Self-Regulation When it is Challenging: Motivation and Difficulties in Daily Life

by

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B.A., The University of Western Ontario, 2014
M.Sc., University of Victoria, 2017

A Dissertation Submitted in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the Department of Psychology

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Abstract

Despite good intentions, people often encounter challenges and obstacles in pursuit of their goals. The types of difficulties people experience each day have been well-documented (e.g., desires and temptations, resource depletion, social influences). However, despite these difficulties, some people are still able to attain their goals. Research on self-determination theory (Ryan & Deci, 2000) suggests that relative autonomous motivation (RAM) may explain inter-individual (and intra-individual) differences in effort and persistence when self-regulation is difficult (e.g., Ntoumanis et al., 2014). In two manuscripts, a series of daily diary designs are used to examine the role of motivation when self-regulation is difficult. The first focuses on the role of RAM during goal striving in a healthy eating across each day (Study 1) and during lunches (Study 2). These studies provide some evidence that students with higher (vs. lower) RAM are more likely to attain more difficult healthy eating goals, which may be due to perceiving fewer obstacles in pursuit of these goals, or through the use of more effective (i.e., approach-based) strategies. Then, the second manuscript involves undergraduate students enrolled in online (Study 1) and in-person classes (Study 2) during the Covid-19 pandemic, and focuses on how their situational motivation to do schoolwork may be impacted when they experience motivational interference. Mixed findings emerged regarding the impact of motivational interference on students' situational motivation but further evidence highlighted the protective effects of RAM when interference occurred. Taken together, these manuscripts contribute to a growing body of research on the study of self-regulation in daily life and on the role of RAM when difficulties arise.

Keywords: motivation, self-regulation, difficulty, self-determination theory

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Acknowledgements

I would like to acknowledge a number of individuals for their support and contributions toward the completion of this dissertation. Most importantly, I want to acknowledge the contributions of my supervisor, Dr. Fred Grouzet. This research was conducted as part of an ongoing research project on self-regulation in daily life, and I truly appreciate that Fred brought me into this research program and for his continued assistance, supervision, and mentorship since over the past six years. This dissertation would not be possible without his thoughtful guidance and efforts to foster my curiosity. His mentorship helped me develop my skillset as a researcher and will continue to guide my thinking throughout my career.

I also want to thank Dr. Scott Hofer and Dr. Patti-Jean Naylor for their insightful feedback on the final draft of this dissertation. I really appreciate the support and flexibility you both provided to me throughout the dissertation process and during my time as a graduate student – PJ for your insights on eating behaviour and practical applications, and Scott for your perspective on longitudinal data and inter- and intra-individual variability.

I also want to thank the tireless team of research assistants in the PEP Lab. Although there are too many of you to name here, I always appreciated the dedication, focus, and punctuality that each of you brought to the lab. This research was made possible through your efforts. Within the lab, I also thank my fellow graduate students for helping me learn about research methods, data science, and the nuances of psychological theories. Tom Spence, Shelby Logan, Tyler Carey, and Elliott Lee, you provided the environment for sharing critical discussions, having interesting conversations, and helping me see different perspectives.

Finally, I would like to acknowledge the funding support that I received during my doctoral degree from the University of Victoria.

Dedication

I dedicate this work to the people I love - my family, my partner, my close friends, and my community. I would not have completed ~~with~~ this work without you and your continued support. You are the reason I look forward to the future.

Self-Regulation When it is Challenging: Motivation and Difficulties in Daily Life

For centuries, scholars have proposed that controlling one's urges, temptations, and desires is the key to a good life and functioning society (e.g., Aristotle's writings on vice and virtue; Plato's chariot allegory), and much of this sentiment still exists in the discourse around self-regulation today (Baumeister & Heatheron, 1996). Empirical studies have shown the capacity for self-regulation to be negatively related to committing crimes (Henry et al., 1999), experiencing poverty (Palacios-Berrios & Hanson, 2019), and discriminating against others (Legault et al., 2007; Monteith et al., 2010). In contrast, having a greater capacity for self-regulation predicts a range of positive outcomes, such as improved academic achievement (Elliot et al., 2011; Mischel et al., 1989), physical health (Rasmussen et al., 2006), and even finding meaning in life (Van Tongeren et al., 2018). In a sense, self-regulation has been proposed to predict everything – if the capacity and willingness to exert oneself is there, good things happen; if not, the result is self-regulatory failure. If a student is procrastinating and misses a deadline, or a dieter fails to meet their goal, people often attribute it to a lack of effort. Given the benefits of self-regulation, some authors have even questioned why evolution has not selected for a more perfect capacity to control one's thoughts, actions, and behaviours (e.g., Hayden, 2019).

However, we know that it is not that simple. Motives that guide human behaviour come from many sources, such as physiological needs (e.g., hunger), psychological needs (e.g., relatedness), environmental influences (e.g., social pressures), and personal goals. Sometimes goals can be in conflict, and it is not always clear that pursuing one is more adaptive than another. Even when pursuing a clearly-defined goal people often encounter difficulties, requiring the exertion of more effort to overcome them. Moreover, the capacity to exert this effort is limited (Baumeister et al., 1998).

By focusing on the role of motivation as it is conceptualized by self-determination theory (i.e., autonomous and controlled forms of motivation; Ryan & Deci, 2000), the aim of this dissertation is to further our understanding of how people manage difficulties during self-regulation. First, I provide an overview of prominent models of self-regulation and review types of motivation from a self-determination theory perspective. Second, I draw on research from multiple areas to explore what can make self-regulation difficult, and discuss why autonomous motivation may be more adaptive than controlled forms of motivation when people face difficulties. Third, I discuss why self-regulation is particularly suited to being studied in daily life. Then, using a series of daily diary designs, I examine motivation and self-regulation in two domains of behaviour that are known to involve challenges – healthy eating and learning at university.

What is Self-Regulation?

It is easy to set a goal, but simply setting a goal is not sufficient to attain it. People tend to pursue several goals at once, and achieving a goal requires exerting effort, managing obstacles and challenges as they arise, reprioritizing other goals, monitoring goal progress, making adjustments as needed, and potentially disengaging from the goal if it is not longer feasible. Collectively, these behaviours comprise self-regulation, which has been described as the dynamic process of determining a desired end-point (i.e., goal) and then taking action to move toward it while monitoring progress along the way (Inzlicht et al., 2020). Self-regulation has been a focus for researchers spanning several decades, and a number of influential models have been proposed (e.g., Ajzen, 1985; Bandura, 1991; Ryan & Deci, 2000).

Prominent Models of Self-Regulation

One of the early models of self-regulation was developed by Carver and Scheier (1998), who embraced a systems-view of human behaviour regulation by drawing parallels between

regulatory systems in both machines and humans. Accordingly, they propose that self-regulation consists of having a goal or standard that one is striving to meet, which is entered into a comparative calculation that determines the degree of discrepancy (i.e., distance) between a person's current state and their goal state (i.e., inputs). Then, observing discrepancies leads to action (i.e., output), which can manifest as behaviour aimed at reducing the discrepancy.[1] Focusing more on the organization of goals, goal systems theory (Kruglanski et al., 2002) has also had a major impact on the field of self-regulation. The theory proposes that goals exist in a hierarchy, with more immediate, short-term goals (i.e., means) at lower levels of the hierarchy than more distant, long-term goals, which allows for thinking about the relationship between goals at both horizontal (i.e., the same) and vertical levels (i.e., different), and how conflict between goals can be a source of difficulty in goal striving (i.e., counterfinality; Kruglanski et al., 2015). Focusing on the relationships between goals and their means has advanced our understanding of when and why self-regulation may be challenging by highlighting the role of factors such as goal commitment, choice, ~~and~~ adjustment (Shah & Kruglanski, 2000), and relationships between means and goals (i.e., equifinality, multifinality; Kruglanski et al., 2015; Zhang et al., 2007).

Research on self-control has also contributed greatly to our understanding of self-regulation (e.g., Muraven & Baumeister, 2000), but the relationship between the two concepts has not always been clear. Some researchers have equated self-control and self-regulation, referring to both as the capacity to override and alter one's responses (Baumeister & Vohs, 2007). For example, avoiding temptations altogether to facilitate one's goal attainment has been

[1] In their model, Carver and Scheier also acknowledge the role of "external disturbances", that is, that human behaviour does not exist in a vacuum, and socio-environmental influences can impact the process of self-regulation.

considered as a "preventative self-control strategy", to some extent equating the active inhibition of a response with the meta-cognitive planning associated with goal pursuit (Duckworth et al., 2016; Hofmann & Kotabe, 2012). Others have likened self-control to decision-making more generally (Berkman et al., 2017), but -I view self-control as one aspect within the broader process of self-regulation. Specifically, I adopt the dual-process view of self-control as the active inhibition of a "hot", tempting, automatic option in favour of a "cold", rational, controlled option (Fujita et al., 2006; Metcalfe & Mischel, 1999). Self-regulation is the more continual process of setting a goal, striving for it (e.g., exerting self-control), monitoring one's progress, and making changes as needed (Carver & Scheier, 1998; Inzlicht et al., 2020). This view also highlights the importance of goal adjustment capacities (e.g., disengagement, re-engagement) for effective self-regulation (Wrosch et al., 2003).

One of the most prominent models of self-control has been the strength-energy model (Baumeister et al., 1998). Recognizing that the capacity to exert self-control seems to wane with repeated use, Baumeister and colleagues (1998) conducted a series of studies demonstrating that self-control seems to work like a muscle, with repeated short-term use draining its' strength, and practice over time improving it. This draining effect was referred to as a state of "ego-depletion", in which the self no longer had the same amount of resources for effortful exertion that it had previously. Ego-depletion has had a significant impact on social psychological research on self-control and on lay theories of self-control (e.g., Cherry, 2020). However, within the past 10 years, research on ego-depletion has ~~introduced~~ involved competing meta-analyses (Hagger et al., 2010; Carter & McCullough, 2014), and both failed and successful pre-registered replication attempts (Dang et al., 2020; Hagger et al., 2016), leading some researchers to re-evaluate the research methods (i.e., dual-task paradigm) and the role of psychological energy for successful self-control. Others have simply abandoned the model and accused its' proponents of engaging

in questionable research practices (e.g., *p*-hacking, post-hoc theorizing; Friese et al., 2019). As a functional alternative, the process model (Inzlicht et al., 2014) proposes that waning self-control is the result of shifting attention and motivation (i.e., willingness) after previous bouts of self-control, as opposed to relying on a limited resource. At this point, more research is needed to resolve debates, and some researchers have already begun to go back to the drawing board (e.g., Lin et al., 2020; Radel et al., 2019).

Considering the Type of Self-Regulation: A Self-Determination Theory Perspective

As a broad theory of motivation and human functioning, self-determination theory (Ryan & Deci, 2000) has received a wealth of empirical support and emerged as a prominent model of self-regulation. Given it's focus on different types of self-regulation, self-determination theory may be particularly well-suited as a lens to study when and why people may strive towards their goals, and how they manage difficulties along the way. For these reasons, I adopt the perspective of self-determination theory for this program of research.

A central focus of self-determination theory is on the *type* or *why* of motivation (Deci & Ryan, 2000).[2] In the early 1970s researchers began to recognize that, although external incentives (e.g., money, awards, punishment) may be "motivating" in that they move a person to act, they may have negative consequences for the person's intrinsic motivation (Deci, 1971; Lepper et al., 1973). Instead of combining as two separate motivational forces to move a person to act, they seem to instead crowd each other out, such that receiving external incentives for a

[2] Colloquially, the term "motivation" is often equated with effort, engagement, and persistence, but is better understood as the driving force that energizes these behaviours. Like self-regulation, the study of motivation has been approached from multiple perspectives, leading to the development of many theories (e.g., Brehm & Self, 1989; Elliot, 1999). Within self-determination theory, however, the terms "motivation" and "self-regulation" are generally synonymous, with both referring to why a person may (or may not) act, or regulate their behaviour.

previously intrinsically motivating activity can replace the motivational tendency. Although not all external incentives have this undermining effect (see cognitive evaluation theory; Deci & Ryan, 1985a), the type of motivation reflects why a person engages (or not) in a behaviour.

Moving beyond intrinsic and extrinsic motivation, research involving self-determination theory has further expanded our understanding of the types of human motivation (Deci & Ryan, 2008a). Several subtypes of behaviour regulation have been proposed to lie on an continuum of self-determination. On one end lies intrinsic motivation, characterized by interest, enjoyment, and pleasure from engaging in an activity, and on the other end lies external regulation, involving regulation through environmental incentives (e.g., rewards, punishment). In between, and in order of decreasing self-determination, lie integrated regulation (i.e., behaviour integrated into one's sense of self), identified regulation (i.e., personal endorsement of the outcome of a behaviour), and introjected regulation (i.e., acting out of feelings of guilt or contingent self-worth). Beyond external regulation, the self-determination continuum also includes amotivation, which involves regulation "without motivation", or with no reason for doing so. Given that it does not invoke intentional goal-directed behaviour, it is not uncommon for researchers to exclude it in their analysis (e.g., Sheldon et al., 2016). An array of measures have been developed to assess these types of behaviour regulation across different domains (e.g., academics, physical activity, pro-environmental behaviour, etc.), and at both the personality-level (Deci & Ryan, 1985b) and state-level (Guay et al., 2000).

To understand how the type of motivation can vary between- and within-person for the same behaviour (e.g., exercise), self-determination theory posits that humans have basic psychological needs for autonomy, competence, and relatedness, and when these needs are satisfied, more self-determined forms of motivation develop (Deci & Ryan, 2008b). Empirical evidence for this proposition comes from both experimental (Peng et al., 2012) and longitudinal

studies (Olafsen et al., 2018), among other types of research (e.g., Milyavskaya & Koestner, 2011). When these needs are not met, or are thwarted, a person may shift towards more external, or introjected forms of behaviour regulation (Verstuyf et al., 2012).

Although separately examining each type of motivation may provide the most statistical information (e.g., intrinsic, integrated, identified, etc.), it does not present a concise measure of a person's motivation to engage in a given behaviour, and does not necessarily reflect their degree of self-determination. Instead, some researchers have opted to focus on *autonomous* and *controlled* forms of motivation (e.g., Donald et al., 2020; White et al., 2018). At the centre of this distinction is a person's perceived locus of causality. The more autonomous, "want-to" forms of motivation include intrinsic, integrated, and identified regulation, which involve a relatively internal, autonomous locus of causality. In contrast, external and introjected forms of regulation tend to involve a feeling of being controlled, and arise from a comparatively external locus of causality (i.e., "have-to").

Other approaches to conceptualizing motivation been proposed as well. In one of the first efforts to create a self-determination "score", Ryan and Connell (1989) applied weightings to each type of motivation based on it's location on the continuum. This involved weighting the ends of the continuum (i.e., intrinsic motivation, amotivation) more heavily than the middle of the continuum (i.e., introjected regulation, identified regulation), such that weights ranged from -3 to +3. After weights were applied, all six scores were averaged to create a relative autonomy index. Findings from the use of self-determination measures tend to show strong, positive associations between types of regulation that are proximal on the continuum (e.g., intrinsic motivation and identified regulation), and diminishing (or even negative) associations as this theoretical distance decreases (e.g., integrated regulation and external regulation; Sheldon et al.,

2017). Nonetheless, the continuum structure of self-determined motivation and how to use these measurements in empirical research has been a focus of debate (Chemolli & Gagne, 2014).

