation of the effects of this research due to a factor that has been shown to exacerbate self-control failure—high temperatures—also gives me confidence that self-control failure is at least a key determinant of the effects, if not the only one. But I acknowledge that additional processes may underlie the results, which future research could explore further.

Another limitation pertains to the intrinsic structure of Twitter data. I gathered the data without any help from Twitter. Thus, this data is at an aggregate level, and I do not have access to individual-level information that would have enriched my understanding. For instance, some individuals may have engaged with the content but forgotten to press

“like.” This may not change the broad results, as my focus is on relative changes in likes through the day, for vices versus virtues. However, there is no doubt that individual-level information would have provided better insights into the observed effects. These limitations aside, the results afford implications for practice and theory.

1.14.3 Implications

The results of this research have implications for consumers who may themselves want to understand when they are more susceptible to what kind of informational content, and to public-policy makers trying to safeguard consumer welfare in this regard. On the flip side, the results could help marketers improve the engagement with their customers by releasing information at a time when their customers are most likely to be receptive. Those who create original content to share—and that includes most firms, not just newspapers and magazines—will attract more reader engagement by timing their own content depending on what kind of content they have. For instance, brands may want to post virtue content, such as technical announcements and corporate social responsibility activities during morning hours; and post vice content, such as tempting flash discounts, during evening hours. Similarly, those who collate the content of others, such as news aggregator websites and mobile phone applications, can boost consumers’ attention by choosing which content to share at which times of the day. It is known that news aggregator websites and applications play a complementary role in boosting engagement (Chiou and Tucker 2017; Sismeiro and Mahmood 2018). Many news aggregators (e.g., *Google News*, *Apple News*, and *Flipboard*) have smartphone apps that curate daily news

highlights, and seek consumer attention by sending alerts. However, these alerts often refer to curations that mix vice and virtue content. Instead, the news apps may consider alerting consumers on curated virtue news in the morning and vice news in the evening.

This research also contributes to prior research in many ways. I add to the growing findings from social-media research. Extant research reveals insights into what leads to engagement with different kinds of content such as the size of the audience, emotions, and utility (Barasch and Berger 2014; Berger and Milkman 2012; Toubia and Stephen 2013). This work assesses engagement with vice versus virtue content on social media, and demonstrate that there is an asymmetry in engaging with these two types of content during the course of a day.

I also contribute to research on self-control, where a key marker is whether there is an asymmetry between vices and virtues. As mentioned earlier, these asymmetric results, and moderation via temperature, point to a process of self-control failure. With caveat that other processes may be at play as well, this research would be the first one to demonstrate self-control failure using large-scale social media datasets.

Finally, the contribution is to research on time-of-day effects. By providing robust empirical evidence, I have hopefully provided more clarity to the question of how consumers engage with media. Because of various reasons, such as when people have free time, and when content may be available, it may indeed be true that some type of media engagement is higher in the evening (Cain and Gradisar 2010; Exelmans and Van den Bulck 2017; Hoffman et al. 2012). What I find, though, is that this is not a general trend that applies to all types of media. For media that is more virtue rather than vice, engagement may not be higher in the evening, and may even be lower. This nuance is

important because it suggests that certain types of media content are more suitable at certain times of the day. In the context of social media, I demonstrate that both the intention to engage (i.e., reading likelihood) and actual engagement (i.e., liking, clicking, following, and choice) shift away from virtue and toward vice content as the day progresses away from the morning and toward the evening.

ESSAY 2: TIME-OF-DAY EFFECTS ON ENGAGEMENT WITH HIGH-CONSTRUAL VERSUS LOW-CONSTRUAL SOCIAL MEDIA CONTENT

2.1 ABSTRACT

As social media platforms expand services from chatting to social discovery, consumers' usage of these platforms is evolving from personal networking, such as keeping up with friends and family, to content networking, such as keeping up with the recent news and events from media organizations and companies. Following this transition, companies, brands, and celebrities rise and fall depending on the engagement of their messages on social media. Recent research suggests diverse set of drivers for message engagement, but our knowledge is still limited about how the engagement of content changes during the day. This research introduces a novel effect of time of day on construal level in the context of content engagement on social media. I propose that, as the day wears on, individuals' engagement shifts away from high-construal content, such as messages that relate to events happening far away (e.g., international news), towards low-construal content, such as messages that relate to events happening nearby (e.g., local news). These results have implications for both theory and practice.

2.2 INTRODUCTION

A recent global consumer research survey suggests that using social media for networking is about to be overthrown by another motivation: seeking updates on recent events and news from media companies, celebrities, and brands (Bayindir and Kavanagh 2018). Moreover, as reported by the same survey, more than half of the consumers monitor contents of companies by following them on social media, and similar proportion of consumers interact with companies on a regular basis. Considering the fact that consumers are willing to interact with brands on social media, it is more important than ever for managers to convey effective messages. By posting more persuasive messages on social media, companies may reach a broader audience. Researchers have long discussed the role of construal level on engagement with messages and eventual persuasion (Agrawal and Wan 2009; Han, Duhachek, and Agrawal 2016; Hernandez, Wright, and Rodrigues 2015; Kim, Rao, and Lee 2009; Lee, Keller, and Sternthal 2010; White, MacDonnell, and Dahl 2011). However, it is not clear how time of day would shape consumers' engagement with messages as a function of construal level.

In the current research, I suggest that time of day will influence the engagement with online content depending on its construal level. In particular, I focus on construal that arises due to geographical distance, and examine its role in the context of engaging with information. As the day progresses from morning to evening, I predict a shift in engagement from high-construal content, such as messages that relate to events happening far away (e.g., international news), towards low-construal content, such as messages that relate to events happening nearby (e.g., local news). I argue for this shift

toward low-level construal later in the day based on research on self-control. It is known that when individuals' self-control is reduced, they adopt low- (vs. high-) level construal. For instance, when making choices after their self-control is reduced, people prefer proximal attributes that align with a low level of construal rather than distal attributes that align with a high level of construal (Wan and Agrawal 2011). This influence of reduced self-control also supports a shift toward low-level thinking later in the day because recent research suggests that self-control failure may become more severe as morning turns to evening (Dai et al. 2015; Kouchaki and Smith 2014; essay 1 of this dissertation). Thus, my key prediction is that individuals' engagement with content on social media should shift away from high-level (e.g., international news) and toward low-level messages (e.g., local news) as the day progresses.

I observed this effect in two studies. Initially, in study 1, I observe actual engagement on Twitter and document that individuals engage in messages on international matters in the morning, whereas they engage in messages on local matters in the evening. Then, in study 2, I replicate this effect for individual news titles using a more controlled setting in the behavioral lab with student participants.

This research aims to make several contributions. First, this work demonstrates a new predictor of construal level. While prior research suggests a diverse set of predictors for construal level, to best of my knowledge this is the first work demonstrating time-of-day effects on construal level. Second, adding to the stream of research that examines time-of-day effects on consumer behavior (Gullo et al. 2019; Kanuri, Chen, and Sridhar 2018), this research shows that construal levels change from morning to evening. This work also has strong implications for digital marketers because the timing of the posts is

crucial on social media (Kanuri et al. 2018). In line with the effects observed in this essay, the social media managers may want to post messages that are congruent with high-level construal in the morning but to post messages that are congruent with low-level construal in the evening. I elaborate further on the implications for both theory and practice in the General Discussion.

2.3 CONSTRUAL LEVEL THEORY: HIGH-LEVEL AND LOW-LEVEL THINKING

Construal level theory has been one of the most influential theories in social psychology with a broad impact on consumer behavior research. Construal level reflects the way that individuals form mental representations for activities in abstract or concrete terms. As mental representations move from abstract to concrete, construal level descends from high to low levels (Freitas, Gollwitzer, and Trope 2004). High-level (i.e., abstract) construal reflects context-free, generalized and primary features of activities; on the other hand, low-level (i.e., concrete) construal reflects context-specific, detailed and secondary features of activities (Trope and Liberman 2003). For instance, the activity of “playing ball” may simply seem as "having fun" in a high-level construal but it may include details such as the color of the ball in a low-level construal (Trope, Liberman, and Wakslak 2007). As is evident from this example, when individuals rely more on high-level mindsets, they focus on the “why” aspect, explaining the purpose of the action; however, when they rely more on low-level mindsets, they focus on the “how” aspect, explaining the process of the action (Vallacher and Wegner 1989).

One of the main premises of construal level theory is that high-level and low-level mental representations are associated with psychological distance, such that individuals use a high-level mindset to represent psychologically distant events but use a low-level mindset to represent psychologically close events (Trope et al. 2007). Psychological distance relates to how individuals subjectively experience whether something is near or distant to themselves along four dimensions: time, space, social perspective, or hypothetically (Liberman and Trope 2014; Trope and Liberman 2010, Trope et al. 2007). Events feel psychologically closer in time for *tomorrow* rather than *next year* (Liberman and Trope 1998), in space for the *current location* rather than *an abroad location* (Fujita et al. 2006), in social perspective for *similar other* rather than *dissimilar other* (Liviatan, Trope, and Liberman 2008), and in hypothetical sense for *highly probable* rather than *improbable* events (Todorov, Goren, and Trope 2007).