However, more recent conceptualizations of motivations have involved researchers using a (typically non-weighted) measure of relative autonomous motivation (RAM) by subtracting the average controlled motivation score from the average autonomous motivation score, and omitting amotivation altogether (e.g., Vaz et al., 2016). While some approaches may provide a more nuanced analysis of the relationship between variables or may explain more variance in an outcome, the decision to choose one measurement approach over another ultimately depends on the focus of the researcher (e.g., focusing on RAM, or on the role of different forms of motivation; Howard et al., 2020).

Why Does the Type of Self-Regulation Matter?

Although a behaviour (e.g., running, eating healthy, studying) could arise from any type of motivation, different types of motivation have been shown to lead to different behaviours. For example, a student may study for more autonomous or controlled reasons, but autonomous motivation is shown to be a better predictor of academic achievement and learning than controlled motivation (Guay et al., 2010). In contrast, controlled motivation is negatively related to student well-being (Koestner et al., 2008), and predictive of academic integrity violations (i.e., cheating; Aelterman et al., 2019). Similar patterns have emerged outside of the classroom, in domains such as healthy eating and exercise (Mata et al., 2011), work (Vansteenkiste et al., 2007), sport (Vlachopoulos et al., 2000), relationships (La Guardia & Patrick, 2008), and in goal pursuit more generally (Sheldon & Houser-Marko, 2001). To illustrate, a runner with higher (vs. lower) RAM may run more frequently, with greater persistence, and enjoy it more, leading to more long-term mental and physical health benefits, and a higher chance of reaching their running goals.

What Could Make Self-Regulation Difficult?

Attaining a goal is usually not an easy feat, but what makes self-regulation difficult? Each day, people face a wide range of difficulties that vary in source, kind, and extent that they impact the feasibility of attaining a goal. Something that is "difficult" is defined as being hard to do, carry out, manage, or overcome (Merriam-Webster.com, 2020), which highlights the role of effort in overcoming difficulties.[3] However, effort is aversive (Kool et al., 2010; Kurzban, 2016) and uses up valuable resources (e.g., energy; Baumeister et al., 2007; Boksem & Tops, 2008). Indeed, people tend to prefer things that are easy and convenient, as evidenced by consumer preferences and multi-billion dollar industries for massively wasteful products such as coffee pods (OpenPR, 2020) and disposable cups (Grand View Research, 2020). All else being equal, people prefer the easier route, but what types of challenges and obstacles can make self-regulation difficult in the first place? In the next section, I draw from a range of literatures to describe several common sources of difficulty, including desires and temptations, resource limits, environmental influences, social influences, and difficulties in self-monitoring and forethought (for a more in-depth review, see Wagner & Heatherton, 2015). Although I present these sources of difficulty in separate sections, they tend to involve more similarities than differences, and often occur simultaneously. For instance, an environment may invoke behavioural cues, but the cues are experienced by the individual as creating desires or temptations. Similarly, trying to focus one's attention on writing a manuscript could simultaneously involve difficulties created by competing goal-inconsistent temptations (e.g., sleep) and limited resources (e.g., energy).

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[3] To further highlight the centrality of effort in defining difficulty, a recent large-scale replication study showed found perceived effort and difficulty to be so highly correlated that they were combined to form an index (Vohs et al., in press).

Desires and Temptations

As a source of difficulty, desires and temptations have received the most attention from researchers (e.g., Baumeister et al., 1998; Fishbach & Converse, 2010), in part because such experiences are common (Hofmann et al., 2012). Desire has been described as a driving force behind "wanting" something, while temptation is the result of this desire coming into conflict with a person's long-term goals (Kotabe & Hofmann, 2012). Many types of motives could create the experience of desire, such as physiological needs for hunger or sex, psychological needs for autonomy and building social bonds, and personal goals such as learning how to play guitar. Colloquially, the terms desire and temptation are often used interchangeably, which may be a reflection of how common it is for desires to be experienced as temptations.

Desires are a source of difficulty because they pull attention and engagement away from a focal goal, creating a conflict (i.e., temptation). For example, seeing an array of baked goods at a café may prime a dieter's desire to have a cookie, thereby requiring them to exert self-control to overcome the temptation. Likewise, a worker with a strong dislike for their colleague may have to overcome to temptation to verbally insult them, at least if they endorse the longer-term goal of being employed. Even the mere presence of a smartphone can be enough to influence a student's engagement with their schoolwork, and the desire to use social media and connect with others pulls attention away from their studies (Ward et al., 2017). Recognizing that desires can derail goal pursuits, researchers have examined how more preventative (i.e., pro-active) strategies can promote goal attainment (Kotabe & Hofmann, 2015; Williamson & Wilkowski, 2020). Such approaches could include avoiding the café altogether, or making amends with the co-worker. These strategies may improve the likelihood of goal attainment by altering the desire, or removing the cues that would prime the desire altogether.

Limited Resources

Part of the reason that managing desires and temptations is difficult is that a person's capacity to exert self-control is limited. The notion of limited psychological energy has been around for at least a century (e.g., Freud, 1927), but was popularized by the ego-depletion effect as demonstrated by Baumeister and colleagues in a classic experiment involving the temptation of fresh-baked cookies (see also Muraven et al., 1998). Accordingly, exerting self-control is proposed to rely on a limited resource (i.e., psychological energy), such that repeated self-control efforts make self-control failure more likely. A multitude of studies have replicated this effect (Hagger et al., 2010), and people's perceptions are consistent with it, showing that people are more likely to believe their capacity to exert self-control is limited after doing so (Klinger et al., 2018). Despite critiques of this model (Friese et al., 2019), one reason that self-regulation may be difficult is that controlling one's thoughts, emotions, and behaviours relies on a limited resource (or at least seems to).

However, psychological energy is not the only limited resource. Physical resources, such as food, water, and space are also limited. This has been the focus of social psychological and anthropological research on "commons dilemmas", where individuals and groups have to make difficult decisions because of these limits (Hobfoll & Lilly, 1993). For most people in a capitalist system, money is also a limited resource. Having to make decisions between products or services that may both be desirable (or needed) can be a source of difficulty as well (Tomasik et al., 2015). Lastly, perhaps the most existential of all resources is time. Humans, like all living beings, have a finite amount of time to grow, develop, and pursue these goals. When two goals cannot be pursued simultaneously a person has to make a choice, which can be a difficult, negative experience (e.g., Grund et al., 2015). Thus, the limits to many types of resources, and having to navigate these limits, are a common source of difficultly in self-regulation.

Environmental Cues and Constraints

While desires can occur spontaneously (Killingsworth & Gilbert, 2010), it is well-recognized that the environment plays an important role in moderating the frequency, and strength of desires a person experiences. For example, research has shown that contextual cues (e.g., specific situations, presence of cigarette smoke) can influence a cigarette smoker's capacity to refrain from smoking (Shiffman et al., 2020). The impact of the physical context on behaviour is also a major focus of environmental psychology more generally (Russell & Ward, 1982). While the environment could involve cues that facilitate a person's goal strivings (e.g., the gym priming the goal for exercise), the range of goals that people pursue simultaneously often means environments also activate competing goals (e.g., a smartphone priming the goal of using social media while at the gym), which can introduce an obstacle for self-regulation.

In addition to the behavioural cues they provide, environments differ in the extent that they afford opportunities for goal-directed action, or make such efforts more challenging. The environmental obstacles that impact a person's goal striving are known as enactment constraints (Kotabe & Hofmann, 2015), as they constrain the possible behaviours that can be enacted. For the gym-goer with a daily exercise routine, a temporary closure of the gym or piece of equipment introduces such an obstacle. Likewise, a student who tries to read their textbook in the quiet section of a library faces fewer distractions than a student who tries to do so in the cafeteria. The role of contextual influences has also been a central focus of research on nudge theory (e.g., Arno & Thomas, 2016; Thaler & Sunstein, 2009), showing how minor changes in the environment can have meaningful impacts on a person's choices and behaviour. Often, these changes are outside of an individual's awareness (Jung & Mellers, 2016), ~~showing~~ illustrating how removing environmental obstacles and shaping habits could make goal attainment more likely with no change in perceived effort.

Social Influences

Other people can also be a source of difficulty in self-regulation. This is made apparent by research on peer pressure and influences from the broader social context, highlighting how they can lead people to adopt goals that interfere with their personal goals (e.g., Banarjee & Dittmar, 2008; Dumas et al., 2012), and increase engagement in maladaptive behaviours more generally (Kasser et al., 2004). Just the presence of others has been shown to influence how much food a person eats during a meal (De Castro & Brewer, 1992; Herman & Polivy, 2003) by shifting the regulation of eating behaviour away from internal cues (Vartanian et al., 2008). In addition, using social media to interact with close friends and family has been shown to negatively influence the choices a person makes, as well as their persistence on a subsequent task, although the mechanisms are not well-understood (Wilcox & Stephen, 2013). Nonetheless, social influences could also have a positive impact on a person's self-regulation, promoting the adoption of adaptive goals (e.g., Song et al., 2015) and supporting an individual in their goal pursuits (Hofmann et al., 2015; for a discussion, see Grouzet, 2013).

Difficulties in Self-Monitoring and Forethought

In addition to the challenges people face when striving towards their goals, there are also difficulties involved in monitoring one's behaviour and goal progress. First, a person may fail to recognize that a desire is incompatible with their goal, which has been termed a lapse in conflict-monitoring (Hofmann & Kotabe, 2012; Myrseth & Fishbach, 2009). For example, a student who joins friends at the bar for one drink and plans to return home to study could soon forget this goal and consume more drinks than initially planned, not recognizing that the second and third drinks were in conflict with his initial goal. Relevant to this example, alcohol intoxication has been proposed as one of the major threats to effective self-regulation (Wagner & Heatherton, 2015), as it contributes to the likelihood of both lapses in conflict-monitoring (i.e., alcohol myopia; Steele

& Josephs, 1990) and inhibition (e.g., Fillmore & Blackburn, 2002). Much of the research on the role of self-monitoring for effective self-regulation involved laboratory studies on the effects of self-awareness on behaviour. Using a basic paradigm of having participants sit in front of a mirror, researchers showed that enhanced self-awareness could reduce the amount of food that dieters consume (Sentyrz & Bushman, 1998), as well as aggressive behaviour (Scheier et al., 1974). Likewise, completing a daily diary of one's behaviour could enhance self-awareness and foster self-monitoring in daily life, leading to behaviour that is more in line with a person's goals (e.g., quitting smoking; McFall, 1970).

Another challenge for effective self-regulation lies in the imperfection of people's predictions about the future. Wilson and Gilbert (2003) have illustrated a number of biases in people's predictions about how they will feel if future events occur (i.e., affective forecasting), and much of this research can be extended to people's predictions about their future psychological energy and motivation. For example, a professor may excitedly anticipate a holiday break as a time to catch up on reading and writing, only to find that they overestimated the energy they would have at this time by not accounting for ongoing demands (e.g., reference letters, visiting in-laws) and focusing only on the tasks that they would not have to do (i.e., isolation effect; Kahneman & Tversky, 1979). However, more research is needed to examine the extent that imperfect motivational forecasts occur and impair self-regulation.

How Relative Autonomous Motivation Could Make Self-Regulation Less Difficult

Difficulties require effort to overcome, and people differ in how well they manage these difficulties. Indeed, part of the reason that autonomous (but not controlled) motivation is associated with positive outcomes is that it involves managing difficulties more effectively. For instance, encountering an obstacle during goal striving can require effort and persistence to work through it, and some evidence suggests RAM is associated with a greater willingness to persist

(Ntoumanis et al., 2014; Sheldon & Elliot, 1999). In two studies of athletes, Ntoumanis and colleagues (2014) found that autonomous motivation predicted greater persistence on an exercise task, while controlled motivation was unrelated to persistence. Enhanced persistence was observed both when autonomous motivation was self-reported (Study 1), and primed (Study 2). Similar effects have been observed for engaging in pro-environmental behaviours, showing autonomous motivation to be a better predictor of engagement in more difficult behaviours than controlled motivation (Aitken et al., 2016; Green-Demers et al., 1997). Thus, part of the reason RAM may improve the likelihood of goal attainment is that it leads to increased persistence through difficult tasks.

However, an alternative explanation for the autonomous motivation-persistence relationship is that the type of motivation influences how a person perceives difficulties and effort (Werner et al., 2016). For example, both studies by Ntoumanis and colleagues (2014) involved an objective measure of persistence (i.e., levels of a physical activity challenge that were completed), but it is possible that autonomously motivated individuals perceived the task as less challenging than those with less autonomous motivation.[4] Consistent with this view, autonomous motivation is considered to be less depleting than controlled motivation (Moller et al., 2006; Muraven et al., 2007; Muraven, 2008), and may even have revitalizing effects (Muraven et al., 2008; Nix et al., 1999). Likewise, emerging research on self-control suggests more effective forms of behaviour regulation promote goal attainment by reducing the number of difficulties that arise, and not necessarily through greater effort (Duckworth et al., 2016; Gillebaart & de Ridder, 2015). Thus, autonomous motivation may predict goal persistence not

[4] Although the cited studies on motivation and pro-environmental behaviours measured perceived task difficulty, the authors did not report associations with autonomous and controlled motivation (Aitken et al., 2016; Green-Demers et al., 1997).

because it involves exerting more effort, but due to perceiving challenges as being easier to overcome. Notably, studies on the role of motivation for overcoming difficulties often demonstrate a weak (or zero) association between controlled motivation and behaviour, and a positive link between autonomous motivation and behaviour (e.g., Aitken et al., 2016). In these cases, the effects of either autonomous or RAM often (though not necessarily) share the same valence and evoke similar implications (e.g., Lee et al., 2021).

Within a self-control framework, Milyavskaya and colleagues (2015) conducted a series of studies that build on our understanding of motivation, effort, and difficulties. In both lab and daily life settings, the authors found autonomous (but not controlled) motivation to be negatively related to the number of obstacles in one's goal pursuit. In addition, when a temptation arose, autonomous (but not controlled) motivation was negatively related to the subjective strength of the temptation. Taken together, these results are consistent with the view that autonomous motivation involves greater persistence because it feels more "effortless". This could manifest as differences in the number and strength of temptations when pursuing a goal, depending on a person's motivation.

In addition to perceived effort, motivation is also related to the types of strategies that people use when striving towards their goals (e.g., Pulfrey et al., 2011). In a 2008 study, Otis and Pelletier found that the relationship between women's motivation and healthy eating outcomes was mediated by the types of strategies they used to meet their goals. Specifically, autonomous motivation to eat healthy involved more approach-based strategies (e.g., thinking about new and healthy recipes to try), and in turn predicted healthy eating behaviour. In contrast, controlled motivation towards healthy eating led to more avoidance-based strategies (e.g., avoiding eating at certain times), and subsequently predicted dysfunctional eating behaviours (e.g., binge-eating). Compared to approach-based strategies, avoidance-based strategies have been shown to predict

more negative outcomes (Elliott & Church, 1997; Oertig et al., 2013), and may also be more difficult to use (Herman & Mack, 1975; Sullivan & Rothman, 2008). A similar finding emerged in Ntoumanis and colleagues (2014) study, showing that the motivation-persistence relationship was mediated by the types of strategies that were used, which differed among those with more autonomous or controlled motivation. In sum, some studies suggest that both perceived "effortlessness" and differences in strategy use may explain why autonomous motivation is more adaptive for goal pursuit than more controlled forms of motivation. However, more research is needed to extend these findings to other behavioural domains, and to further understand the role of autonomous and controlled motivation when self-regulation is difficult.

Many questions remain about the relationship between different types of difficulties, motivation, energy, self-control, and other self-regulatory processes. In part, this is because self-regulation is a dynamic process. However, a promising approach to studying self-regulation is to use intensive longitudinal designs to observe goals, motivation, and behaviour in daily life.

Studying Self-Regulation in Daily Life

Self-regulatory processes are constantly unfolding and interacting with the socio-environmental context, highlighting the importance of using research methods that adequately capture this complexity (Maner, 2016). An *intensive longitudinal design* denotes repeated assessments over a short measurement period such as days or weeks, and comprises a range of research designs for observing a phenomenon "as-it-happens" (e.g., daily diary, event-contingent recording, ecological momentary assessment; Bolger et al., 2003). Advances in technology and widespread access to internet-connected smart devices have made it easier for researchers to employ intensive longitudinal designs in their own research (Tennen et al., 2006). The use of these research designs is becoming increasingly common in psychological research and often involve one or more scheduled or random measurements per day, typically through self-report.

One reason for adopting intensive longitudinal designs for self-regulation research is to minimize retrospective bias. Methodological studies have demonstrated that people tend to forget events, feelings, thoughts, and behaviours as time progresses (Patrick & Lee, 2010; Shiffman et al., 1997). This is especially true of more mundane occurrences that people commonly experience, which are often the focus of self-regulation researchers (e.g., goal striving, self-monitoring, encountering obstacles). By minimizing the time that elapses between a thought, event, feeling, or behaviour, and its' measurement, intensive longitudinal designs can improve the accuracy of self-report.

Involving personally relevant goals for participants is another important reason for using these designs. Although in-lab research on goal setting and striving has contributed to our understanding of self-regulation (Locke et al., 1981), the extent that findings reflect how these processes unfold in real life could be questioned (DeLongis et al., 1992). For example, a major critique of the ego-depletion effect has been the predominant use of the dual-task paradigm as critics suggest the tasks used may be insufficient to lead participants to exert self-control as they would in daily life (Lurquin & Miyake, 2017). Similarly, it can be challenging to create personally meaningful tasks in the lab since success or failure on the goals in these tasks tends to have no bearing on a participant's life (e.g., completing a Stroop task). In contrast, intensive longitudinal designs can involve participants reporting their own personal goals, progress, and difficulties over time, enhancing the idiosyncrasy and internal validity of studies employing these designs.

However, employing intensive longitudinal designs involves some difficulties. First, careful considerations of the number and spacing of measurements is dependent on the research question. For example, a study on experiences of self-control may involve repeated, random assessments across a day, while it may be more appropriate to use less frequent, scheduled

measurement intervals in a study on longer-term goal progress. In addition, the measurements themselves should be designed to minimize participant burden, as this is an important factor for the quality and quantity of participants' responses (Eisele et al., 2020). This often means using a reduced version of a scale (or even just a single item) to measure a construct, as opposed to a full version. Further, researchers should be aware of the effects of repeated assessments on participants' self-regulatory processes. Simply asking participants how well they are meeting their goals each day could even be sufficient to influence their thoughts and behaviours (i.e., measurement reactivity; Barta et al., 2012) or introduce other forms of bias in measurement (e.g., initial elevation bias; Shrout et al., 2018). Lastly, the use of intensive longitudinal designs also creates a hierarchical data structure (e.g., observations nested within participants), which requires the use of a multilevel modeling framework for statistical analysis. Nonetheless, it is precisely this hierarchical data structure that allows researchers to examine self-regulatory processes at both within-person and between-person levels, furthering our knowledge of the interaction between traits (e.g., grit), states (e.g., fatigue), and contexts.

Taken together, the benefits to studying self-regulation with intensive longitudinal methods far outweigh the challenges in design, implementation, and analysis. Self-regulation is a dynamic process involving shifting goals, strategies, motivation, and obstacles, and the research methods used to study it should reflect this temporal variability. Using intensive longitudinal designs can allow researchers to observe the types of difficulties people face in daily life, when and why they arise, how people manage them, and the consequences of doing so.

Program of Research

The current dissertation involves two manuscripts that focus on the role of motivation when self-regulation is difficult. Each manuscript represents research that employed daily diary designs to examine the challenges and obstacles people face as they occurred in real life, and to

distinguish between within- and between-person levels of association between constructs. The first manuscript, *Healthy eating in daily life: The role of relative autonomous motivation when it is difficult*, includes three studies (two daily diary studies) examining the moderating role of autonomous (relative to controlled) motivation when healthy eating is difficult. The second manuscript, titled *Learning during the Covid-19 pandemic: How motivational interferences impact students' motivation for schoolwork*, involves two daily diary studies focusing on how interferences in online and in-person learning can influence students' situational motivation while engaging with schoolwork (e.g., studying, writing).

Chapter 2: Healthy Eating in Daily Life:

The Role of Relative Autonomous Motivation When it is Difficult

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Contributions

I planned the series of studies in this manuscript in collaboration with Dr. Grouzet. We both conducted Studies 1 and 2, and collected additional data involving the ratings participants' food goals. I used data from Study 1 as part of my Masters Thesis. I performed the analysis for all studies, wrote the first draft of the manuscript, and made several revisions as suggested by Dr. Grouzet and peer reviewers of journals where the manuscript has been submitted. Some edits on different versions of the manuscript were made by Dr. Grouzet.

Abstract

Most people try to eat healthy, but the temptation of unhealthy foods (among other factors) can make it difficult. Despite these difficulties, some people still achieve their healthy eating goals. Following self-determination theory (SDT; Ryan & Deci, 2000), we propose that relative autonomous motivation (RAM) can foster people's effort in pursuing health goals. In two daily diary studies, we tested the hypothesis that RAM predicts attainment of healthy eating goals, especially when it is difficult. In Study 1, we focused on difficulties associated with trying to eat certain foods while avoiding others, whereas in Study 2, we focused on difficulties associated with the availability of unhealthy and healthy foods. Multilevel analyses provided some support for our hypothesis and highlighted the role of RAM for eating (vs. skipping) lunch and packing a lunch – two approach-based healthy eating strategies. We discuss these findings in relation to SDT and propose directions for future research on within-person changes in motivation and other sources of difficulty.

Keywords: relative autonomous motivation, self-determination theory, self-regulation, eating behavior

Healthy Eating in Daily Life: The Role of Relative Autonomous Motivation When it is Difficult

Most people want to eat healthy because of the benefits for their physical and mental health (e.g., Tohill, et al., 2004; White, et al., 2013). Yet, many people struggle to meet their healthy eating goals. In Canada, this is evidenced by poor eating habits, high rates of obesity, and a growing weight loss and dieting industry (Statistics Canada, 2019a, 2019b). People often overeat, choose unhealthy foods, and fail to get enough vitamins and essential nutrients. Researchers have studied various causes of unhealthy eating, including the availability and salience of certain foods (Baskin et al., 2016), social norms and influence (Cruwys, et al., 2015), and lapses in self-control (Hofmann, et al., 2014).

Despite a number of challenges for people trying to make healthy food choices, some people are still able to eat healthy. Self-determination theory (SDT; Ryan & Deci, 2000) posits that the quality of a person's motivation could explain the effort, persistence, and success in attaining such goals. Specifically, autonomous forms of motivation are associated with more positive outcomes than controlled forms of motivation (e.g., Ng et al., 2012; Williams et al., 2006). Under the SDT framework, the purpose of the current research is to examine the role of autonomous (vs. controlled) motivation (aka Relative Autonomous Motivation, RAM) for healthy eating, especially when it is difficult.

Why Do People Eat Healthy?

Many people are motivated to eat healthy for different reasons. Some people enjoy choosing healthy foods, or eat healthy because it is good for their health, whereas others eat healthy to avoid feeling guilty or to assent to social expectations. Self-determination theory (SDT; Ryan & Deci, 2000) proposes that these reasons could reflect different types of behavior regulation that lie on a continuum ranging from autonomous (i.e., self-determined) forms of motivation to controlled forms of motivation. Autonomous forms of motivation are characterized

by inherent enjoyment for the behavior (i.e., intrinsic motivation), congruence between the behavior and personally meaningful goals and values (i.e., integrated regulation), and/or personal valuation of the outcome (i.e., identified regulation). In contrast, behavior arising from controlled forms of motivation involves internal pressures, guilt, shame, and contingent self-worth (i.e., introjected regulation), compliance with external pressures or expectations, and/or striving to obtain a reward or avoid punishment (i.e., external regulation).

Autonomous motivation has been linked to positive outcomes in a range of contexts, such as education (Wang, 2008), work (Gagne & Deci, 2005), responsible alcohol consumption (Pavey & Sparks, 2009), and physical activity (Teixeira, et al., 2012). In a healthy eating context, Pelletier and colleagues (2004) found that autonomous motivation was associated with healthy eating and dieting success, whereas controlled motivation was associated with dysfunctional eating patterns (e.g., binge eating). Likewise, Hagger and colleagues (2006) found that greater autonomous than controlled motivation (i.e., Relative Autonomous Motivation) was positively related to attitudes, intentions, and actual healthy eating behaviors. Together, these findings are consistent with a meta-analysis showing that autonomous motivation predicts engagement for a large range of health behaviors (Ng et al., 2012).

The Role of Relative Autonomous Motivation when Healthy Eating is Difficult

Trying to eat healthy often means managing temptations and overcoming challenges. Autonomous (vs. controlled) motivation can be an important factor in this endeavor. Indeed, in a pro-environmental context, Green-Demers and colleagues (1997) found that while most people engage in relatively easy behaviors (e.g., recycling), autonomous motivation is a stronger predictor of engagement in more difficult behaviors (e.g., buying eco-friendly products) compared to controlled forms of motivation. This finding has been replicated in a recent study on eco-friendly transportation (Aitken, et al., 2016). Likewise, Ntoumanis and colleagues (2014)

found that autonomous motivation (but not controlled motivation) was positively related to effort and performance during a progressively difficult exercise session.

According to SDT, autonomous motivation involves behaving in ways that are consistent with one's interests and values. This type of motivation is proposed to require less energy than controlled forms of motivation. For example, it takes less energy to clean one's house when an individual wants to do it (autonomous motivation) than when they feel obligated to do so (controlled motivation). Therefore, higher levels of autonomous motivation than controlled motivation (i.e., higher relative autonomous motivation or RAM) might be associated with greater persistence in the face of difficulties because the individual does not feel their actions require as much effort as when the behavior arises from controlled forms of regulation. Recent findings from Milyavskaya and colleagues (2015) provide support for this view, showing that greater autonomous motivation (but not controlled motivation) is associated with perceiving fewer temptations and obstacles to one's goal pursuit (see also Werner et al., 2016).

What Makes Healthy Eating Difficult?

Part of what makes healthy eating difficult is having to both avoid tempting unhealthy foods (e.g., junk foods) and approach nutritious foods (e.g., fruits and vegetables). This distinction reflects the concept of approach-avoidance motivation, defined as the energization by and direction of behavior toward positive stimuli (approach) and away from negative stimuli (avoidance; Elliot, 2006). Approach-avoidance motivation manifests as the framing of goals, means, or strategies moving towards desired end-states (e.g., eating two servings of whole grains) or away from undesired end-states (e.g., limiting consumption of sugar). However, most of the time people tend to focus on approaching healthy food *or* avoiding unhealthy food, with mixed results.

A focus on eating healthy foods may satisfy one's hunger, subsequently reducing cravings, temptations, and the likelihood of eating unhealthy foods (Steel, et al., 2006). Approaching healthy food may also be a relatively simple goal to enact, involving a specific endpoint, measurable goal progress, and clearly defined means to attain the goal (e.g., eat two servings of whole grains). In contrast, research on restraint theory suggests that focusing on limiting or avoiding certain foods is more challenging (Herman & Mack, 1975; Polivy, et al., 2005). Trying not to eat certain foods may indeed increase desires and cravings for them, making them even more difficult to avoid (Jansen, et al., 2007; Pham, et al., 2016). Also, avoidance eating goals only involve undesired end-states (i.e., "anti-goals"), and do not specify a direction for action. For example, trying to avoid sugary foods does not tell the person what to eat, nor how long to avoid sugar. Therefore, goal progress may be difficult to interpret and any actions required to attain a goal may be unclear (Carver & Scheier, 2012).

Consistent with this view, researchers have found that avoidance goals may be more difficult than approach goals. For example, Mor and Cervone (2002) found that people report fewer means for attaining their avoidance goals than for their approach goals. Accordingly, Sullivan and Rothman (2008) found that participants who tried to eat fewer unhealthy snacks (i.e., avoidance) ate less healthy and benefitted more from planning than did participants who tried to eat more healthy snacks (i.e., approach). These findings echo Elliot and colleagues' (1999), showing that students with more avoidance-based studying goals were more "disorganized" and performed worse on exams than those with approach-based goals. Together, these findings suggest that part of the difficulty of avoidance goals is identifying when and how to work towards them. Furthermore, Henson and colleagues (2010) showed in a survey of over one thousand people that dietary recommendations framed as avoidance are rated as more difficult than those framed in an approach manner.

The Current Studies

Previous research has shown that greater (relative) autonomous motivation predicts engagement and persistence when difficulties arise. In two daily diary studies, we tested the hypothesis that relative autonomous motivation (RAM) predicts healthy eating when it is difficult. To this aim, we used idiographic diary designs that set this research apart from studies requiring participants to focus on predetermined food categories such as vegetables and junk food (e.g., White et al., 2013), and previous research using cross-sectional designs (e.g., Harrison et al., 2011; Pelletier et al., 2004). Although studying motivation and eating behavior in daily life provides little control over extraneous variables, it allowed us to observe these phenomena as they naturally occur, and to contribute to a growing body of research on self-regulation in everyday life (e.g., Hofmann et al., 2014; Wilkowski et al., 2018).

Study 1

The aim of this first daily diary study was to examine the role of RAM when trying to eat healthy foods and avoid unhealthy foods. We invited participants to set three approach food goals and three avoidance food goals, and then to report their food consumption each day for three weeks, with the possibility of setting new daily food goals. Based on the above literature that trying to avoid unhealthy foods is more difficult than trying to eat healthy foods, we hypothesized that RAM is more strongly associated with meeting avoidance goals (i.e., trying to limit or not eat certain foods) than with meeting approach goals (i.e., trying to eat more of certain foods).

Method

Participants

In Fall 2016, we recruited 156 undergraduate psychology students from a Canadian university through a research participant pool in exchange of course credits. The sample included

88% female students and 93% of participants were under 24 years of age (M = 20, SD = 2.83). Data from one participant was not used for the analyses because they did not complete any daily surveys.