Research on construal level theory demonstrates that as individuals' mindset turns from low-level to high-level, their perception of psychological distance increases in all four dimensions (Liberman and Förster 2009). Moreover, the reverse is also true because there is a bidirectional relationship between construal levels and psychological distance (Liberman, Trope, and Stephan 2007). Accordingly, when individuals feel psychologically distant rather than close, they adopt more high-level rather than low-level mindsets. This effect has been demonstrated for psychological distance in time (Liberman and Trope 1998), space (Fujita et al. 2006), social sense (Liviatan et al. 2008), and hypothetical sense (Wakslak et al. 2006). Thus, confirming the core premise of construal level theory, extensive research shows that high-level and low-level mindsets influence psychological distance, and are influenced by it.

In addition to the role of psychological distance, prior research examines the role of several factors in the adoption of abstract and concrete mindsets. In terms of individual-level differences, certain characteristics may lead to adopting high-level rather than low-level mindsets. For instance, Wan and Rucker (2013) show that high confidence prompts a high-level mindset whereas low confidence prompts a low-level mindset. Focusing on individuals' self-view, Spassova and Lee (2013) demonstrate that an independent self-view connects to an abstract (i.e., high-level) portrayal of future events as if these events are happening in the more distant future, but an interdependent self-view connects to a concrete (i.e., low-level) portrayal of future events as if these events are happening in the more near future. Similarly, research building on regulatory focus shows that people with promotion focus construe information in a high-level whereas those with a prevention focus construe information in a low-level (Lee et al. 2010).

Moreover, several situational factors may influence construal levels. Pertaining to visual perceptions, for example, black and white images urge a high-level mindset, but colored images urge a low-level mindset (Lee et al. 2014). Whereas thinking about the concept of time triggers a high-level mindset, the concept of money triggers a low-level mindset (MacDonnell and White 2015).

As should be evident from the above, prior research suggests several drivers of construal level and sheds light on the reasons that people think in more high-level or low-level construal. But we do not yet know whether the level of construal follows a pattern throughout a day, which may make people engage differently with different types of content at different points in time.

2.4 TIME-OF-DAY EFFECTS ON CONSTRUAL LEVELS: THE ROLE OF SELF-CONTROL

Drawing from self-control research, I propose that time of day will influence engagement with content at different construal levels. As explained in detail in essay 1, self-control failure occurs when individuals exert effort to maintain self-control as this initial effort impairs future efforts of control in the subsequent tasks (Muraven and Baumeister 2000). Following this stream of research, Vohs and Schmeichel (2003) demonstrated that individuals having reduced self-control focus more on the present moment, which leads them to narrow down their attention in the immediate feelings and thoughts by losing attention to the future. In other words, when self-control is reduced, individuals' level of focus moves away from high-level thinking (i.e., attention to future which is temporally distant) to low-level thinking (i.e., attention to present which is temporally close). Supporting this argument, Wan and Agrawal (2011) show that self-control failure leads to a low-level construal by increasing the individuals' attention to lack of self-control. Relatedly, individuals having reduced self-control narrow down their attention to low-level construal, such that using fewer categories while grouping objects and using a more concrete language (Bruyneel 2006; Bruyneel and Dewitte 2012). Building on these findings, I suggest that construal levels should follow a certain pattern throughout the day, depending on the self-control failure. This is because, even though previous work manipulates the feeling of self-control through various tasks, self-control failure may also occur naturally during the day.

As mentioned in essay 1, individuals start the day with replenished self-control in the morning, but self-control is prone to fail as the day progresses (Baumeister 2002). Previous research show that self-control failure leads to more automatic and impulsive responses later in the day. For instance, Danziger, Levav, and Avnaim-Pesso (2011) show that judges make more default decisions of denying parole later in the day. Similarly, health professionals disregard rules of washing hands more often later in their work shift (Dai et al. 2015). Overall, people become more likely to cheat or lie as the day progresses (Kouchaki and Smith 2014). Thus, evidence from earlier research confirms that self-control failure happens naturally during the day.

As individuals feel increasingly lower self-control as the day progresses, they should adopt a level of construal that matches with that feeling reduced self-control (Wan and Agrawal 2011). Specifically, individuals' mindset should move away from a high-level construal in the morning hours to a low-level construal in the evening hours. Moreover, it is known that individuals process messages more efficiently and favorably when the message corresponds to their mental representational state (Kim et al. 2009; Schwarz and Clore 1983). That is, congruent with their mindsets, individuals' engagement with messages should shift away from high-level messages to low-level messages as the day progresses. This is what I observe in two studies. Next, I will elaborate further on my prediction and the studies that I conducted.

2.5 OVERVIEW OF PREDICTIONS AND STUDIES

I predict a switch in engagement from a high-level to a low-level content as morning turns to evening. Specifically, in early hours of a day, messages that are high-level in terms of geographical distance (e.g., international news) should be more engaging; in contrast, in late hours of a day, messages that are low-level in terms of geographical distance (e.g., local news) should be more engaging. I observe these effects in two studies. In study 1, actual engagement on Twitter, which I measure through “likes,” is higher for international news in the morning, whereas it is higher for local news in the evening. In study 2, I replicate this effect in a lab setting in which student participants see news titles and report their likelihood of reading them.

2.6 STUDY 1

The purpose of study 1 is to test whether engagement shifts from high-level to low-level messages as the day progresses. To investigate this, I focus on actual engagement behavior on Twitter. Specifically, I investigate engagement with international news (i.e., high-level geographical distance) and local news (i.e., low-level geographical distance) that is highlighted on the Twitter account of a newspaper. I measure engagement relying on the number of “likes.”

2.6.1 Data Description

I collected 871,060 observations from the Twitter account of *The Times of India* newspaper between April 24, 2018, and April 24, 2019 by using Twitter’s Application

Programming Interface (API). I used Twitter's Streaming API to record real-time updates from this newspaper; thereby, I repeated the data collection every 30 minutes to record the most recently posted tweets and consumer engagement for each tweet. Having this dynamic streaming data enabled me to examine changes in consumer engagement over time in a day. Additionally, I collected information about each tweet, such as content of the tweets, the number of likes, release time and date of tweets, hashtags in the text of tweets, media included in tweets.

I observed the number of likes for each original tweet; therefore, I disregarded retweets (i.e., tweets originating from another Twitter account). In the final data, there were 80,915 unique tweets. I measured time of day from the local time at which the tweet is posted. Similar to studies 6 and 7 in essay 1, I examined the number of likes compiled during an hour after the tweet is posted. Importantly, I converted Coordinated Universal Time (UTC), which is standard time documentation for Twitter API, to Indian Standard Time (IST) by doing this I was able to observe the engagement in local time.

I examined international and local news based on the Uniform Resource Locator (URL) tags (i.e., web addresses) that are attached to the text of tweets. As a tweet can be limited with 280 characters, which is doubled in 2017 (Rosen and Ihara 2017), most of the news and media companies (e.g., newspapers and magazines) use URLs to connect their tweets to the news articles on their websites. Then, a viewer can click on the URL and read the related news article from the website of the media company. Additionally, because of the limitation of characters, Twitter automatically shortens URLs in a tweet. Thus, URLs consist of a random combination of letters and numbers.

In the specific case of *The Times of India* newspaper, the short URLs are converted into hierarchical URLs on the website of the newspaper. These hierarchical URLs appear as a meaningful path with news categories. For instance, the newspaper categorizes international news under the “*World*” category. It categorizes local news under the categories of “India” and “City,” with the latter sub-category including specific cities such as Delhi, Mumbai, and Hyderabad. To identify these categories, I employed Python coding to collect the hierarchical URLs using the short URL information within the text of the tweets. Following this methodology, I categorized 53,780 (66.5%) of all tweets. From these categorized tweets, international news included 5,118 tweets (10%), and local news included 29,209 tweets (54%). The rest of the tweets were categorized into other news types, such as business, technology, sports, etc.

2.6.2 Method

In this study, I observed whether the number of likes changed differently for international versus local news throughout the day. Considering that the dependent variable (i.e., number of likes) is a count variable that is zero or a strictly positive integer, Poisson or negative binomial regressions would be more appropriate to use rather than OLS regression (Coxe, West, and Aiken 2009). Violating an assumption of Poisson regression, the data demonstrated overdispersion, as the variance of likes (747.83) was much greater than the mean of likes (28.81, see table 6 for summary statistics). Therefore, I used a negative binomial regression.

In the model, I used news type (international = -1, local = 1), time of day (6 am = 0, 5 am = 23), and their interaction as the main predictors. I controlled for various factors that may have an impact on consumers' liking of tweets. For instance, I controlled for the level of tweet posting in the recent past by using the one-hour-lagged number of tweets. I also included a variable for the minutes elapsed (i.e., duration) between two tweets in sequential order to acknowledge the tweet posting frequency. Considering the newspaper can post the same content on different days, I added control for the number of repeated tweets. Furthermore, acknowledging the differences in messages, I examined if the following attachments are included in a tweet: a media file (e.g., a photograph or video), hashtag related to the content, and a reply for other accounts.

2.6.3 Results and Discussion

The results demonstrated that the influence of time of day on engagement was not significant ($b = .001$, $SE = .001$, $z = 1.2$, 95% CI $(-.001, .003)$, $p = .2$), but engagement was significantly higher for local than for international news ($b = .11$, $SE = .01$, $z = 9.57$, 95% CI $(.09, .14)$, $p < .001$). Importantly, the results uncovered a significant two-way interaction of time of day and news type ($b = .003$, $SE = .001$, $z = 2.78$, 95% CI $(.001, .005)$, $p < .01$). These results confirmed that the relative engagement with local (vs. international) news increased as the day progressed. The relative change was in line with the theory. Specifically, for local news, a positive slope for time of day indicated that liking behavior increased over the course of the day ($b = .12$, $SE = .02$, $z = 5.51$, 95% CI $(.08, .16)$, $p < .001$; figure 8). But, for international news, a negative slope for time of day

was not significant ($b = -.04$, $SE = .04$, $z = -.84$, 95% CI $(-.12, .05)$, $p = .4$). These results were robust to changes in the control variables (see table 7 for details).

2.7 STUDY 2

Study 1 focused on the engagement on Twitter across international and local tweets of a newspaper during the day. In the current study, I replicated the findings of study 1 in a more controlled environment with undergraduate students in a behavioral lab. I concentrate on four international news titles and four local news titles across multiple sources (see appendix J for titles and sources). Participants randomly read the news titles of either international or local news titles. Then, they indicated their likelihood of reading news titles at different times in a day. I predicted a shift in reading likelihood from international to local news as morning turns to evening.

2.7.1 Pretest

I conducted a pretest to confirm that the news titles are different in terms of their international-local perceptions. In this pretest, 181 undergraduate students ($M_{\text{age}} = 20.3$, 33.7% female) participated in the study to earn partial course credit. They read news titles in a random order and rated each title as international or local news (international = 0, local = 100). Confirming the manipulation, participants rated the international (vs. local) titles as more international (vs. local) on the 100-point scale ($M_{\text{International}} = 23.25$, $SD = 19.77$, $M_{\text{Local}} = 71.51$, $SD = 19.41$; $t(180) = 20.72$, $p < .001$).

2.7.2 Method

A total of 224 undergraduate students ($M_{\text{age}} = 21.6$, 53.1% female) participated in this study to earn partial course credit (twenty-six responses were excluded because participants incorrectly answered attention-filter questions). Participants were randomly assigned to either the international or the local condition. They responded to the survey between 10 am and 6 pm in the behavioral lab, and I noted the time at which the participants answered the survey. I manipulated the content type between subjects and randomly assigned participants to either the international or local news condition. Accordingly, participants either read four international or four local news titles in randomized order. After each article title, I asked participants about their likelihood of reading the news titles (“How likely is it that you may read the article?” 1 = Very Unlikely, 7 = Very Likely). For both international and local conditions, participants rated each news title separately and I computed an average rating to analyze them.

2.7.3 Results and Discussion

The purpose of this study was to test whether reading likelihood changed differently for international versus local news titles throughout the day. Accordingly, using the dependent variable of reading likelihood, I investigated the two-way interaction between news type (international = -1, local = 1), and time of day spread across nine

hours of data collection (10 am = 0, 6 pm = 8) using the PROCESS SPSS macro (Model 1; Hayes 2013).

The results were not significant for the influence of time of day on reading likelihood ($b = -.01$, $SE = .04$, $z = -.40$, 95% CI $(-.08, .06)$, $p = .7$), but reading likelihood was significantly higher for international than for local news titles ($b = -.76$, $SE = .15$, $z = -5.04$, 95% CI $(-1.05, -.46)$, $p < .001$). Importantly, the results revealed a significant two-way interaction between time of day and news type ($b = .10$, $SE = .04$, $z = 2.94$, 95% CI $(.03, .17)$, $p < .01$, $R^2 = .13$). Further analysis clarified the results. For the international news titles, the slope of time of day was negative, indicating that the reading likelihood was decreasing for the international news titles as the day progressed ($b = -.12$, $SE = .05$, $z = -2.33$, 95% CI $(-.22, -.02)$, $p = .02$; see figure 9). In contrast, for the local news titles, the slope of time of day was positive, indicating that the reading likelihood was increasing for the local news titles as the day progressed ($b = .09$, $SE = .05$, $z = 1.82$, 95% CI $(-.01, .19)$, $p = .07$). In other words, the reading likelihood shifted away from international and towards local news titles as morning turned to evening.

Furthermore, I applied the Johnson–Neyman floodlight analysis technique (Johnson and Neyman 1936; Spiller et al. 2013) to specify significant regions of the effect of news type across different levels of time of day. I found a significant effect of news type on reading likelihood for the values of time of day at and below 5.34 which, given a 9-point measure, corresponds to a time of 3:20 pm ($b = -.20$, $SE = .10$, $z = -1.97$, 95% CI $(-.40, .00)$, $p = .05$). Accordingly, there was a shift after 3:20 pm, such that there was no longer any difference in the reading likelihood between international and local news titles.

2.8 GENERAL DISCUSSION

Earlier research has examined the role of construal level on engagement with messages and eventual persuasion, but, to my knowledge, no prior research has explored the interplay between time of day and construal level on message engagement. This research shows a novel effect of time of day on construal level and a novel implication of this effect on the message engagement. Two studies, including an empirical analysis of data from Twitter and an experiment, shows converging evidence that consumers engage more with in high-level messages (e.g., international news) in the morning but this engagement shifts downward toward low-level messages (e.g., local news) in the evening. In study 1, I measure actual engagement through likes from the Twitter account of a newspaper and show engagement shift toward local news in the evening. In study 2, I replicate this effect with student participants in a lab setting by using individual tweets. Thereby, I document that the effect has implications for social media communications of companies. In the following section, I further discuss the implications of this research for theory and practice.

2.8.1 Theoretical and Practical Implications

Although consumer behavior research has been documented several drivers of construal level (Lee et al. 2010; Lee et al. 2014; MacDonnell and White 2015; Wan and Rucker 2013), to my knowledge, no research has considered the influence of time of day on construal levels. This novel effect of time of day adds as a situational factor on

construal levels. Additionally, previous research has established time of day influences consumer behavior in multiple domains, including variety seeking (Gullo et al. 2019), and content scheduling (Kanuri et al. 2018). Adding to this stream of research, I reveal the effect of time of day on engagement with messages in high-level and low-level construal in social media domain.

From the managerial perspective, it is known that capturing consumers' attention with the message is the main purpose of advertisers and marketers (Pieters and Wedel 2004). Considering the importance of posting time on social media (Kanuri et al. 2018), the proposed results of this research has strong implications for marketers. Accordingly, marketers may post content with different construal levels at different hours. While capturing attention and creating interaction, it is better to post messages congruent with high-level construal earlier in the day; contrarily, it is better to post messages congruent with low-level construal later in the day.

2.8.2 Conclusion

This research proposes a novel effect of time of day on construal level and shows this effect in the domain of social media engagement. Accordingly, when individuals start a day, they engage with messages with high-level geographical distance. By the end of the day, however, individuals' engagement moves towards messages with low-level geographical distance. It is undeniable that companies want to utilize their message content to encourage interaction on social media. Therefore, the results of this research

about the type of messages that may appeal at different times of the day offer strong implications for both theory and practice.

CONCLUSION

As consumers increasingly spend more time on social media and seek updates from companies, both practitioners and researchers are concerned with strategies to improve consumers' engagement with social media posts. Marketing research has largely focused on the role of content while examining consumers' social media engagement, but there is still limited work investigating the influence of time of day on social media engagement. In an attempt to address this gap, I investigate social media engagement depending on the time of day and its interplay with two distinct characteristics of content that have not previously been studied in social-media research: vice versus virtue content, and content that is construed at a low-level versus a high-level.

In the first essay, I focus on vice content, which promises immediate gratification (e.g., related to celebrities and scandals), and virtue content, which promises long-term knowledge benefits (e.g., related to health and economy). I find that as the day wears on, the engagement increases for vice content, but it decreases for virtue content. I consistently observe this vice-virtue asymmetry in seven studies, including five experiments and two studies using large-scale Twitter datasets. I further find support for the process of self-control failure, such that the vice-virtue asymmetry amplifies when day temperatures get higher. In the second essay, I focus on high-construal content, such as messages that relate to events happening far away (e.g., international news), versus low-construal content, such as messages that relate to events happening nearby (e.g., local news). In two studies, including a study using large-scale Twitter dataset and an

experiment, I find that as the day turns from morning to evening, there is a shift in engagement away from high-construal content and toward low-construal content.

Overall, this dissertation contributes to the literature on social media engagement. While prior work shows that social media engagement depends on the type of content, I document that this engagement also depends on the time of day and its interaction with the content type. This dissertation, therefore, addresses a gap in the literature of social media engagement by elucidating the influence of time of day and its interaction with two different aspects of social media content: (1) vice versus virtue content, and (2) high versus low construal content.

TABLES (ESSAY 1)

Table 1: Study 6A Summary Statistics

	Mean	SD	Min	Max
Number of likes	47.26	55.36	0	346
Time of day	9.90	5.55	0	23
Magazine type (1 = Vice)	0.21	0.98	-1	1
Weekend (1 = Weekend)	-0.63	0.78	-1	1
Lagged number of tweets (by one hour)	4.83	4.15	1	39
Duration (in minutes)	24.77	115.39	0	14981
Number of followers ¹	6.78	4.00	1.6	14.9
Repeated tweets	1.03	0.33	1	13
Photo (1 = yes)	0.29	0.45	0	1
URL (1 = yes)	0.97	0.17	0	1
Hashtag (1 = yes)	0.10	0.30	0	1
Mention (1 = yes)	0.12	0.32	0	1
Reply (1 = yes)	0.01	0.09	0	1
Day-of-month dummies	14.85	8.59	0	30
Month-of-year dummies	5.51	3.44	0	11

The number of observations is 176,390.

¹ Values are rescaled (i.e., divided by 1,000,000 to improve readability).