Procedure

Participants were first invited to complete a series of demographic questions and a measure of autonomous and controlled motivation for regulating eating behavior.[5] They were also asked to set three approach food goals and three avoidance food goals for the next three weeks. Then, during the daily diary phase, participants received an email each morning at 6:00 A.M. inviting them to complete a daily survey before 1:00 P.M.. In this survey, they were first asked to report their previous day consumption of the six foods they listed as approach and avoidance food goals (i.e., Three-Week Goals). Second, they were asked to select three approach and three avoidance food goals that could be the same food goals initially set or new goals for the current day (i.e., Daily Goals). For example, a participant may have initially listed "salad" as an approach food goal, but may not have the intention to eat salad on a given day. Participants who added a new food goal were asked to report on their consumption of these foods the following day. The median number of diary surveys completed by a participant was 19 (out of 21; M = 85% of surveys), and data from 155 participants were included in the analyses (see Table 1 for descriptive statistics).

[5] Given our focus on approach and avoidance goals, we also included the Behavioral Inhibition Scale/Behavioral Activation Scale (BIS/BAS; Carver & White, 1994). However, the inclusion of this variable in the analyses did not make any significant difference (see *Supplemental Material* for details).

Measures

Relative Autonomous Motivation to Eat Healthy

The Regulation of Eating Behavior Scale (Pelletier et al., 2004) was used to assess RAM for regulating one's eating behaviors. Participants were asked why they regulate their eating behaviors, which they answered through 24 statements assessing six types of regulation ranging from intrinsic motivation to amotivation using a 7-point scale (from 1 = "Does not correspond at all" to 7 = "Corresponds exactly"). None of the items demonstrated skewness scores exceeding |3| and only the amotivation subscale items demonstrated kurtosis scores exceeding |3|, and the 6-factor structure demonstrated good fit to the data, $\chi^2(237) = 361.68$, $p < .001$, CFI = .940, SRMR = .073, RMSEA = .056 [90% CI: .043, .067]. We calculated RAM score for regulating eating behaviors by subtracting average scores on controlled motivation subscales (i.e., introjected regulation and external regulation, Cronbach's $\alpha = .82$) from autonomous motivation scores (i.e., intrinsic motivation and integrated/identified regulation, Cronbach's $\alpha = .91$).[6] RAM scores ranged from -4.38 to 15.75 ($M = 6.54$, $SD = 4.31$) with higher scores reflecting higher autonomous than controlled motivation.

Approach and Avoidance Eating Goals

For the Three-Week Goals, participants were asked to list three foods that they intended to eat "some or a lot of" (i.e., approach goals) and three foods that they intended "to limit or avoid" (i.e., avoidance goals) over the course of the next three weeks.[7] Participants could also add additional approach and avoidance food goals (i.e., Daily Goals) during the three-week span

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[6] We did not include amotivation in the calculation of RAM as it signifies an absence of intention to act and not necessarily a degree of autonomous motivation.

[7] Despite instructions to list "food" goals, some participants set goals that involved drinks. Data for these goals (n = 47 goals, 5% of all observations) was not used in the analyses.

of the study. Most participants (78.2 %) listed at least one additional eating goal (*M* = 6.2, *Mdn* = 4, *Range* = 0-41). In addition, participants were asked to select which of their initial food goals they endorsed for the current day. On average, participants endorsed four food goals per day (*M* = 3.5, *Mdn* = 4, *SD* = 2.02). Most commonly, participants listed vegetables (14.7%), fruit (14.1%), and salad (5.1%) as approach food goals, and chocolate (7.7%), chips (7.2%), and candy (5.6%) as avoidance food goals.

Eating Goal Success versus Failure

For the initial three approach and three avoidance goals (i.e., Three-Week Goals) and any additional food goals listed on the previous day (i.e., Daily Goals), participants were asked how much of each of the foods they ate using an 8-point Likert-type scale: (1) "I didn't eat any", (2) "Ate much less than intended", (3) "Ate less than intended", (4) "Ate slightly less than intended", (5) "Ate as much as intended", (6) "Ate slightly more than intended", (7) "Ate more than intended", or (8) "Ate much more than intended". Food goals were presented to participants in a random order. To assess goal success versus failure, the responses were recoded differently for approach and avoidance food goals. For Approach Food Goals, ratings ranging from (5) "Ate as much as intended" to (8) "Ate much more than intended" were coded (+1) for success, while ratings ranging from (1) "I didn't eat any" to (4) "Ate slightly less than intended" were coded (0) for failure. For Avoidance Food Goals, ratings ranging from (1) "I didn't eat any" to (5) "Ate as much as intended" were coded (+1) for success, while ratings from (6) "Ate slightly more than intended" to (8) "Ate much more than intended" were coded (0) for failure. Although we coded all food goals as success or failure, we used the 8-point scale of food consumption to minimize demand characteristics and to make it easier for participants to record their eating behavior. Since participants set goals both at the beginning of the study (i.e., Three-Week Goals) and during the diary phase (i.e., Daily Goals), we examined both goal timeframes.

Goal Specificity

The level of specificity of each food goal was coded by ten trained coders, each of them rating half or all the participants' goals, so each goal was rated by six independent coders. A Goal Specificity score was thus created by rating each food goal as (-2) "Specific food content", (-1) "Specific food type", (0) "Food type", (+1) "Category", or (+2) "Very broad category". For example, an apple would be coded as (0) "Food type", whereas fruits and vegetables would be coded as (+2) "Very broad category". To create a single Goal Specificity score for each food goal, any discrepancies in coding were resolved through discussion among all coders (mean weighted Cohen's $\kappa = 0.46$ prior to discussion).

Results[8]

Perceived Difficulty of Approach versus Avoidance Goals

We first tested the assumption that Avoidance Food Goals are more difficult than Approach Food Goals. To avoid any effect of asking participants to rate the difficulty of their goals on their responses during the diary study (and to reduce the burden on participants), we asked to an independent sample of undergraduate students from the same university and participant pool (n = 103, 95% female, 94% under 24 years of age, M = 21.32) to rate the perceived difficulty of the approach and avoidance eating goals set by participants in this daily diary study (n = 518 distinct food goals). The response options ranged from (1) "Not at all difficult" to (5) "Very difficult", and included the options to indicate if they do not know what a

[8] All analyses reported in this manuscript were conducted using the "psych" (Revelle, 2018) and "lme4" packages in R (Bates, et al., 2015).

certain food was, or if they do not eat that type of food due to dietary restrictions.[9] Using hierarchical linear models with maximum likelihood estimation and random intercepts (Level-1 = Goal-level, Level-2 = Person-level) to predict Goal Difficulty, we found that Avoidance Food Goals (coded +1) were rated as more difficult than Approach Food Goals (coded -1), $B = 0.27$ [95% CI = 0.25, 0.29], $p < .001$, with Goal Type accounting for 4.8% of Level-1 variance in Goal Difficulty.

These independent raters also completed the REBS (Pelletier et al., 2004)[10], which allowed us to examine whether RAM could predict ratings of Goal Difficulty. The inclusion of RAM and the RAM x Goal Type interaction in a model with Goal Type as a predictor significantly improved fit, $\chi^2(2) = 14.15$, $p < .001$, and accounted for 16% of the Person-level variance in Goal Difficulty. Specifically, higher RAM was associated with lower ratings of food goal difficulty, $B = -0.12$ [95% CI = -0.05, -0.13], $p < .001$. Furthermore, the RAM x Goal Type interaction suggested that RAM may have influenced perceptions of difficulty differently for approach and avoidance goals , $B = -0.01$ [95% CI = 0.00, -0.03], $p = .053$. Analysis of simple effects suggested a stronger effect of RAM for avoidance goals, $B = -0.14$ [95% CI = -0.04, -0.24], $p = .010$, than for approach goals, $B = -0.11$ [95% CI = -0.03, -0.19], $p = .010$.

[9] Due to reduction of in-person classes as a result of the Covid-19 pandemic, we asked these students to provide difficulty ratings retrospectively, thinking back to how difficult it would have been to pursue each goal while taking courses on the university campus. Responses from participants who reported to not have attended university before COVID-19 pandemic (i.e., $n = 15$ first-year students) were not included in the sample description and the analyses. Because of the high number of different food goals ($n = 518$) and to minimize participants burden, only half of the food goals were presented to each independent rater, but some of them ($n = 33$) rated all the food goals in two sessions.

[10] For this independent sample of raters, we found reasonable fit for the 6-factor structure of the scale, $\chi2(237) = 470.30$, $p < .001$, CFI = .90, SRMR = .090, RMSEA = .087 [90% CI: .076, .099], and good reliability for the both autonomous and controlled motivation subscales (Cronbach's $\alpha = 0.94$ and $\alpha = 0.86$, respectively).

RAM and the Effect of Goal Type on Goal Success

To predict goal success/failure during the diary study, we fit a series of three-level generalized linear models with maximum likelihood estimation and random intercepts (Level-1 = Goal-level, Level-2 = Day-level, and Level-3 = Person-level). We found higher success rates for Avoidance Goals (coded +1) than Approach Goals (coded -1) both for Three-Week Goals and Daily Goals, *OR* = 2.23 [95% CI = 2.14, 2.32], $p < .001$, and *OR* = 1.71 [95% CI = 1.63, 1.80], $p < .001$, respectively. The low ICCs for Goal Success/Failure (between .17 and .27) indicated that much of the variance was at the Goal-level, which could hinder our capacity to detect an effect of RAM (Person-level). Building on these models, the inclusion of RAM and the cross-level Goal Type x RAM interaction term significantly improved model fit, $\chi^2(2) = 12.07$, $p = .002$. Accordingly, the interaction between RAM and Goal Type was significant, *OR* = 0.98 [95% CI = 0.96, 0.99], $p = .001$. As depicted in Figure 1, simple effect analysis suggested a stronger positive relationship between RAM and goal success for approach food goals, *OR* = 1.05 [95% CI = 0.99, 1.11], $p = .081$, than for avoidance food goals, *OR* = 1.02 [95% CI = 0.86, 1.21], $p = .820$. In part, this may have been because the very high rates of goal success for avoidance goals (85% of instances) created a ceiling effect. For Daily Goals, however, the inclusion of RAM and the RAM x Goal Type interaction did not significantly improve model fit, $\chi^2(2) = 2.29$, $p = .318$. As shown in Table 2, RAM and the associated interaction term were non-significant, *OR* = 1.03 [95% CI = 0.99, 1.07], $p = .198$, and *OR* = 0.99 [95% CI = 0.97, 1.01], $p = .494$, respectively.

RAM and the Effect of Goal Specificity on Goal Success (Post-Hoc Analysis)

To further understand the relationship between goal type and goal difficulty, we modeled the effects of goal specificity (as a proxy for goal difficulty) on goal success/failure. We expected that broader avoidance goals would be more difficult than specific avoidance goals

(e.g., more difficult to avoid “junk food” than “chocolate cake”) and that the reverse would be true for approach goals (e.g., more difficult to try to eat “kale” than “fruits and vegetables”). Indeed, we found that broader the approach food goals were coded, easier to attain they were rated by the independent raters, $r = -0.34$, $p < .001$, and broader the avoidance food goals were, more difficult they were rated, $r = 0.58$, $p < .001$.

For Three-Week Goals, the interaction between Goal Type and Goal Specificity was significant, *OR* = 1.07 [95% CI = 1.02, 1.12], $p = .009$, with simple effects analysis showing that success rates were higher when approach food goals were broader, *OR* = 1.58 [95% CI = 1.44, 1.74], $p < .001$, and lower when avoidance food goals were broader, *OR* = 0.77 [95% CI = 0.71, 0.84], $p < .001$. Adding RAM and all associated interactions significantly improved model fit, $\chi^2(4) = 18.55$, $p < .001$. For approach food goals, there was a significant RAM x Goal Specificity interaction, *OR* = 0.93 [95% CI = 0.90, 0.96], $p < .001$, indicating that, as depicted in Figure 2, RAM seemed to be a better predictor of approach goal success for more specific (coded -2, -1, or 0) goals, *OR* = 1.08 [95% CI = 0.99, 1.16], $p = .063$, than broader goals (coded +1 or +2), *OR* = 1.04 [95% CI = 0.87, 1.24], $p = .680$. For avoidance goals, the RAM x Goal Specificity interaction was non-significant, *OR* = 1.01 [95% CI = 0.95, 1.08], $p = .444$.

For Daily Goals, a model with Goal Type and Goal Specificity showed a significant interaction, *OR* = 0.77 [95% CI = 0.72, 0.81], $p < .001$. As expected, simple effects analysis showed higher success rates for more broad approach goals, *OR* = 1.19 [95% CI = 1.07, 1.33], $p = .001$, and for more specific avoidance goals, *OR* = 0.74 [95% CI = 0.67, 0.81], $p < .001$. However, including RAM and all associated interaction terms did not improve model fit, $\chi^2(4) = 3.28$, $p = .513$ (see Table 3).

We conducted additional post-hoc analyses to further understand the role of RAM in relationships between goal specificity, goal type, and endorsement of Three-Week Goals on a

given day. Details of these analyses are provided in *Supplemental Materials*. In sum, RAM was unrelated to setting more or less specific goals, and was unrelated to the number of goals participants set during the study. Also, endorsing a Three-Week Goal on a given day was positively associated with success rates only for approach goals, and success rates for avoidance goals were higher on days when participants were also successful at their approach goals.

Brief Discussion

Study 1 provided some support for the hypothesis that RAM predicts healthy eating when it is difficult. Consistent with previous research (e.g., Milyavskaya et al., 2015), post-hoc analyses showed that higher RAM was also associated with lower perceptions of food goal difficulty. However, despite higher ratings of difficulty for avoidance goals than approach goals, we observed a higher success rate for avoidance goals than for approach goals. This finding may be partly explained by food availability because many avoided foods might have been unavailable to students. If this was the case, this would lead to goal success but not necessarily represent a source of difficulty. This could also create a ceiling effect that may account for the absence of a relationship between motivation and avoidance goal success/failure.

Study 2

We conducted a second daily diary study to further test the hypothesis that RAM predicts healthy eating when it is difficult, taking into consideration the difficulties associated with the availability of certain foods. Food environments with many junk and convenience foods are often referred to as “toxic” or “obesogenic” and have been partly blamed for increases in obesity rates (Swinburn, et al., 1999). When unhealthy foods are more available, salient, and ready-to-eat, people may perceive fewer costs involved in eating these foods (e.g., preparation, time, effort), making it difficult to avoid or limit consumption. In contrast, trying to eat healthy foods is easier when they are more accessible and ready-to-eat (Kroese, et al., 2015) but more difficult when

more preparation or time is required. The difficulties associated with food availability exist at multiple levels, highlighting the role of geography (Inagami, et al., 2006), kitchen and dining environments (Stroebele & de Castro, 2004), time pressure and convenience foods (Celnik, et al., 2012) and portion size (Fisher, et al., 2003).

In Study 2, we considered the difficulties associated with eating healthy foods when they are less available and avoiding unhealthy foods when they are readily available. Food availability could also explain the ceiling effect we observed in Study 1. In contrast to Study 1, we chose to focus on eating behavior during lunches because it would be difficult for participants to report on the availability of a food across an entire day. In addition, students often have lunch on the university campus where junk foods are often readily available.