TABLES (ESSAY 1)

Table 2: Study 6A Results

Variable	Model 1		Model2	
	Coef.	Std. Err.	Coef.	Std. Err.
Time of day	0.001**	0.0004	0.002***	0.001
Magazine type (1 = Vice)	-0.06***	0.005	-0.03***	0.01
Time of day*Magazine type	0.01***	0.0004	0.01***	0.001
Lagged number of tweets (by one hour)	0.002***	0.001	0.01***	0.001
Duration (in minutes) ¹	-0.5***	0.1	-1.0***	0.1
Number of followers ¹	0.001***	0.00001	0.001***	0.00001
Repeated tweets	-0.10***	0.01	-0.10***	0.01
Photo (1 = yes)	-0.30***	0.005	-0.30***	0.01
URL (1 = yes)	-0.41***	0.01	-0.37***	0.01
Hashtag (1 = yes)	0.26***	0.01	0.18***	0.01
Mention (1 = yes)	-0.04***	0.01	-0.03***	0.01
Reply (1 = yes)	-0.67***	0.02	-0.62***	0.02
Weekend (1 = Weekend)			0.14***	0.01
Time of day*Weekend			0.003***	0.001
Magazine type*Weekend			0.03***	0.01
Time of day*Magazine type*Weekend			0.004***	0.001
Day-of-month dummies	YES		YES	
Month-of-year dummies	YES		YES	
Intercept	3.88***	0.02	3.88***	0.02
Chi ²	27,917***		32,590***	
N	176,390		176,390	

* p < .1, ** p < .05, *** p < .01.

¹ The coefficients and standard errors are rescaled (i.e., multiplied by 1000 to improve readability).

TABLES (ESSAY 1)

Table 3: Study 6B Results

Variable	Coef.	Std. Err.
Time of day	-0.33***	0.02
Magazine type (1 = Vice)	-15.43***	0.22
Time of day*Magazine type	0.22***	0.02
Lagged number of tweets (by one hour)	0.02***	0.01
Lagged number of likes (by one hour)	0.01***	0.00
Intercept	20.50***	0.25
Adj. R ²	0.10	
N	139,151	

* p < .1, ** p < .05, *** p < .01.

TABLES (ESSAY 1)

Table 4: Study 7 Summary Statistics

	Mean	SD	Min	Max
Number of likes	25.37	21.33	0	825
Time of day	9.54	5.10	0	23
Content type (1 = Vice)	-0.51	0.86	-1	1
Temperature	89.88	3.47	83	98.7
Lagged number of tweets (by one hour)	12.64	6.10	1	32
Duration (in minutes)	7.72	16.82	0	1197
Number of followers ¹	11.3	0.06	11.2	11.4
Repeated tweets	1.01	0.10	1	5
Photo (1 = yes)	0.63	0.48	0	1
Hashtag (1 = yes)	0.13	0.33	0	1
Mention (1 = yes)	0.68	0.47	0	1
Reply (1 = yes)	0.01	0.08	0	1
Day-of-month dummies	14.90	8.83	0	30

The number of observations is 32,283.

¹ Values are rescaled (i.e., divided by 1,000,000 to improve readability).

TABLES (ESSAY 1)

Table 5: Study 7 Results

	Coef.	SE
Time of day	0.004***	0.001
Content type (1 = Vice)	-0.05***	0.01
Time of day*Content type	0.01***	0.001
Temperature (mean-centered)	0.02***	0.003
Time of day*Temperature	-0.0001	0.0003
Content type*Temperature	-0.001	0.003
Time of day*Content type*Temperature	0.001**	0.0003
Lagged number of tweets (by one hour)	-0.001***	0.0001
Duration (in minutes)	-0.003***	0.0002
Number of followers ¹	-.01***	.0001
Repeated tweets	-0.39***	0.04
Photo (1 = yes)	0.15***	0.01
Hashtag (1 = yes)	0.30***	0.01
Mention (1 = yes)	-0.21***	0.01
Reply (1 = yes)	-0.20***	0.04
Day-of-month dummies	YES	
Intercept	15.87***	0.69
Chi ²	3,692***	
N	32,283	

* $p < .1$, ** $p < .05$, *** $p < .01$.

¹ The coefficients and standard errors are rescaled (i.e., multiplied by 1000 to improve readability).

TABLES (ESSAY 2)

Table 6: Study 1 Summary Statistics

	Mean	SD	Min	Max
Number of likes	28.81	27.35	0	1401
Time of day	9.74	5.52	0	23
News type (1 = Local)	0.70	0.71	-1	1
Lagged number of tweets (by one hour)	12.27	6.21	1	52
Duration (in minutes)	8.60	17.80	0	1197
Repeated tweets	1.00	0.02	1	2
Photo (1 = yes)	0.77	0.42	0	1
Hashtag (1 = yes)	0.08	0.28	0	1
Reply (1 = yes)	0.01	0.11	0	1

The number of observations is 34,223.

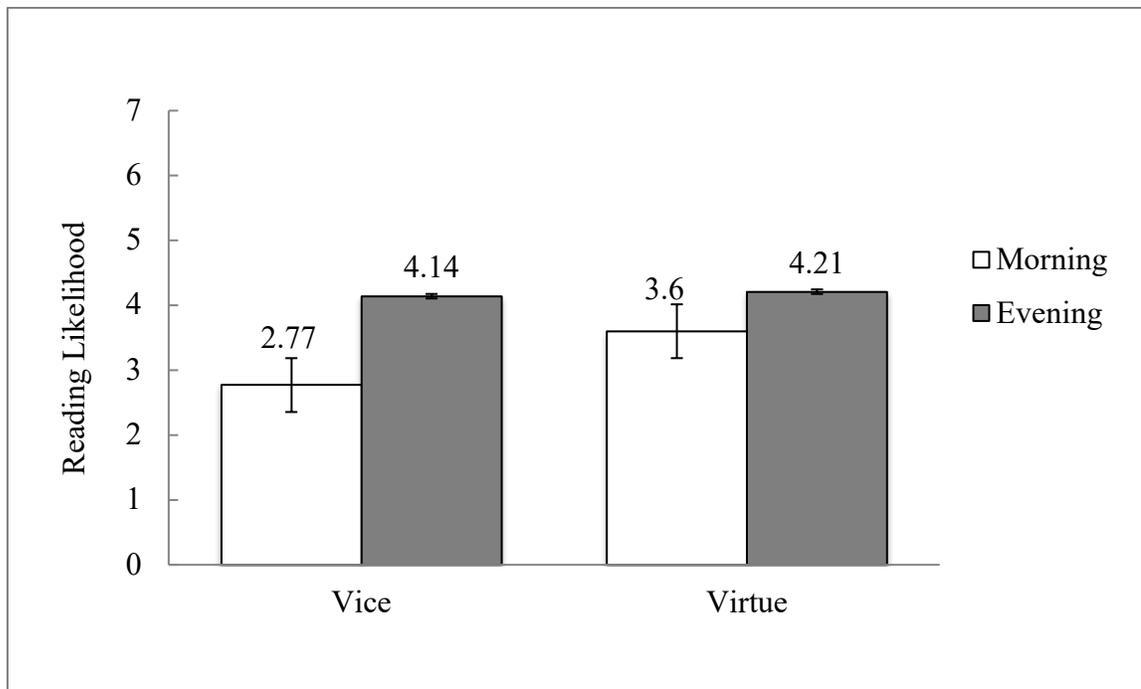
TABLES (ESSAY 1)

Table 7: Study 1 Results

Variable	Coef.	Std. Err.
Time of day	0.001	0.001
News type (1 = Local)	0.11***	0.012
Time of day*News type	0.003***	0.001
Lagged number of tweets (by one hour)	-0.01***	0.001
Duration (in minutes)	-0.002***	0.0002
Repeated tweets	-0.29*	0.153
Photo (1 = yes)	-0.13***	0.009
Hashtag (1 = yes)	0.40***	0.013
Reply (1 = yes)	-0.07**	0.032
Intercept	3.72***	0.154
Chi ²	2500.63***	
N	34,223	

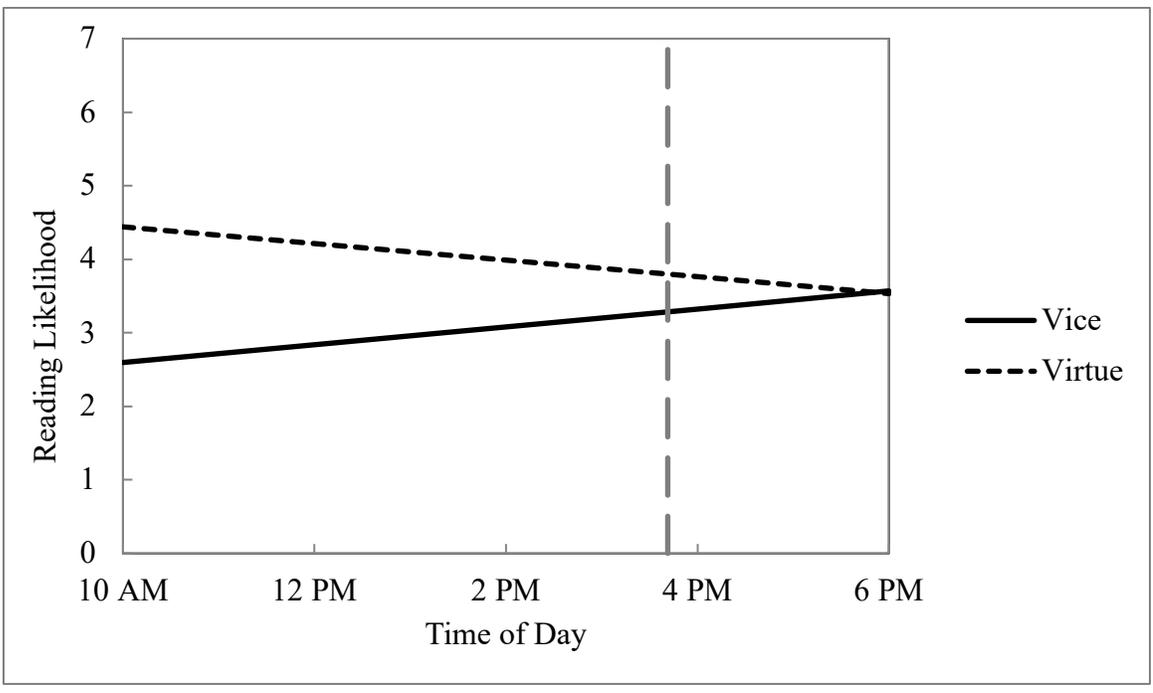
* p < .1, ** p < .05, *** p < .01.