Method

Participants

During Fall 2017, we recruited 139 undergraduate psychology students from a Canadian university through a research participant pool in exchange of course credits.[11] The sample included 89% female students and 89% of participants were under 24 years of age (M = 21, SD = 4.59). Data from four participants were not included in the analyses because three did not complete any daily diaries and one did not complete the measure of RAM.

Procedure

We used a similar three-week diary design as in Study 1, but simplified the design by only focusing on Three-Week Goals. Participants completed the same measures as in Study 1[12]

[11] To determine sample size for this study, we used the "simr" package in R to conduct simulation-based power estimates (Green & MacLeod, 2016). These simulations indicated that a sample of 130 participants would be needed to provide power of .80, assuming the same effect size and response rate observed in Study 1.

[12] This included the BIS/BAS (Carver & White, 1994) but we did not find any significant differences by including these variables in the analyses.

and were asked to set three approach food goals and three avoidance food goals during lunches. During the diary phase, participants received a daily email inviting them to complete the diary after lunch, between 12:00 P.M. and 8:00 P.M.. The diary involved questions about the availability and consumption of the foods specified by the participant, as well as several questions about participants' experiences during lunch (e.g., time, location). The median number of diary surveys that participants completed was 17 (out of 21; *M* = 76% of surveys).

Measures

Relative Autonomous Motivation to Eat Healthy

We measured RAM with the Regulation of Eating Behavior Scale (Pelletier et al., 2004). The 6-factor structure demonstrated adequate fit in our sample, $\chi^2(237) = 430.02$, $p < .001$, CFI = .90, SRMR = .094, RMSEA = .077 [90% CI: .065, .089], and good reliability for the autonomous (Cronbach's $\alpha = .93$) and controlled (Cronbach's $\alpha = .80$) subscales. Like in Study 1, we calculated RAM scores that ranged from -4.25 to 10.38 (*M* = 3.43, *SD* = 2.85).

Approach-Avoidance Eating Goals

Participants were asked to list three foods that they intended to eat "some or a lot of" (i.e., approach food goals) during lunches and three foods that they intended to "limit or avoid" (i.e., avoidance food goals) during lunches for the next three weeks.[13] Fruit (9.5%), vegetables (8.2%), and salad (8.2%) were the most common approach goals, whereas chips (5.2%), pizza (4.4%), and chocolate (4.4%) were the most common avoidance goals.

[13] Despite instructions to list "foods," some participants set goals that involved drinks. Data from these goals were not included in the analyses (n = 25 goals, 3% of all observations).

Goal Specificity

Using the same approach as in Study 1, each food goal was coded by a group of eight trained coders to indicate how broad or specific it was. Each coder rated at least half of the participants' goals, so that each goal was rated by six independent coders. Any discrepancies among coders were resolved through discussion (mean weighted Cohen's $\kappa = 0.57$ prior to discussion).

Eating Goal Success vs. Failure

We assessed goal success versus failure using the same food consumption measure and coding procedure as in Study 1.

Food Availability

Food availability was assessed with three questions. First, we asked participants for each of their six food goals: "Was this food available to you at lunch?" Response options were (1) "No, this food was not available", (2) "Yes, but I had to purchase ingredients to prepare and/or cook it", (3) "Yes, but some preparation and/or cooking was required, or I had to purchase it already prepared (e.g., grocery, restaurant, cafeteria)", and (4) "Yes it was readily available (e.g., already prepared or purchased)". Second, we asked participants how much it cost, or would have cost them to get each food at lunch (1 = "No cost", 5 = "Very expensive"). Third, we asked participants how long it took, or would have taken them to prepare, cook, or purchase each food (1 = "No time at all", 5 = "A long time"). For these last two questions, there was also a response option for "I was unable to purchase this food when I decided to eat lunch today", which was coded as missing data. All food availability items were grand-mean-centered for analyses to facilitate interpretation.

Lunch Context

To further understand participants' experiences during lunches, we first asked them to indicate where they were when they decided to eat lunch, with response options being "At home", "On campus in a place where food could be purchased (e.g., cafeteria)", "On campus in a place food could not be purchased (e.g., outside, in a classroom)", "At work", "In transit (e.g., walking, in a car)", "Off campus in a place where food could be purchased (e.g., café, restaurant, market)", "In a location not listed here", and "I did not eat anything for lunch today". Second, we asked them what time it was when they decided to eat lunch, with response options ranging from "Before 11 A.M." to "After 2 P.M.", with 30-minute intervals in between. We finally asked them whether they had brought their own lunch (coded +1) or not (coded 0).

Results

Perceived Difficulty of Approach versus Avoidance Goals

Using the same approach as in Study 1, we verified that the reported avoidance goals are more difficult than reported approach goals by asking an independent sample of undergraduate students from the same university and participant pool (n = 72 including 41 raters who also rated food goals from Study 1; 92% female, 96% under 24 years of age, M = 21.06) to rate the difficulty of the food goals that were set by participants in this diary study.[14] As predicted, avoidance goals were rated as more difficult than approach goals, B = 0.23 [95% CI = 0.22, 0.24], $p < .001$, with Goal Type accounting for 3.7% of Level-1 variance in Goal Difficulty.

[14] Due to shift to online classes as a result of the Covid-19 pandemic and campus lock down, we asked these raters to provide difficulty ratings retrospectively, thinking back to how difficult it would have been to pursue each goal while taking courses on the university campus.

We also examined whether RAM (as measured by REBS; Pelletier et al., 2004) [15] predicted ratings of Goal Difficulty in this independent sample of raters. The inclusion of RAM and the RAM x Goal Type interaction improved fit over a model with only Goal Type as a predictor, $\chi^2(2) = 192.28$, $p < .001$, and accounted for 8.1% of the Person-level variance in Goal Difficulty. Specifically, higher RAM was associated with lower ratings of food goal difficulty, $B = -0.11$ [95% CI = -0.02, -0.19], $p = .021$. However, the interaction was also significant, $B = 0.06$ [95% CI = 0.05, 0.07], $p < .001$, with simple effects showing the effect was only present for approach goals, $B = -0.16$ [95% CI = -0.07, -0.26], $p < .001$, and not for avoidance goals, $B = -0.04$ [95% CI = -0.17, 0.09], $p = .525$.

RAM and the Effect of Food Availability on Goal Success

To examine the role of RAM in the relation between food availability and goal outcomes, we first fit a three-level generalized linear model (Level-1 = Goal-level, Level-2 = Day-level, and Level-3 = Person-level) with random intercepts and Goal Success/Failure as the dependent variable, and included both Goal Type (Approach Goal = -1; Avoidance Goal = +1) and Food Availability as Level-1 predictors. Results showed that avoidance goals had higher success rates than approach goals, $OR = 15.61$ [95% CI = 13.81, 17.66], $p < .001$ (see Fig. 3). The Goal Type x Food Availability interaction was significant, $OR = 0.31$ [95% CI = 0.29, 0.34], $p < .001$, and simple effects showed success rates were higher when approached foods were more available, $OR = 4.92$ [95% CI = 4.35, 5.56], $p < .001$, and when avoided foods were less available, $OR = 0.22$ [95% CI = 0.26, 0.31], $p < .001$. Then, we added RAM scores as a Level-3 predictor,

[15] When combining raters of food goals from Study 1 and Study 2 (n= 134), we found good fit for the 6-factor structure of the scale, $\chi2(237) = 359.01$, $p < .001$, CFI = .90, SRMR = .083, RMSEA = .091 [90% CI: .071, .110], and good reliability for the both autonomous and controlled motivation subscales (Cronbach's $\alpha = 0.94$ and $\alpha = 0.82$, respectively).

and the corresponding cross-level interaction, but they did not significantly improve model fit, $\chi^2(4) = 4.06$, $p = .399$.

However, the above analyses included observations where participants did and did not eat lunch. By definition, not eating lunch means successfully avoiding certain foods and failing to eat others. Therefore, we re-analyzed the data that included only observations where participants did not eat lunch (24.5% of observations; see Table 4 for descriptive statistics) and used this reduced dataset for all subsequent analyses. However, similar to Study 1, we found low ICCs for both approach (.09) and avoidance goal success/failure (.18), indicating that our capacity to detect an effect of RAM on goal outcomes may have been limited by low Person-level variance. Building on a model with only Goal Type as a predictor, including RAM and all corresponding interactions did not significantly improve fit, $\chi^2(4) = 7.65$, $p = .106$ (see Table 5). Contradictory to the results of the likelihood ratio test, the RAM x Goal Type and two-way interactions were significant, *OR* = 1.06 [95% CI = 1.01, 1.10], $p = .008$, and *OR* = 0.97 [95% CI = 0.94, 1.00], $p = .042$, respectively. Accordingly, the RAM x Food Availability interaction neared significance for avoidance goals, *OR* = 0.95 [95% CI = 0.89, 1.01], $p = .079$, but not for approach goals, *OR* = 1.02 [95% CI = 0.98, 1.06], $p = .282$. The negative effects of Food Availability on avoidance goal success appeared to be slightly higher for those with high RAM scores (i.e., +1 SD), OR = 0.30 [95% CI = 0.21, 0.44], $p < .001$, than those with low RAM scores (i.e., -1 SD), OR = 0.45 [95% CI = 0.31, 0.65], $p < .001$. However, we followed best practices in hierarchical modeling by trusting likelihood ratio tests over Wald tests of coefficients when they are contradictory (Singer & Willett, 2003).

We then examined the role of RAM and food costs for approach and avoidance goal success. In a model with Goal Type (coded -1 for Approach and +1 for Avoidance), Food Costs, and the associated interaction, the Goal Type x Food Costs interaction was significant, *OR* = 0.80

[95% CI = 0.75, 0.86], $p < .001$. Unexpectedly, higher food costs were associated with higher approach goal success, *OR* = 1.26 [95% CI = 1.16, 1.38], $p < .001$, and lower avoidance goal success, *OR* = 0.84 [95% CI = 0.73, 0.98], $p = .019$. Including RAM and all associated interactions significantly improved model fit, $\chi^2(4) = 21.41$, $p < .001$, and the two-way interaction was significant, *OR* = 1.05 [95% CI = 1.02, 1.08], $p < .001$. Analysis of simple effects indicated that the RAM x Food Cost interaction was significant for both approach goals, *OR* = 0.96 [95% CI = 0.93, 0.99], $p = .003$, and avoidance goals, *OR* = 1.06 [95% CI = 1.01, 1.12], $p = .012$. For approach goals, food cost was unrelated to goal success for those high (+1 SD) in RAM, OR = 1.01 [95% CI = 0.89, 1.14], $p = .927$, but positively related for those low (-1 SD) in RAM, OR = 1.53 [95% CI = 1.36, 1.72], $p < .001$. Likewise, the effects of food cost on avoidance goal success were only present for those with low RAM scores (-1 SD), *OR* = 0.74 [95% CI = 0.61, 0.90], $p = .003$, and not high RAM scores (+1 SD), *OR* = 0.97 [95% CI = 0.79, 1.18], $p = .729$.

Finally, we examined the role of RAM and time required to prepare or get food for approach and avoidance goal success. In a model with Goal Type, Required Time, and the associated interaction, the Goal Type x Required Time interaction was significant, *OR* = 0.85 [95% CI = 0.79, 0.92], $p < .001$. Unexpectedly, Required Time was positively associated with approach goal success, *OR* = 1.22 [95% CI = 1.12, 1.33], $p < .001$, and unrelated to avoidance goal success, *OR* = 0.97 [95% CI = 0.83, 1.13], $p = .680$. Including RAM and all associated interactions significantly improved model fit, $\chi^2(4) = 18.76$, $p < .001$. The two-way interaction was significant, *OR* = 1.05 [95% CI = 1.02, 1.08], $p < .001$. Analysis of simple effects indicated that the RAM x Required Time interaction was significant for approach goals, *OR* = 0.93 [95% CI =0.89, 0.98], $p = .003$, but not for avoidance goals, *OR* = 1.04 [95% CI = 0.97, 1.24], $p = .240$. For approach goals, RAM was positively related to goal success, *OR* = 1.31 [95% CI =

1.02, 1.68], $p = .029$, but the effects of Required Time were stronger among those high RAM scores (+1 SD), $OR = 0.64$ [95% CI = 0.60, 0.69], $p < .001$, than those with low RAM scores (-1 SD), $OR = 0.81$ [95% CI = 0.76, 0.86], $p < .001$.[16]

RAM and Perceived Food Availability (Post-Hoc Analysis)

In order to examine whether participants' RAM may have influenced perceptions of food availability, we fit a three-level hierarchical linear model with Food Availability as the dependent variable. The effect of Goal Type was significant, indicating that approached foods were perceived as more available than avoided foods, $OR = 0.87$ [95% CI = 0.85, 0.89], $p < .001$. Including RAM and the associated interaction in this model improved fit, $\chi^2(2) = 34.58$, $p < .001$. The main effect of RAM was non-significant, $OR = 0.99$ [95% CI = 0.90, 1.10], $p = .870$, but the interaction was significant, $OR = 0.93$ [95% CI = 0.91, 0.96], $p < .001$. As illustrated in Figure 4, simple effects analysis showed a crossover interaction. Participants with high RAM scores (+1 SD) viewed approached foods as more available and avoided foods as less available, $OR = 0.90$ [95% CI = 0.85, 0.96], $p < .001$ when compared to those with low RAM scores (-1 SD), $OR = 1.07$ [95% CI = 1.00, 1.14], $p = .056$.

RAM as a Predictor of Eating versus Skipping Lunch (Post-Hoc Analysis)

Noticing that not all participants did eat lunch, we examined whether this behavior was related to RAM. We fit a two-level generalized hierarchical linear model with a random intercept for each participant, eating lunch (No coded "0", Yes coded "1") as the outcome and RAM as a

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[16] We conducted additional analyses to understand the unexpected relationships between food costs, required time, and goal success/failure. These analyses are detailed in the *Supplemental Materials*. Despite instructions to participants, it seems that they interpreted these two questions in a different way than anticipated. Ostensibly, participants reported their required time and costs if they ate the foods, but often selected response options for no cost or time if they did not. In other words, foods may have been available, but participants often reported no costs or time (because they spent no time or money) rather than using the response option to indicate an inability to purchase or prepare the food. Therefore, we cannot be confident in the validity of these two items. We still report the associated findings, but any interpretation should be made with caution.

predictor. The main effect of RAM was significant, *OR* = 1.21 [95% CI = 1.10, 1.34], $p < .001$, indicating that higher RAM was associated with greater likelihood to eat lunch (see Table 6).

RAM and the Relation between Goal Specificity and Goal Success (Post-Hoc Analysis)

We also examined the relations between RAM and goal specificity. Details of these post-hoc analyses are in *Supplemental Materials*. In short, RAM was unrelated to setting more or less specific goals, but RAM was positively associated with achievement of broader approach goals. Moreover, when participants were more successful at their approach goals on a given day, they were more successful at their avoidance goals that day.

The Role of the Lunch Context (Post-Hoc Analysis)

Lastly, we conducted analyses to further understand participants' experiences during lunches. Most of the time participants ate lunch between 11:30 A.M. and 1:30 P.M. (68.6%) and ate lunch either at home (43.3%) or on campus (38.4%). Participants packed a lunch on 39.2% of days when they ate lunch on campus. We expect it is easier for students to meet their healthy eating goals when eating lunch at home than on campus or somewhere where food could be bought (e.g., café, restaurant), since unhealthy foods are often present and preparing healthy foods may not be possible. Likewise, we expect that it is easier for students to meet their healthy eating goals on campus when they pack their own lunch. To test these predictions, we fit several additional models, which are detailed in *Supplemental Materials*. For both approach and avoidance goals, success rates were higher when eating lunch at home (vs. on campus or in places where food was available for purchase), and when participants packed a lunch to eat on campus. Finally, RAM was unrelated to where students ate lunch, but more autonomously motivated individuals were more likely to pack a lunch when on campus.

Brief Discussion

Study 2 provided mixed evidence for our hypothesis. We did not find evidence that the difficulties associated with food availability were more likely to be overcome with greater RAM. However, RAM was related to perceptions of food availability, and to perceived difficulty. Further, the findings showed that RAM is linked to the strategies people use to eat healthy (e.g., eating vs. skipping lunch, packing lunch).

General Discussion

The purpose of this research was to test the hypothesis that RAM leads to healthy eating when it is difficult. Specifically, we focused on difficulties involved when trying to eat certain foods and avoid others (Study 1) and when these foods are more or less available (Study 2). Both studies provided some evidence for our hypothesis. In Study 1, RAM was associated with success for three-week approach goals, and especially for specific approach goals that were the most difficult. Yet, this effect was not present for daily goals. In Study 2, RAM did not predict healthy eating when availability of certain foods could make it more challenging. However, the effect of RAM on perceived food availability may partly explain this finding. Similarly, post-hoc analyses in both studies demonstrated that individuals with higher RAM rated healthy eating goals as being less difficult. In Study 2, we also found that RAM predicted the likelihood of eating lunch, and of packing a lunch when on campus – two potential healthy eating strategies. Finally, in both studies success in approaching healthy food was positively related to success in avoiding unhealthy food. Below, we discuss these findings by first addressing the unexpected findings and then we discuss the evidence regarding our initial hypothesis. Finally, we interpret the findings regarding healthy eating strategies and the role of RAM.

Difficulty of Approaching versus Avoiding Foods

As expected, the approach goals that participants have identified in both Study 1 and 2 have been rated by an independent sample of similar individuals (i.e., undergraduate students) as being easier to attain than avoidance goals. However, we observed that avoidance goals had higher success rates than approach goals, which could be explained by the complexity of approach and avoidance goals. Indeed, the difference between approach and avoidance food goals is more complex than the activation-inhibition dichotomy. For avoidance goals, individuals can *try to limit* (reflecting moderation) or *not eat* (reflecting abstinence) foods, which likely differs in terms of endorsement, strategies, goal persistence, and goal difficulty. For example, trying to not eat meat may require very different tactics than trying to eat less meat, which may not be equally challenging. Similarly, for approach goals, individuals could try to eat *some* or *a lot of* food, but it may be more difficult to achieve the relatively intense goal of eating *a lot of* carrots than the more modest goal of eating *a few* carrots. Without assessing these different degrees of approach and avoidance goals, it is difficult to know whether it could be a source of bias in the current studies. However, findings on the prevalence of skipped lunches (Study 2) suggest that individuals often set avoidance goals involving abstinence. Given the North American focus on diets and weight maintenance (Yaemsiri, et al., 2011), it might not be surprising to see a higher success rate for avoidance/abstinence goals than approach goals (see below). Further research should consider the degree of people's approach and avoidance goals and the associated difficulties.

The Role of RAM When Healthy Eating is Difficult

Based on previous research (e.g., Green-Demers et al., 1997; Ntoumanis et al., 2014), we hypothesized that greater RAM leads to healthy eating because it involves greater persistence when difficulties arise. Study 1 provided some support for this hypothesis, but the effects were

only present for three-week approach goals and not for daily goals or three-week avoidance goals. This could be explained by the fact that daily goals are more salient, and thus easier, than three-week goals that required participants to stick to the long-term goals, making it more difficult. In Study 2, we found no effect of RAM on goal success when food availability made eating healthy more difficult. However, post-hoc analyses showed that RAM influenced perceptions of food availability, which is consistent with other research (e.g., Milyavskaya et al., 2015). Indeed, we found that people with higher (vs. lower) RAM perceived healthy foods as being easier to access, and unhealthy foods as less available.

Our findings also showed that the role of RAM in explaining the achievement of difficult goals could also be approached in an alternative way. Indeed, although we found no relationship between RAM and goal specificity or goal endorsement, it is plausible that RAM influenced the level of difficulty of participants' goals. For example, RAM to eat healthy often involves an interest and enjoyment in healthy eating, which may have led individuals with higher RAM to set more challenging healthy eating goals. Indeed, post-hoc analyses in both studies showed that RAM was negatively related to ratings of food goal difficulties, so peoples' RAM may influence the difficulty of goals they set, as part of a general strategy to eat healthy.

RAM and Strategies for Eating Healthy

Further analyses highlighted unexpected findings on daily eating behaviors and the role of RAM in adopting different healthy eating strategies. In Study 2, we found that RAM was related to packing a lunch to eat on campus, which led to higher goal success rates. We also found that RAM predicted the likelihood of eating lunch, and that achieving approach goals on a given day increased the likelihood of attaining avoidance goals as well. Consistent with these findings, Pelletier and colleagues (2004) found that autonomous motivation was associated with greater concern for the quality of one's diet (i.e., what to eat), whereas controlled motivation was

related to the quantity of food (i.e., how much to eat). Then, Otis and Pelletier (2008) found that autonomous motivation was related to the use of approach strategies, whereas controlled motivation was related to avoidance strategies. Therefore, it is not surprising to see RAM associated with the use of two approach strategies: eating (or not skipping) lunch and packing one's own lunch when away from home. Conversely, not eating lunch could be viewed as an avoidance strategy when motivation was predominantly controlled (or less autonomous). Skipping lunch is a way to eat fewer foods, but eating lunch can also be a means to consume more healthy foods. Notably, the fact that RAM predicted approach goal success could be interpreted as an effective use of approach strategies.

In addition, autonomous motivation is related to a preference for food variety (Otis & Pelletier, 2008) and creativity (e.g., Sheldon, 1995), so individuals higher in RAM may have been more likely to meet their personal healthy eating goals through alternative means not measured in this study. For example, eating other healthy foods (and avoiding other unhealthy foods) not listed as food goals still involves eating healthy, and missing this possibility in the diary study could have resulted in finding reduced estimates of the impact of RAM on eating goal success/failure.

Across both studies, we also found that individuals who were more successful at their approach goals were also more successful at their avoidance goals. It seems that eating healthy foods may have made it easier to avoid unhealthy foods. This could be the result of satisfying hunger with healthy foods (Steel et al., 2006) or motivational spillover (e.g., Silva et al., 2011). Regardless, this finding contributes to the existing literature on healthy eating strategies (e.g., Adriaanse, et al., 2011; Sullivan & Rothman, 2008).

Limitations

Because of the complexity of these studies, the findings are limited at different levels. First, there is much variability and unpredictability involved in studying eating behavior in daily life. As a result, the effects that are detected using daily diary designs are often smaller than those manipulated or isolated in controlled settings. This was indeed the case across these two studies, where most effects were fairly small and explained little of the variance in goal success/failure (often less than 5%). Nonetheless, these effects should be more robust to contextual factors and replicable across samples (Maner, 2016). In a healthy eating context, this trade-off between ecological and internal validity should always be considered. While lab-based studies provide insight into specific aspects of eating behavior (e.g., Robinson et al., 2014), daily diary designs provide rich observations of people's day-to-day eating patterns, contexts, and challenges (e.g., Conner, et al., 2015).

Second, we found very little variance in goal success/failure at the person-level (around 20%). Although we still observed an effect of RAM on goal success/failure in Study 1, the low person-level variance likely limited the capacity to do so, which could explain why we did not observe this effect in Study 2. The use of longer timeframes (e.g., weekly reporting over the course of two or three months) could have elicited more variance at the person-level and made it easier to observe the hypothesized effects, whereas daily measurements captured more within-person variations in eating behaviour.

Third, we measured RAM at the contextual-level (i.e., healthy eating context) whereas motivation at the situational-level might be a better moderator as suggested in Vallerand's (1997) hierarchical model. People might be more likely to engage in behaviors that are difficult when their situational RAM was high, independently from their general RAM for eating healthy. We also focused on only a subset of possible healthy eating difficulties. Further research should

consider other contexts and challenges, such as the presence of friends and family (Cruwys et al., 2014), and eating after a demanding day (e.g., Wichianson, et al., 2009).

Another limitation is related to the possibility of measurement reactivity. By setting their own healthy eating goals, participants may have found themselves in a form of intervention during the diary studies. During the participants' debriefing, they often reported seeing this three-week phase as a challenge, holding themselves more accountable and enhancing their self-awareness of their eating behavior. Measurement reactivity could introduce a bias in the findings, such that participants' eating behavior may have been healthier than normal. In Study 1, we even observed an increase in goal success rates over the three-week phase, which provides some evidence of measurement reactivity, but is promising for healthy eating interventions and for the development of self-regulation applications and programs. Measurement reactivity and bias are common issues in psychological research (Borsboom, 2006; Shrout et al., 2018), and using more intensive or objective measures of food consumption (e.g., multiple 24-hour dietary recalls; Jonnalgadda et al., 2000) would not necessarily solve these problems.

Conclusion

Overall, two daily diary studies provide some evidence that RAM leads to healthy eating when it is difficult. Most importantly, we found that RAM is associated with perceiving fewer difficulties, and with the use of more approach-based healthy eating strategies. These findings help to explain why some people are more likely to meet their healthy eating goals than others, and contribute to a growing literature on the role of RAM for engaging in and maintaining various health behaviors.

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Tables

Table 1
Descriptive statistics for Study 1.

	Three-Week Goals	Daily Goals
Number of goal outcomes	15754	10453
Number of days	2769	2347
Approach goals		
Mean success rate	48.8%	59.5%
$ICC_{Person\text{-}level}$	.21	.17
$ICC_{Day\text{-}level}$	.03	.04
Avoidance goals		
Mean success rate	85.6%	84.6%
$ICC_{Person\text{-}level}$	.26	.27
$ICC_{Day\text{-}level}$	.12	.12

Notes. ICC = intraclass correlation coefficient.

Table 2
Goal Success/Failure as a function of RAM and Goal Type for Study 1.

	Three-Week Goals		Daily Goals	
Intercept	0.76 [0.05] **	0.76 [0.05] ***	0.96 [0.06] **	0.96 [0.06] ***
Goal Type	0.80 [0.02] **	0.80 [0.02] **	0.54 [0.02] **	0.54 [0.02] **
RAM		0.02 [0.02]		0.03 [0.02]
RAM x Goal Type		-0.02 [0.01] **		-0.01 [0.01]
Simple Effects				
Approach Goals				
RAM		0.05 [0.03] †		
Avoidance Goals				
RAM		0.01 [0.03]		
χ^2 model comparison (df)	12.07 (2) **		2.29 (2)	
BIC	17,251.5	17,258.6	11,318.1	11,334.2
Marginal R^2	.146	.148	.071	.072
Δ Person-level variance	- 1.9%		- 1.7%	
Δ Day-level variance	+ 1.6%		+ 0.2%	

Notes. Unstandardized coefficients and standard errors reported; Dependent variable is Goal Success (+1) versus Failure (0); Goal Type coded -1 for Approach and +1 for Avoidance; RAM = Relative Autonomous Motivation; Marginal R^2 represents the variance accounted for by fixed effects following recommendations from Nakagawa and Schielzeth (2013); The level-1 (residual) variance in generalized hierarchical linear models with a binomial distribution is always defined as $\pi^2/3$, so we only report changes in variance at Level-2 (day) and Level-3 (person; for a discussion, see Austin & Merlo, 2017); $p < .10$ †, $p < .05$ *, $p < .01$ **, $p < .001$ ***

Table 3
Goal Success/Failure as a function of RAM, Goal Type, and Goal Specificity for Study 1.

	Three-Week Goals		Daily Goals	
Intercept	0.49 [0.11] ***	0.49 [0.11] ***	1.01 [0.06] ***	1.01 [0.11] ***
Goal Type	1.10 [0.03] ***	1.10 [0.03] ***	0.71 [0.03] ***	0.71 [0.03] ***
Specificity	0.07 [0.03] **	0.08 [0.03] **	-0.09 [0.03] **	-0.09 [0.03] *
RAM		0.05 [0.02] *		0.03 [0.02]
Goal Type x Specificity	-0.46 [0.03] ***	-0.55 [0.04] ***	-0.27 [0.03] ***	-0.27 [0.03] ***
RAM x Goal Type		-0.28 [0.01] **		0.01 [0.01]
RAM x Specificity		-0.03 [0.01] **		0.01 [0.01]
RAM x GT x Specificity		0.02 [0.01] **		-0.01 [0.01]
Simple Effects				
Approach Goals				
Specificity		0.50 [0.05] ***		0.18 [0.05] **
RAM		0.09 [0.03] **		
RAM x Specificity		-0.07 [0.02] ***		
Avoidance Goals				
Specificity		-0.26 [0.04] ***		-0.31 [0.05] ***
RAM		0.03 [0.03]		
RAM x Specificity		-0.01 [0.01]		
BIC	16,764.5	16,784.4	11,137.9	11,171.4
Marginal R^2	.183	.185	.092	.093
χ^2 model comparison (df)	18.55 (4) ***		3.28 (4)	
Δ Person-level variance	- 2.7%		- 1.7%	
Δ Day-level variance	+ 1.7%		+ 0.4%	

Notes. Unstandardized coefficients and standard errors reported; Dependent variable is Goal Success (+1) versus Failure (0); Goal Type coded -1 for Approach and +1 for Avoidance; RAM = Relative Autonomous Motivation; Specificity values range from (-2) to (+2) with larger values indicating broader goals; Marginal R^2 represents the variance accounted for by fixed effects following recommendations from Nakagawa and Schielzeth (2013); The level-1 (residual) variance in generalized hierarchical linear models with a binomial distribution is always defined as $\pi^2/3$, so we only report changes in variance at Level-2 (day) and Level-3 (person; for a discussion, see Austin & Merlo, 2017); $p < .10$ †, $p < .05$ *, $p < .01$ **, $p < .001$ ***

Table 4
Descriptive statistics for Study 2.

	All observations	Only when lunch was eaten
Number of goal outcomes	12365	9342
Number of days	2123	1614
Approach goals		
Mean goal success rate	21.3%	31.5%
$ICC_{Person\text{-}level}$	.28	.13
$ICC_{Day\text{-}level}$	.09	.001
Avoidance goals		
Mean goal success rate	96.5%	91.6%
$ICC_{Person\text{-}level}$	.45	.09
$ICC_{Day\text{-}level}$	.18	.04
Food Availability		
Mean (SD)	2.25 (1.27)	2.39 (1.29)
Median	2	3
$ICC_{Person\text{-}level}$	.19	.18
$ICC_{Day\text{-}level}$	.13	.06

Notes. ICC = intraclass correlation coefficient.