FIGURES (ESSAY 1)

Figure 1: Reading Likelihood as a Function of Time of Day and Magazine Type in Study 1

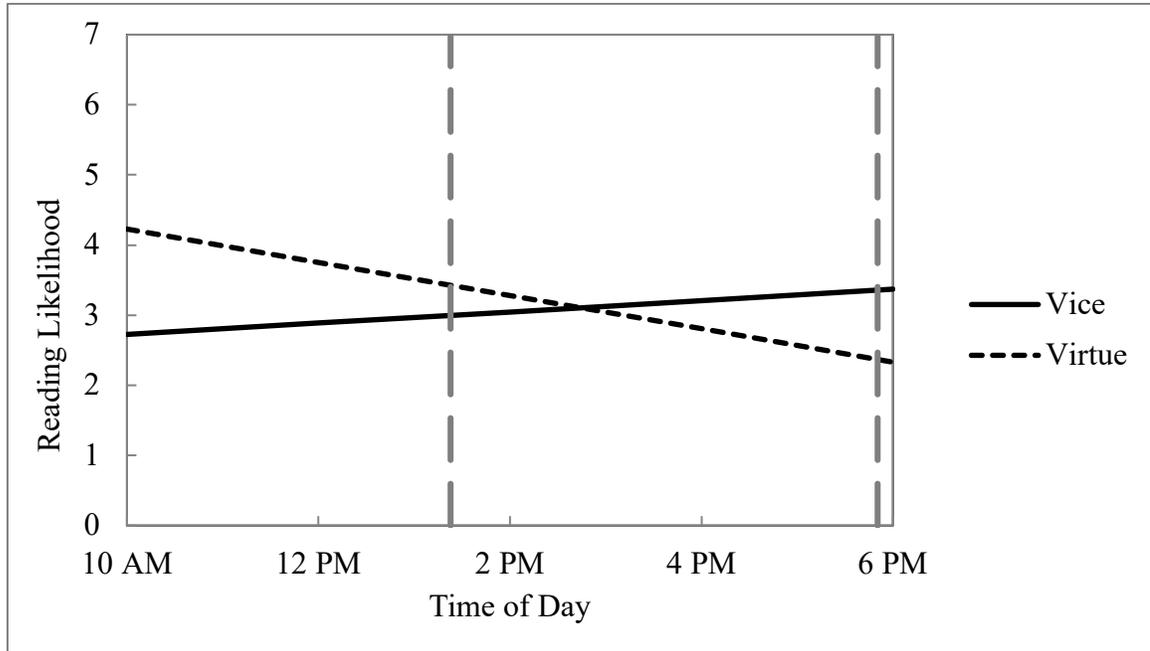
FIGURES (ESSAY 1)

Figure 2: Reading Likelihood of Vice and Virtue Magazines by Time of Day in Study 2



NOTE. —Grey long dashed line is fixed at Johnson-Neyman points (3:41 PM).

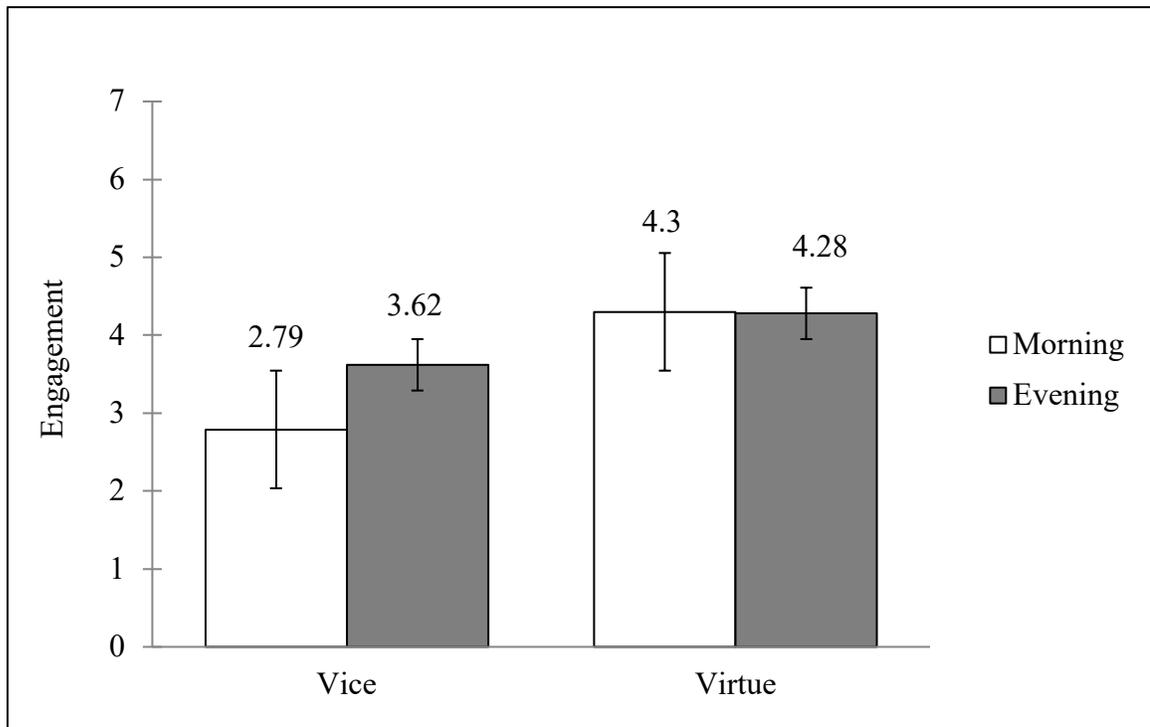
FIGURES (ESSAY 1)

Figure 3: Reading Likelihood of Vice and Virtue Websites by Time of Day in Study 3

NOTE. —Grey long dashed lines are fixed at Johnson-Neyman points (1:23 PM and 5:50 PM).

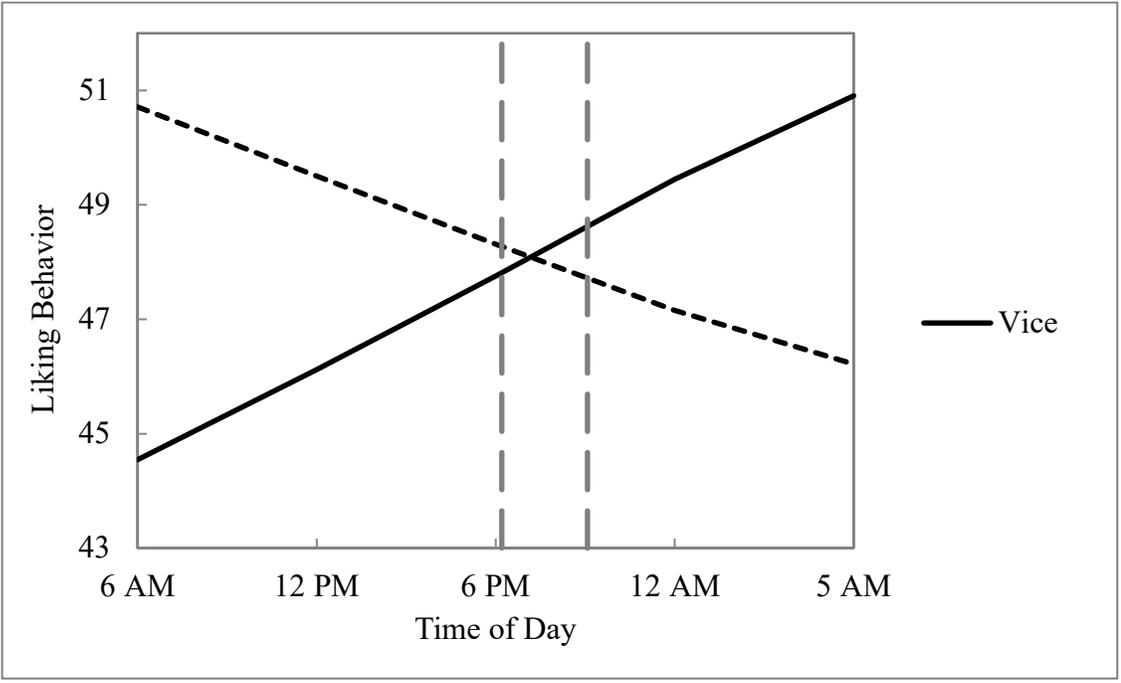
FIGURES (ESSAY 1)

Figure 4: Engagement for Vice and Virtue Tweets by Time of Day in Study 4



FIGURES (ESSAY 1)

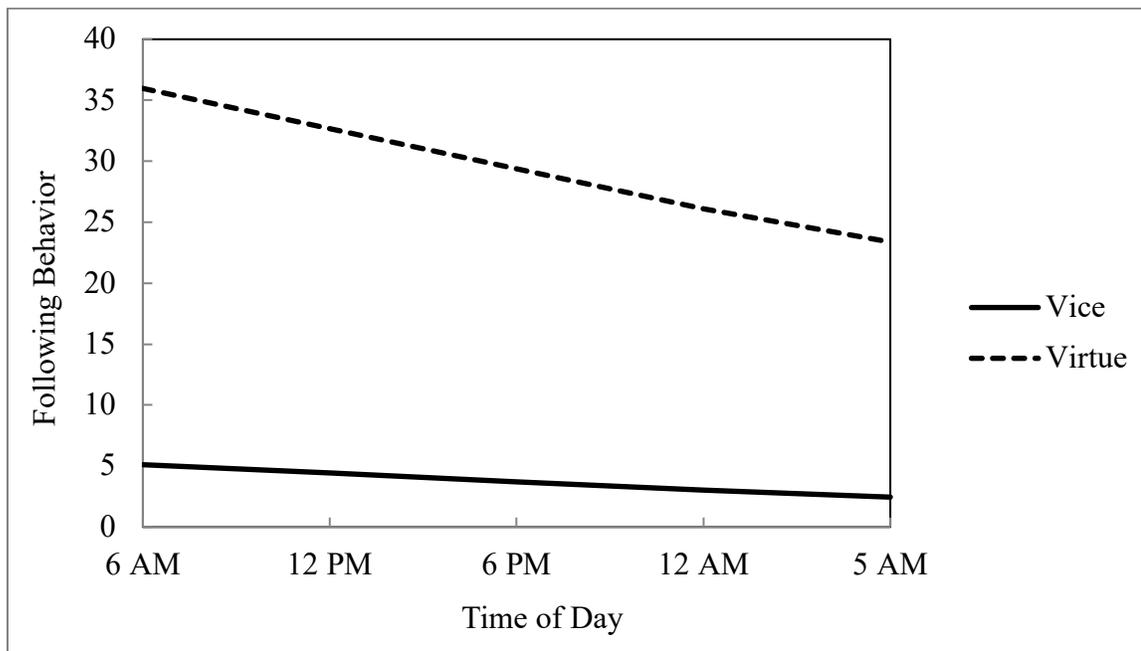
Figure 5: Liking Behavior for Vice and Virtue Magazines by Time of Day in Study 6A



NOTE. —Grey long dashed lines are fixed at Johnson-Neyman points (6:05 PM and 8:27 PM).

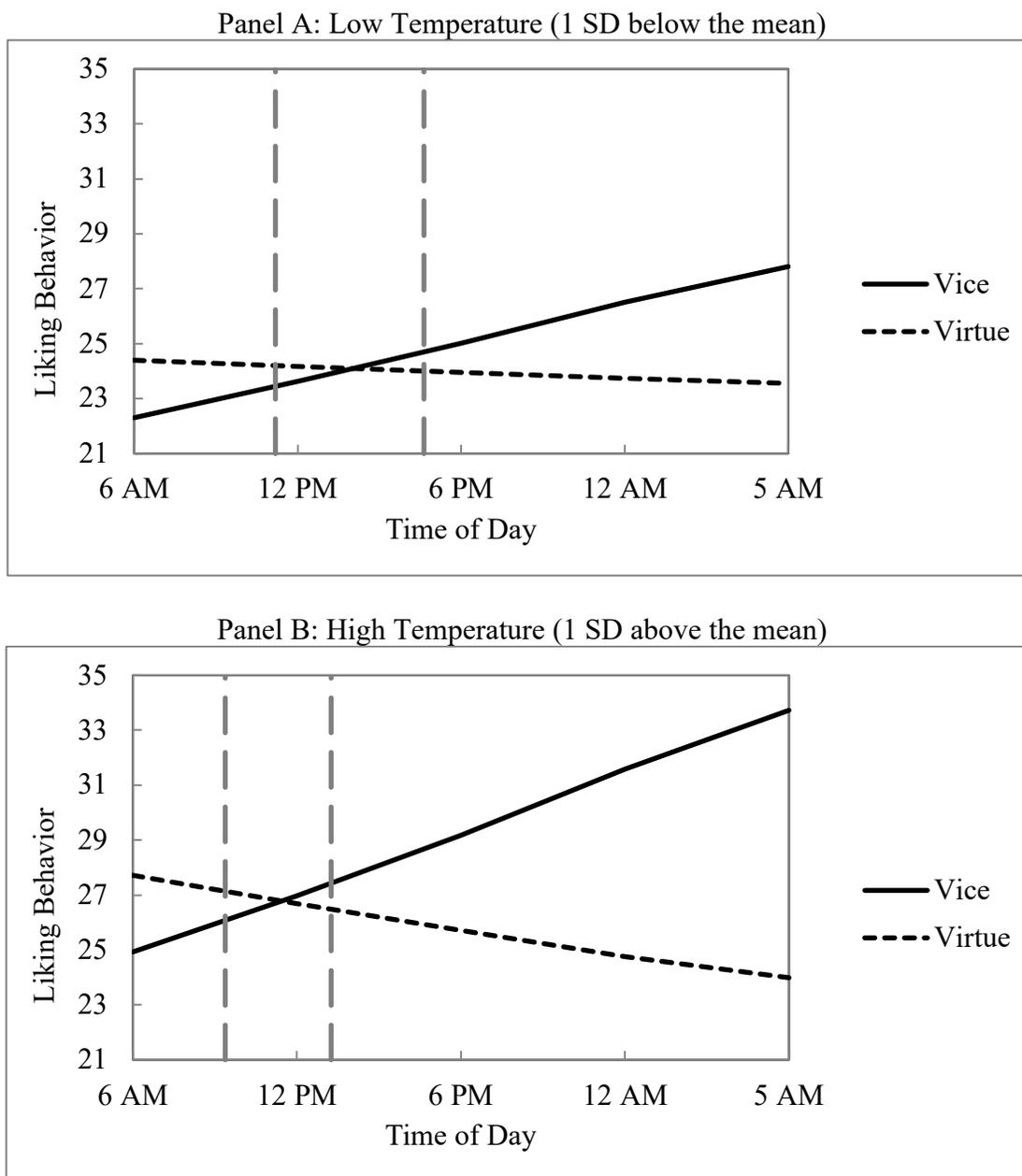
FIGURES (ESSAY 1)

Figure 6: Hourly Increase in Following Behavior for Vice and Virtue Magazines by Time of Day in Study 6B

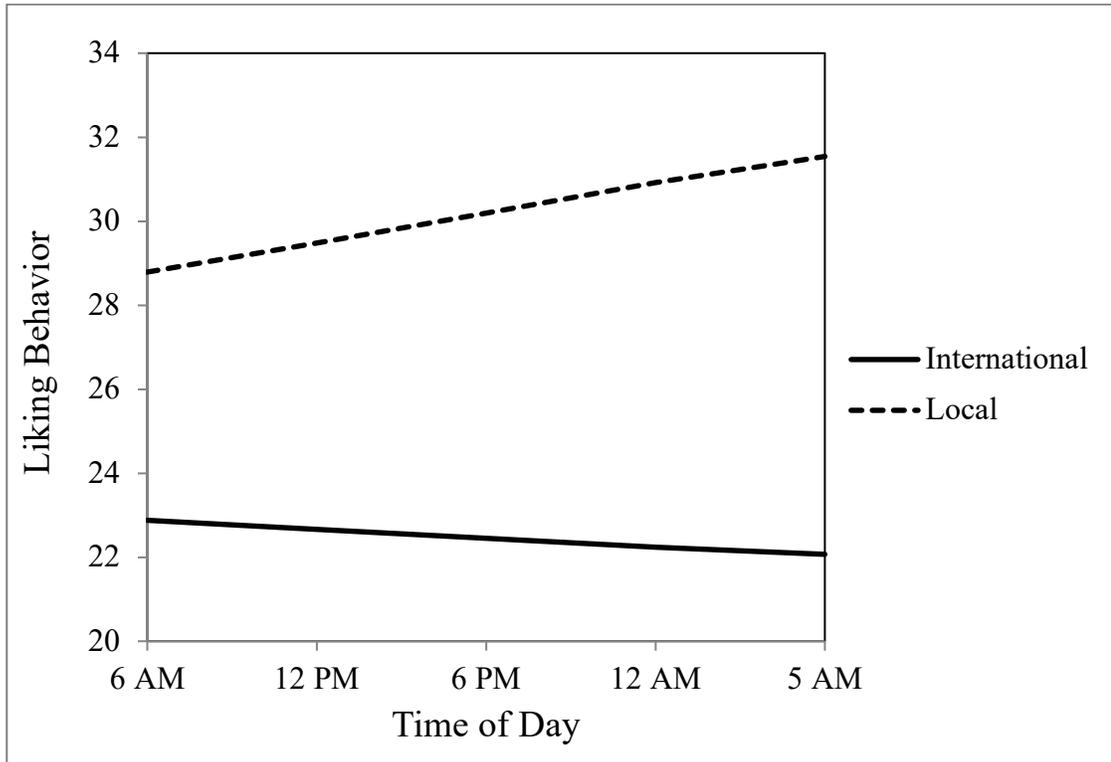


FIGURES (ESSAY 1)