Table 5
Goal Success/Failure as a function of Goal Type, Food Availability and RAM for Study 2.

	All observations		Only when lunch was eaten	
Intercept	0.86 [0.09] ***	0.87 [0.09] ***	0.93 [0.09] ***	0.93 [0.09] ***
Goal Type	2.75 [0.06] ***	2.76 [0.06] ***	2.35 [0.06] ***	2.36 [0.06] ***
Food Availability	0.15 [0.04] ***	0.14 [0.04] ***	0.14 [0.04] ***	0.13 [0.04] **
RAM		0.05 [0.03]		0.05 [0.03]
Goal Type X Food Avail.	-1.16 [0.04] ***	-1.17 [0.04] ***	-1.12 [0.04] ***	-1.13 [0.04] ***
RAM x Goal Type		0.03 [0.02]		0.05 [0.02] **
RAM x Food Avail.		-0.01 [0.01]		-0.02 [0.01]
RAM x GT x Food Avail.		-0.02 [0.01]		-0.03 [0.01] *
Simple Effects				
Approach Goals				
Food Availability		1.59 [0.06] ***		1.46 [0.06] ***
RAM				0.01 [0.05]
RAM x Food Availability				0.02 [0.02]
Avoidance Goals				
Food Availability		-1.34 [0.08] ***		-1.28 [0.09] ***
RAM				0.08 [0.06]
RAM x Food Availability				-0.05 [0.03] †
χ^2 model comparison (df)	4.06 (4)		7.65 (4)	
BIC	7,784.4	7,818.0	6,594.0	6,622.9
Marginal R^2	.687	.690	.639	.647
Δ Person-level variance	- 0.1%		- 0.8%	
Δ Day-level variance	- 0.2%		+ 0.6%	

Notes. Unstandardized coefficients and standard errors reported; Outcome variable is Goal Success (+1) versus Failure (0); Goal Type coded -1 for Approach and +1 for Avoidance; RAM = Relative Autonomous Motivation; Food Availability is grand-mean centered; Marginal R^2 represents the variance accounted for by fixed effects following recommendations from Nakagawa and Schielzeth (2013); The level-1 (residual) variance in generalized hierarchical linear models with a binomial distribution is always defined as $\pi^2/3$, so we only report changes in variance at Level-2 (day) and Level-3 (person; for a discussion, see Austin & Merlo, 2017); $p < .10$ †, $p < .05$ *, $p < .01$ **, $p < .001$ ***

Table 6

Perceived food availability, the likelihood of eating lunch, and the likelihood of packing lunch as a function of RAM

	Perceived food availability		Likelihood of eating lunch		Likelihood of packing lunch	
Intercept	-0.02 [0.05]	-0.03 [0.05]	1.46 [0.14] ***	1.47 [0.14] ***	-1.48 [0.20] ***	-1.48 [0.20] ***
Goal Type	-0.14 [0.01] ***	-0.14 [0.01] ***				
RAM		-0.01 [0.02]		0.19 [0.05] ***		0.14 [0.07] *
RAM x Goal Type		-0.02 [0.01] ***				
Simple Effects						
Approach Goals						
RAM		0.02 [0.02]				
Avoidance Goals						
RAM		-0.02 [0.02]				
χ^2 model comparison (df)	34.58 (2) ***		16.20 (1) ***		4.57 (1) *	
BIC	28966.3	28950.0	2116.1	2107.6	1309.8	1312.4
Marginal R^2	.012	.015	-	.057	-	.023
Δ Person-level variance	- 0.1%		- 14.6%		- 4.2%	
Δ Day-level variance	+ 0.9%					
Δ Goal-level variance	- 0.5 %					

Notes. Unstandardized coefficients and standard errors reported; Food Availability modeled with a three-level hierarchical linear model; Likelihood of eating lunch (No = 0, Yes = 1) and packing lunch (No = 0, Yes = 1) modeled with a two-level generalized hierarchical linear model; Likelihood of packing lunch only involves observations where participants were on campus or in a place where food could be purchased; Goal Type coded -1 for Approach and +1 for Avoidance; RAM = Relative Autonomous Motivation; Marginal R^2 represents the variance accounted for by fixed effects following recommendations from Nakagawa and Schielzeth (2013); $p < .10$ †, $p < .05$ *, $p < .01$ **, $p < .001$ ***

Figures

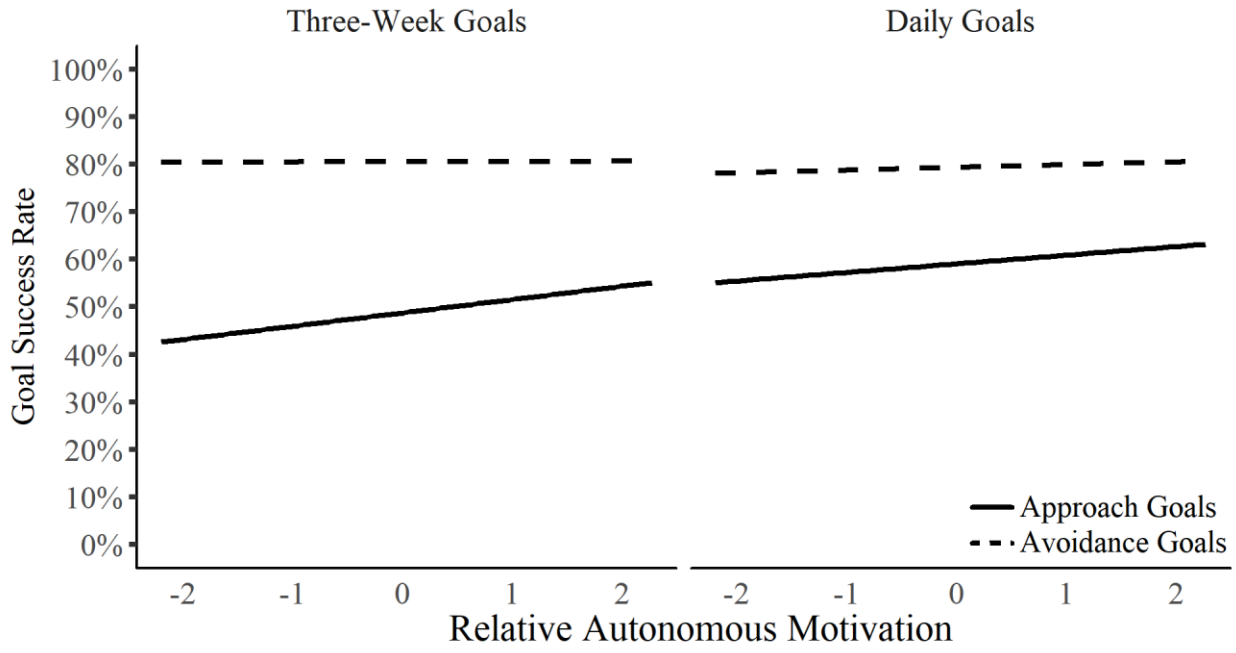

Figure 1. Daily- and three-week approach and avoidance goal success as a function of relative autonomous motivation for Study 1.

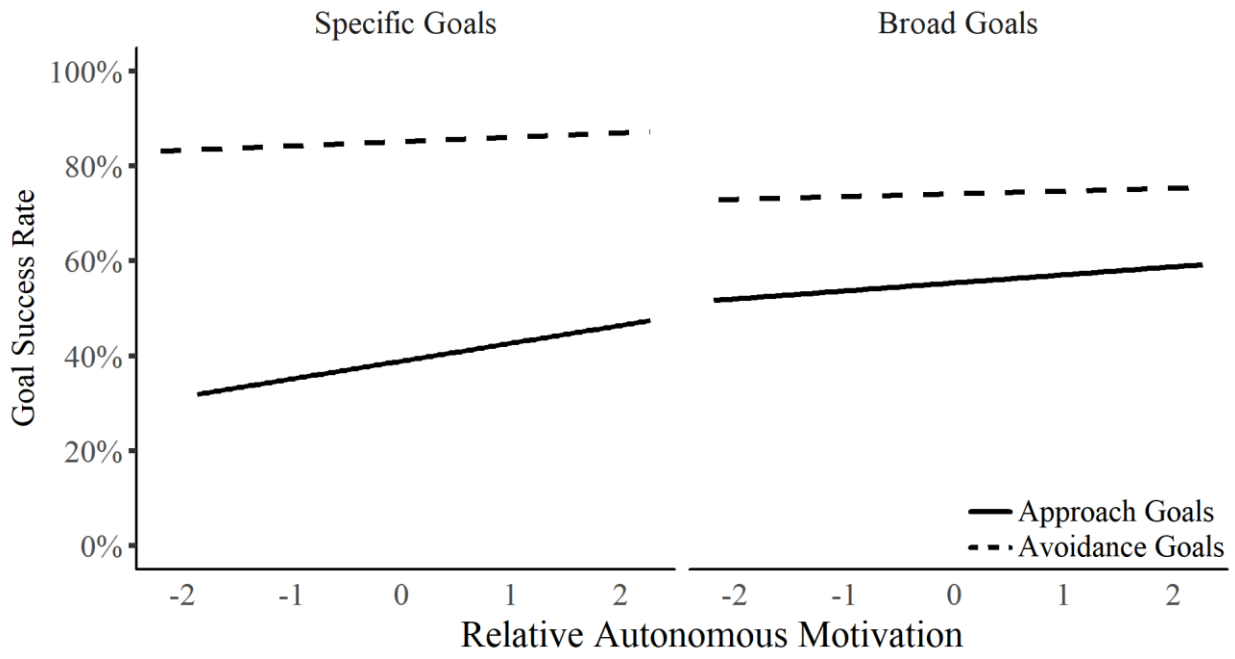

Figure 2. Three-week approach and avoidance goal success as a function of relative autonomous motivation and goal specificity for Study 1. Goal specificity values of (0), (-1), and (-2) coded as "Specific Goals", and (+1) and (+2) as "Broad Goals".

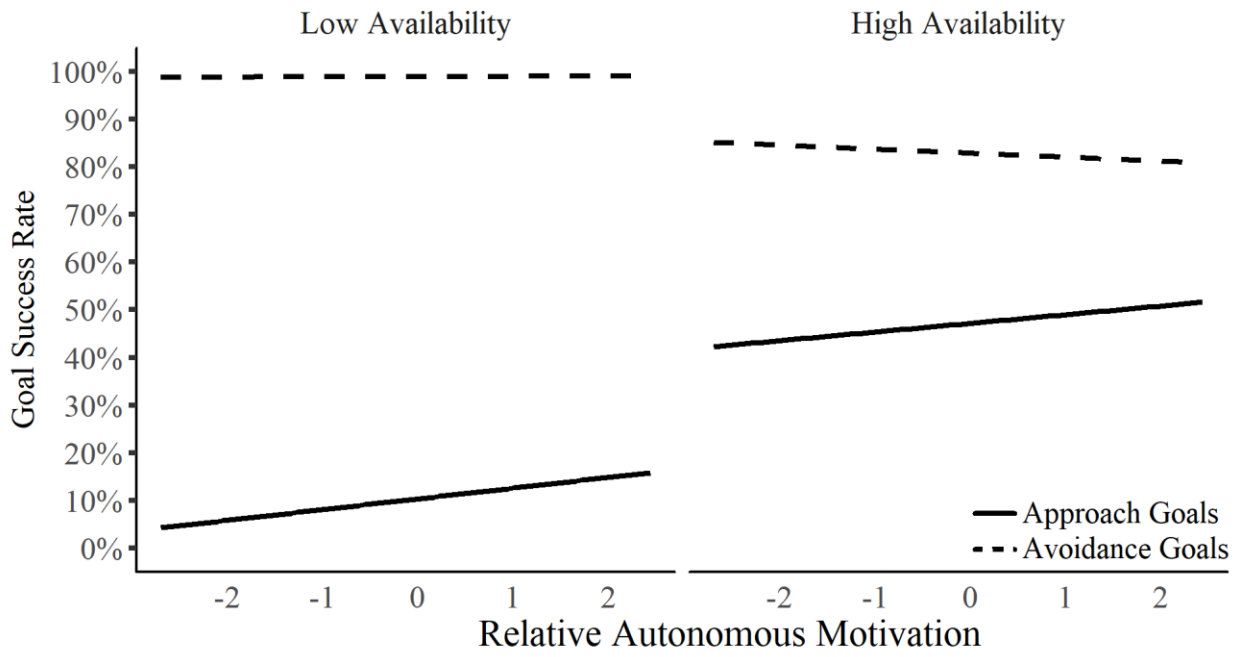

Figure 3. Approach and avoidance goal success as a function of relative autonomous motivation and food availability for Study 2. Low availability comprised of responses for (1) "No, this food was not available" and (2) "Yes, but I had to purchase ingredients to prepare and/or cook it", and high availability of (3) "Yes, but some preparation and/or cooking was required, or I had to purchase it already prepared (e.g., grocery, restaurant, cafeteria)" and (4) "Yes it was readily available (e.g., already prepared or purchased)". Includes only observations where lunch was eaten.

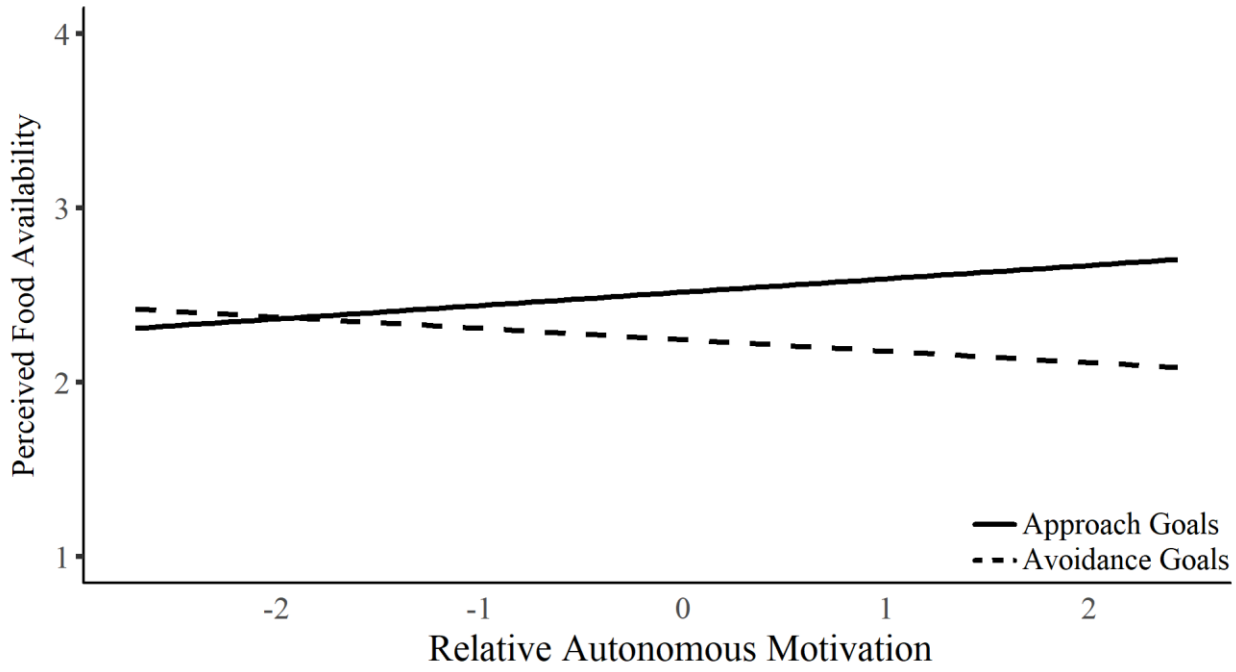

Figure 4. Perceived food availability as a function of relative autonomous motivation for Study 2 for observations where lunch was consumed. To measure food availability, participants were asked "Was this food available to you at lunch?" for each of their food goals, and asked to respond either (1) "No, this food was not available", (2) "Yes, but I had to purchase ingredients to prepare and/or cook it", (3) "Yes, but some preparation and/or cooking was required, or I had to purchase it already prepared (e.g., grocery, restaurant, cafeteria)", or (4) "Yes it was readily available (e.g., already prepared or purchased)".