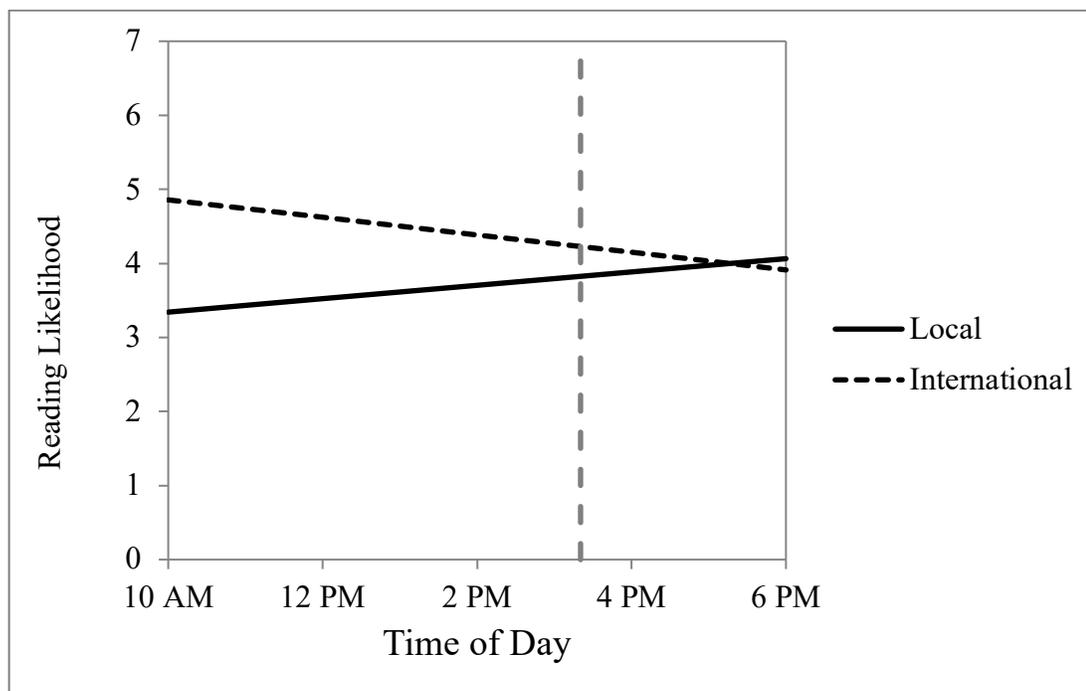
Figure 7: Liking Behavior for Vice and Virtue Content by Time of Day in Study 6 (in Low versus High Temperature Conditions)



NOTE. —Grey long dashed lines are fixed at Johnson-Neyman points (10:58 AM and 4:11 PM for panel A and 9:14 AM and 12:57 PM for panel B).

FIGURES (ESSAY 2)**Figure 8: Engagement for International and Local Content by Time of Day in Study 1**

FIGURES (ESSAY 2)

Figure 9: Reading Likelihood of International and Local News Titles by Time of Day in Study 2

NOTE. —Grey long dashed line is fixed at Johnson-Neyman points (3:20 PM).

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APPENDIX A (ESSAY 1)
Vice and Virtue Condition Scenario (Studies 1 and 2)

Vice condition scenario:

Consider the following type of magazines and answer the below questions accordingly.

List of Magazines:

- Cosmopolitan
- Entertainment Weekly
- People
- Vanity Fair

Virtue condition scenario:

Consider the following type of magazines and answer the below questions accordingly.

List of Magazines:

- Forbes
- Health
- The New Yorker
- The Atlantic

APPENDIX B (ESSAY 1)
Website Definitions (Study 3)

Vice condition:

Deadspin is a website that mostly publishes articles about sports.

Jezebel is a website that mostly publishes articles about celebrities and fashion.

The A.V. Club is a website that mostly publishes articles about films, music, and television.

Virtue condition:

Gizmodo is a website that mostly publishes articles about technology and science.

Jalopnik is a website that mostly publishes articles about cars and the automotive industry.

Splinter is a website that mostly publishes articles about politics.

APPENDIX D (ESSAY 1) CNN Tweets (Studies 4 and 5)

Vice condition:

 **CNN** ✓ @CNN · Oct 30
HBO has ordered a "Game of Thrones" prequel that tells the story of the House of Targaryen



'Game of Thrones' prequel coming to HBO
HBO is now home to "House of the Dragon."
[cnn.com](https://www.cnn.com)

7

 **CNN** ✓ @CNN · Oct 25
"Joker," the gritty comic book film about the origins of the crazed Batman villain, has become the highest-grossing R-rated film of all time



'Joker' becomes the highest-grossing R-rated film ever
"Joker," the gritty comic book film about the origins of the crazed Batman villain, has become the highest-grossing R-rated film of all ...
[cnn.com](https://www.cnn.com)

8

⁷ CNN [@CNN] (October 30, 2019), HBO has ordered a "Game of Thrones" prequel that tells the story of the House of Targaryen [Tweet; thumbnail link to article], Twitter.

<https://twitter.com/CNN/status/1189483191041699840>

⁸ CNN [@CNN] (October 25, 2019), "Joker," the gritty comic book film about the origins of the crazed Batman villain, has become the highest-grossing R-rated film of all time [Tweet; thumbnail link to article], Twitter. <https://twitter.com/CNN/status/1187828971108536321>



CNN @CNN · Oct 25

A bottle of whisky sold for \$1.9 million, exploding records — again. The Macallan Fine and Rare 60-Year-Old 1926 became the most expensive bottle of wine or spirit ever auctioned.



A bottle of whisky sold for \$1.9 million, smashing auction records
A bottle of Macallan Fine and Rare 60-Year-Old 1926 sets the record for the most expensive bottle of wine or spirit to be sold at auction, ...
[cnn.com](#)

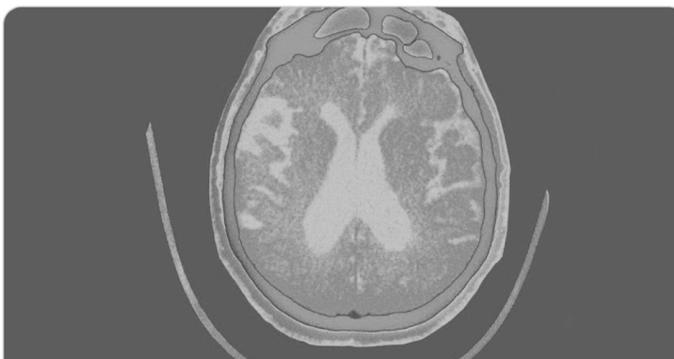
9

Virtue condition:



CNN @CNN · Oct 30

A new study finds personalized lifestyle interventions not only stopped cognitive decline in people at risk for Alzheimer's, but actually increased their memory and thinking skills within 18 months.



Lifestyle changes improved cognition in people at risk for Alzheimers,...
Following personalized lifestyle behaviors for 18 months improved memory and thinking skills in people who are at risk or showing early ...
[cnn.com](#)

10

⁹ CNN [@CNN] (October 25, 2019), A bottle of whisky sold for \$1.9 million, exploding records — again. The Macallan Fine and Rare 60-Year-Old 1926 became the most expensive bottle of wine or spirit ever auctioned [Tweet; thumbnail link to article], Twitter.

<https://twitter.com/CNN/status/1187936927820980226>

¹⁰ CNN [@CNN] (October 30, 2019), A new study finds personalized lifestyle interventions not only stopped cognitive decline in people at risk for Alzheimer's, but actually increased their memory and thinking skills within 18 months [Tweet; thumbnail link to article], Twitter.

<https://twitter.com/CNN/status/1189582781308907520>



CNN ✓ @CNN · Oct 26

People failing to wash their hands after going to the toilet, rather than undercooked meat or other food, is behind the spread of antibiotic-resistant E. coli, according to new research.



Washing your hands is the best way to stop the E. coli superbug

People failing to wash their hands after going to the toilet, rather than undercooked meat or other food, is behind the spread of antibiotic-resistant...

[cnn.com](https://www.cnn.com)

11



CNN ✓ @CNN · Oct 30

Plastic milk bottles are being recycled to make roads in South Africa, with the hope of helping the country tackle its waste problem and improve the quality of its roads.



Plastic bottles repaving South Africa's roads

Plastic milk bottles are being used to make roads in South Africa, potentially helping the country tackle its plastic waste problem.

[cnn.com](https://www.cnn.com)

12

¹¹ CNN [@CNN] (October 26, 2019), People failing to wash their hands after going to the toilet, rather than undercooked meat or other food, is behind the spread of antibiotic-resistant E. coli, according to new research [Tweet; thumbnail link to article], Twitter. <https://twitter.com/CNN/status/1188047696923414529>

¹² CNN [@CNN] (October 30, 2019), Plastic milk bottles are being recycled to make roads in South Africa, with the hope of helping the country tackle its waste problem and improve the quality of its roads [Tweet; thumbnail link to article], Twitter. <https://twitter.com/CNN/status/1189537462797910017>

APPENDIX E (ESSAY 1)
Composite Scale of Morningness¹³ (Study 4)

1. Considering only your own "feeling best" rhythm, at what time would you get up if you were entirely free to plan your day?

- 5:00 - 6:30 am (5)
- 6:30 - 7:45 am (4)
- 7:45 - 9:45 am (3)
- 9:45 - 11:00 am (2)
- 11:00 am - 12:00 (noon) (1)

2. Considering your only "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening?

- 8:00 - 9:00 pm (5)
- 9:00 - 10:15 pm (4)
- 10:15 pm - 12:30 am (3)
- 12:30 - 1:45 am (2)
- 1:45 - 3:00 am (1)

3. Assuming normal circumstance, how easy do you find getting up in the morning?

- Not at all easy (1)
- Slightly easy (2)
- Fairly easy (3)
- Very easy (4)

¹³ Scoring is provided in parentheses next to each option.

4. How alert do you feel during the first half hour after having awakened in the morning?

- Not at all alert (1)
- Slightly alert (2)
- Fairly alert (3)
- Very alert (4)

5. During the first half hour after having awakened in the morning, how tired do you feel?

- Very tired (1)
- Fairly tired (2)
- Fairly refreshed (3)
- Very refreshed (4)

6. You have decided to engage in some physical exercise. A friend suggests that you do this one hour twice a week and the best time for him is 7:00-8:00 a.m. Bearing in mind nothing else but your own "feeling best" rhythm, how do you think you would perform?

- Would be in good form (4)
- Would be in reasonable form (3)
- Would find it difficult (2)
- Would find it very difficult (1)

7. At what time in the evening do you feel tired and, as a result, in need of sleep?

- 8:00 - 9:00 pm (5)
- 9:00 - 10:15 pm (4)
- 10:15 pm - 12:30 am (3)
- 12:30 - 1:45 am (2)

- 1:45 - 3:00 am (1)
8. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for two hours. You are entirely free to plan your day, and considering only your own "feeling best" rhythm, which ONE of the four testing times would you choose?
- 8:00 - 10:00 am (4)
- 11:00 am - 1:00 pm (3)
- 3:00 - 5:00 pm (2)
- 7:00 - 9:00 pm (1)
9. One hears about "morning" and "evening" types of people. Which ONE of these types do you consider yourself to be?
- Definitely a morning type (4)
- More a morning than an evening type (3)
- More an evening than a morning type (2)
- Definitely an evening type (1)
10. When would you prefer to rise (provided you have a full day's work--8 hours) if you were totally free to arrange your time?
- Before 6:30 am (4)
- 6:30 - 7:30 am (3)
- 7:30 - 8:30 am (2)
- 8:30 am or later (1)
11. If you always had to rise at 6:00 am, what do you think it would be like?
- Very difficult and unpleasant (1)
- Rather difficult and unpleasant (2)

A little unpleasant but no great problem (3)

Easy and not unpleasant (4)

12. How long a time does it usually take before you "recover your senses" in the morning after rising from a night's sleep?

0 - 10 minutes (4)

11 - 20 minutes (3)

21 - 40 minutes (2)

More than 40 minutes (1)

13. Please indicate to what extent you are a morning or evening active individual.

Pronounced morning active (morning alert and evening tired) (4)

To some extent, morning active (3)

To some extent, evening active (2)

Pronounced evening active (morning tired and evening active) (1)

APPENDIX F (ESSAY 1)
Need for Cognition Scale¹⁴ (Study 4)

1. I would prefer complex to simple problems.
2. I like to have the responsibility of handling a situation that requires a lot of thinking.
3. Thinking is not my idea of fun.
4. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.
5. I try to anticipate and avoid situations where there is likely chance I will have to think in depth about something.
6. I find satisfaction in deliberating hard and for long hours.
7. I only think as hard as I have to.
8. I prefer to think about small, daily projects to long term ones.
9. I like tasks that require little thought once I've learned them.
10. The idea of relying on thought to make my way to the top appeals to me.
11. I really enjoy a task that involves coming up with new solutions to problems.
12. Learning new ways to think doesn't excite me very much.
13. I prefer my life to be filled with puzzles that I must solve.
14. The notion of thinking abstractly is appealing to me.
15. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.
16. I feel relief rather than satisfaction after completing a task that required a lot of mental effort.
17. It's enough for me that something gets the job done; I don't care how or why it works.
18. I usually end up deliberating about issues even when they do not affect me personally.

¹⁴ Participants indicated their answers on the 7-point scale (1 = Rarely would describe me; 5 = Usually would describe me).

APPENDIX G (ESSAY 1)
State Self-Control Capacity Scale (Study 5)

1. I feel mentally exhausted.
2. Right now, it would take a lot of effort for me concentrate on something.
3. I need something pleasant to make me feel better.
4. I feel motivated. (R)¹⁵
5. If I were given a difficult task right now, I would give up easily.
6. I feel drained.
7. I have lots of energy. (R)
8. I feel worn out.
9. If I were tempted by something right now, it would be difficult to resist.
10. I would want to quit any difficult task I was given.
11. I feel calm and rational. (R)
12. I can't absorb any information.
13. I feel lazy.
14. Right now I would find it difficult to plan ahead.
15. I feel sharp and focused. (R)
16. I want to give up.
17. This would be a good time for me to make an important decision. (R)
18. I feel like my willpower is gone.
19. My mind feels unfocused right now.
20. I feel ready to concentrate. (R)
21. My mental energy is running low.
22. A new challenge would appeal to me right now. (R)
23. I wish I could just relax for a while.
24. I am having a hard time controlling my urges.
25. I feel discouraged.

¹⁵ (R) represents reverse items.

APPENDIX H (ESSAY 1)
CNN Tweets (Study 5 in addition to tweets used in Study 4)

Vice condition:

CNN @CNN · Oct 24
 He's 24 years old. He parties with Rihanna and Bella Hadid. He watches basketball games with Yao Ming.

And on Tuesday, he became a billionaire.



This 24-year-old man just became a billionaire
 A 24-year-old business school graduate has just become an overnight billionaire.
cnn.com

16

Virtue condition:

CNN @CNN · Oct 26
 It's a bird emergency. And we can all be the first responders | David Yarnold for @cnnopinion



The majority of birds in North America face threat of extinction. Here'...
 It's a bird emergency. And we can all be the first responders.
cnn.com

17

¹⁶ CNN [@CNN] (October 24, 2019), He's 24 years old. He parties with Rihanna and Bella Hadid. He watches basketball games with Yao Ming. And on Tuesday, he became a billionaire [Tweet; thumbnail link to article], Twitter. <https://twitter.com/CNN/status/1187358100501729281>

¹⁷ CNN [@CNN] (October 26, 2019), It's a bird emergency. And we can all be the first responders | David Yarnold for @cnnopinion [Tweet; thumbnail link to article], Twitter. <https://twitter.com/CNN/status/1188143762670796800>

APPENDIX J (ESSAY 2) News Titles (Study 2)

International News Titles

- Here's What We Know About the Fires in the Amazon Rainforest (from CNN¹⁸)
- Hundreds Dead, a Million Displaced as Monsoon Rains Inundate India (from Gizmodo¹⁹)
- Is Brazilian Leather Out of Fashion? H&M Stops Buying Over Amazon Fires (from the New York Times²⁰)
- Gran Canaria Fire, Spain's Worst This Year, Forces Evacuation of 9,000 (from the New York Times²¹)

Local News Titles

- Shark!: Cape Cod Recoils in a Summer of Great White Sightings, Real and Imagined (from the New York Times²²)
- N.Y.C. Is on Pace to Draw a Record 67 Million Tourists This Year (from the New York Times²³)
- New York City Officials Unveiled Their Latest Plan to Control the City's Rat Problem (from the New York Times²⁴)
- California's Latest Wildfire Problem: Insuring the Tree Trimmers (from the New York Times²⁵)

¹⁸ Scutti, Susan (2019, August 24), Here's What We Know About the Fires in the Amazon Rainforest, CNN. https://www.cnn.com/2019/08/23/americas/amazon-wildfires-411/index.html?utm_medium=social&utm_term

¹⁹ Funes, Yessenia (2019, August 15), Hundreds Dead, a Million Displaced as Monsoon Rains Inundate India. https://earther.gizmodo.com/hundreds-dead-a-million-displaced-as-monsoon-rains-inu-1837277037?utm_campaign=socialflow_gizmodo_twitter&utm_medium=socialflow&utm_source=gizmodo_twitter&/setsession

²⁰ Andreoni, Manuela, and Sapna Maheshwari (2019, September 5), Is Brazilian Leather Out of Fashion? H&M Stops Buying Over Amazon Fires. <https://www.nytimes.com/2019/09/05/world/americas/h-m-leather-brazil-amazon-fires.html?smtyp=cur&smid=tw-nytimes>

²¹ Minder, Raphael (2019, August 20), Gran Canaria Fire, Spain's Worst This Year, Forces Evacuation of 9,000. <https://www.nytimes.com/2019/08/20/world/europe/gran-canaria-fire-spain.html?smid=tw-nytimes&smtyp=cur>

²² Taylor, Gate (2019, August 20), Shark!: Cape Cod Recoils in a Summer of Great White Sightings, Real and Imagined. <https://www.nytimes.com/2019/08/20/us/sharks-cape-codpanic.html?smtyp=cur&smid=tw-nytimes>

²³ McGeehan, Patrick (2019, August 19), N.Y.C. Is on Pace to Draw a Record 67 Million Tourists This Year. <https://www.nytimes.com/2019/08/19/nyregion/nyc-tourism.html?smid=tw-nytimes&smtyp=cur>

²⁴ Salcedo, Andrea (2019, September 6), New York City Officials Unveiled Their Latest Plan to Control the City's Rat Problem. <https://www.nytimes.com/2019/08/19/nyregion/nyc-tourism.html?smid=tw-nytimes&smtyp=cur>

²⁵ Hepler, Lauren (2019, August 29), California's Latest Wildfire Problem: Insuring the Tree Trimmers. <https://www.nytimes.com/2019/09/29/business/california-fire-insurance.html?smtyp=cur&smid=tw-nytimes>