Supplemental Material

Study 1: Including Approach and Avoidance Sensitivities in the Primary Analyses

We fit each model while controlling for the interactions between Goal Type (i.e., Approach vs. Avoidance) and participants' BIS and BAS scores. To facilitate interpretation, the BIS and BAS scores were standardized and reverse coded. BIS scores were negatively related to goal success, *OR* = 0.98 [95% CI = 0.96, 1.00], *p* = .050, but BAS scores were not, *OR* = 1.01 [95% CI = 0.99, 1.04], *p* = .238, and neither the BIS x Goal Type or BAS x Goal Type interactions were significant, *OR* = 1.00 [95% CI = 0.99, 1.02], *p* = .822, and, *OR* = 0.99 [95% CI = 0.98, 1.00], *p* = .182, respectively. Including these control variables did not significantly influence the findings regarding motivation.

Study 1: Details of Post-Hoc Analyses

Goal Specificity and Relative Autonomous Motivation

We examined whether RAM was related to the specificity of goals that participants set. To do so, we fit a two-level hierarchical linear model with a random intercept for each person, Goal Specificity as the dependent variable, and Goal Type, RAM, and the interaction as predictors. The main effect of Goal Type was significant, *OR* = 0.94 [95% CI = 0.89, 0.99], *p* = .023, indicating that participants set slightly more specific avoidance goals than approach goals. However, neither the main effect of RAM, *OR* = 1.02 [95% CI = 0.99, 1.05], *p* = .203, nor the RAM x Goal Type interaction were significant, *OR* = 1.01 [95% CI = 0.99, 1.03], *p* = .195. Therefore, relative autonomous motivation did not influence the specificity of approach or avoidance goals that participants set.

Endorsing a Three-Week Goal on a Given Day

We examined how endorsing a three-week approach or avoidance goal on a given day was related to the likelihood of goal success. Goal Endorsement was dummy coded (0) "not

endorsed" or (1) "endorsed". A model with Goal Endorsement, Goal Type, and the interaction provided a much better fit than a model with only Goal Type, $\chi^2(2) = 279.92$, $p < .001$. Specifically, endorsing a food goal increased the likelihood of success for approach goals, *OR* = 2.21 [95% CI = 1.97, 2.48], $p < .001$, but not for avoidance goals, *OR* = 0.98 [95% CI = 0.84, 1.13], $p = .752$. Including RAM and the associated interaction terms in this model improved fit, $\chi^2(4) = 11.90$, $p = .018$. When goals were not endorsed, the Goal Type x RAM interaction was significant, OR = 0.97 [95% CI = 0.95, 0.99], $p = .006$, but was non-significant when goals were endorsed, OR = 0.99 [95% CI = 0.97, 1.01], $p = .211$. To determine whether RAM was related to the likelihood of endorsing approach or avoidance goals on a given day, we fit a two-level hierarchical linear model with Goal Endorsement as the dependent variable, and Goal Type, RAM, and the interaction as predictors. The main effect of Goal Type was significant, *OR* = 1.26 [95% CI = 1.22, 1.31], $p < .001$, indicating that avoidance goals were endorsed more often than approach goals. The main effect of RAM and the associated interaction were non-significant, *OR* = 1.03 [95% CI = 0.95, 1.13], $p = .458$, and OR = 1.01 [95% CI = 0.99, 1.02], $p = .270$. Thus, RAM was unrelated to goal endorsement on a given day.

Relation Between Approach and Avoidance Goal Success on a Given Day

We fit a model to investigate the relationship between approach and avoidance goal success on a given day. For both three-week and daily goals, we fit a two-level hierarchical linear model with a random intercept for each person, the proportion of avoidance goal successes as the dependent variable, and the proportion of approach goal successes (person-mean-centered) and the day as predictors. We found that participants were more successful at their avoidance goals on days when they were also successful at their approach goals. The effect was significant for three-week goals, *OR* = 1.07 [95% CI = 1.04, 1.10], $p < .001$, and in the same direction for daily goals, *OR* = 1.04 [95% CI = 1.00, 1.08], $p = .055$. To ensure proper coupling of approach

and avoidance goal successes, we controlled for Day (values scaled from 0 [start of diary] to 1 [end of diary]) in each model. For avoidance goals, the likelihood of goal success increased over the course of the diary phase for both three-week goals, *OR* = 1.44 [95% CI = 1.15, 1.82], *p* = .001, and for daily goals, *OR* = 1.56 [95% CI = 1.17, 2.07], *p* = .002. This was also true for approach goal success for both three-week goals, OR = 1.37 [95% CI = 1.16, 1.64], *p* < .001, and daily goals, *OR* = 1.37 [95% CI = 1.09, 1.73], *p* = .006.

Study 2: Including Approach and Avoidance Sensitivities in the Primary Analyses

For observations where participants ate lunch, we fit each model while controlling for the interactions between Goal Type (i.e., Approach vs. Avoidance) and participants' BIS and BAS scores. To facilitate interpretation, the BIS and BAS scores were standardized and reverse coded. BIS scores were not related to goal success, *OR* = 0.99 [95% CI = 0.97, 1.01], *p* = .258, nor were BAS scores, *OR* = 1.00 [95% CI = 0.98, 1.02], *p* = .899. Likewise, neither the BIS x Goal Type or BAS x Goal Type interactions were significant, *OR* = 1.00 [95% CI = 0.98, 1.01], *p* = .755, and, *OR* = 1.01 [95% CI = 0.99, 1.03], *p* = .170, respectively. Including these control variables did not significantly influence the findings regarding motivation or food availability.

Study 2: Details of Post-Hoc Analyses

Goal Specificity and Relative Autonomous Motivation

We examined the relationship between goal type, goal specificity, RAM, and goal success/failure. As expected, more broad (vs. specific) approach were goals rated as being easier to attain, *r* = -0.42, *p* < .001, and more broad (vs. specific) avoidance goals rated as being more difficult, *r* = 0.51, *p* < .001. In multilevel analyses predicting goal success/failure, the Goal Type x Goal Specificity interaction was significant, *OR* = 0.59 [95% CI = 0.55, 0.64], *p* < .001, and simple effects analysis showed that goal success was higher for broader approach goals *OR* = 1.55 [95% CI = 1.39, 1.74], *p* < .001, and for more specific avoidance goals, *OR* = 0.62

[95% CI = 0.53, 0.72], $p < .001$. As depicted in Supplemental Table 1, including RAM and all associated interactions significantly improved model fit, $\chi^2(4) = 12.50$, $p = .014$. Accordingly, the two-way interaction was significant, *OR* = 1.03 [95% CI =1.01, 1.06], $p = .002$. The RAM x Goal Specificity interaction was significant for approach goals, *OR* = 0.96 [95% CI = 0.92, 1.00], $p = .032$, but not for avoidance goals, *OR* = 1.01 [95% CI = 0.96, 1.06], $p = .759$. Specifically, the positive effects of Goal Specificity on goal success were stronger for those with high RAM scores (+1 SD), *OR* = 1.89 [95% CI = 1.59, 2.26], $p < .001$, than those with low RAM scores (-1 SD), OR = 1.33 [95% CI = 1.14, 1.55], $p < .001$. In other words, broad approach goals were more likely to be achieved by those higher in RAM (see Supplemental Figure 1)

To determine whether RAM was related to setting broader versus specific approach and avoidance goals, we fit a two-level hierarchical linear model with Goal Specificity as the dependent variable, and Goal Type, RAM, and the interaction as predictors. Overall, participants set slightly broader avoidance goals than approach goals, *OR* = 1.07 [95% CI = 1.00, 1.13], $p = .031$, but RAM and the interaction term were non-significant, *OR* = 1.0 [95% CI = 0.97, 1.03], $p = .782$, and *OR* = 1.01 [95% CI = 0.99, 1.03], $p = .527$. Thus, RAM was unrelated to goal specificity.

Relation Between Approach and Avoidance Goal Success on a Given Day

Finally, we tested whether approach and avoidance goal success on a given day were linked. We fit a two-level hierarchical linear model with a random intercept for each person, the proportion of avoidance goal successes as the dependent variable, and the proportion of approach goal successes (person-mean centered) and the day in the diary as predictors. When participants were more successful at their approach goals, they were also more successful at their avoidance goals, *OR* = 1.05 [95% CI = 1.02, 1.09], $p = .003$. To ensure proper coupling of approach and avoidance goal successes, we controlled for Day (values scaled from 0 [start of diary] to 1 [end

of diary]) in each model. The likelihood of goal success did not change over the course of the diary phase for either avoidance, *OR* = 1.00 [95% CI = 0.97, 1.03], *p* = .922, or approach goals, *OR* = 1.00 [95% CI = 0.96, 1.04], *p* = .999.

Lunch Location, Packing Lunch, and Relative Autonomous Motivation

We fit several models to examine the relationship between location (0 = On campus or in a place where food could be purchased, vs. +1 = Home), packing lunch (0 = No, vs. +1 = Yes), relative autonomous motivation, and goal success/failure. In a model with Goal Type, Location, and the associated interaction, the interaction was non-significant, *OR* = 1.06 [95% CI = 0.92, 1.23], *p* = .416. However, the main effect of Location was significant, *OR* = 1.31 [95% CI = 1.11, 1.53], *p* = .001, demonstrating that both approach and avoidance goal success were higher when eating lunch at home than on campus or in a place where food could be purchased. Including RAM and all associated interactions did not improve model fit, $\chi^2(4) = 1.88$, *p* = .759. Also, we found that RAM was unrelated to the likelihood of eating at home, *OR* = 1.00 [95% CI = 0.99, 1.02], *p* = .624.

When participants ate lunch on campus, packing their own lunch improved the likelihood of goal success, *OR* = 1.70 [95% CI = 1.34, 2.15], *p* < .001. This was true for both types of goals, as the Goal Type x Pack Lunch interaction was non-significant, *OR* = 1.10 [95% CI = 0.90, 1.35], *p* = .327. Including RAM and associated interactions did not improve model fit, $\chi^2(4) = 3.41$, *p* = .320. Notably, RAM was positively related to the likelihood of packing a lunch when eating on campus, *OR* = 1.15 [95% CI = 1.01, 1.31], *p* = .033.

Study 2: Additional Analyses of the Costs and Time Required to Prepare or Get Foods

As described in the manuscript, there were some unexpected findings regarding the measures assessing the costs and time required to prepare or get foods. We expected Food Costs and Required Time to be positively related to the likelihood of goal success for avoidance goals,

and negatively so for approach goals. However, Food Costs and Required Time were positively associated with the likelihood of approach goal success, *OR* = 1.26 [95% CI = 1.16, 1.38], $p < .001$, and *OR* = 1.22 [95% CI = 1.12, 1.33], $p < .001$. For avoidance goals, the likelihood of goal success was negatively related to Food Costs, *OR* = 0.84 [95% CI = 0.73, 0.98], $p = .019$, and unrelated to Required Time, *OR* = 0.97 [95% CI = 0.83, 1.13], $p = .680$. Therefore, we conducted additional analyses to further understand these variables.

First, we examined the relationships between Food Availability and both Food Costs and Required Time using three-level hierarchical linear models with Food Availability as the outcome. We expected higher costs and time required to get foods would be associated with lower perceived food availability for both approached and avoided foods. For approach goals, there was a negative relationship between perceived availability and the time required to get or prepare foods, *OR* = 0.86 [95% CI = 0.83, 0.90], $p < .001$, and a more positive (though borderline significant) relationship between perceived availability and the costs of foods, *OR* = 1.04 [95% CI = 1.00, 1.08], $p = .053$, For avoidance goals, the relationship between food costs and perceived availability was non-significant, *OR* = 0.99 [95% CI = 0.95, 1.03], $p = .622$, and there was a negative relationship between perceived availability and the time required to get or prepare foods, *OR* = 0.81 [95% CI = 0.77, 0.84], $p < .001$. Thus, the relationship between Food Availability and Required Time was as expected, but the relationship between Food Availability and Food Costs was not.

Further, we realized that part of the issue with these two items may be in how they were used when foods were unavailable. When foods were perceived as less available or unavailable, we expected participants would report greater costs and required time to get them, or to indicate that they were unable to purchase or prepare them. However, when participants indicated foods were unavailable they often reported “No cost” (21.2%) and “No time at all” (28.3%). We

interpret this finding as a potential problem in how participants used the Food Costs and Required Time measures when foods were unavailable. Therefore, we decided to reanalyze these data after removing observations where foods were unavailable, which were 41.2% of observations. With these observations removed we found the expected relationships between Food Availability and Food Costs for both approach, *OR* = 0.90 [95% CI = 0.88, 0.92], $p < .001$, and avoidance goals, *OR* = 0.85 [95% CI = 0.83, 0.88], $p < .001$, as well as between Food Availability and Required Time for both approach, *OR* = 0.78 [95% CI = 0.76, 0.80], $p < .001$, and avoidance goals, *OR* = 0.78 [95% CI = 0.76, 0.80], $p < .001$. However, for approach goals, there was still an unexpected positive relationship between the likelihood of goal success and both Food Costs, OR = 1.16 [95% CI = 1.05, 1.29], $p = .003$, and Required Time, *OR* = 1.19 [95% CI = 1.07, 1.33], $p = .001$. For avoidance goals, these relationships were non-significant for both Food Costs, *OR* = 0.97 [95% CI = 0.83, 1.14], $p = .693$, and Required Time, *OR* = 0.98 [95% CI = 0.83, 1.17], $p = .841$. Thus, we can conclude that the Food Costs and Required Time variables were not appropriate for modeling healthy eating goal difficulties.

Despite instructions to participants, it seems that they used these two items in a different way than we anticipated. Ostensibly, participants reported their required time and costs if they ate the foods, but often selected response options for no cost or time if they did not. It seems that even if foods were available to participants, they often reported no costs or time (likely because they spent no time or money), rather than using the response option to indicate to indicate they were unable to purchase or prepare the food. Therefore, we cannot be confident in the validity of these two items. Any interpretation should be made with caution.

Supplemental Figure

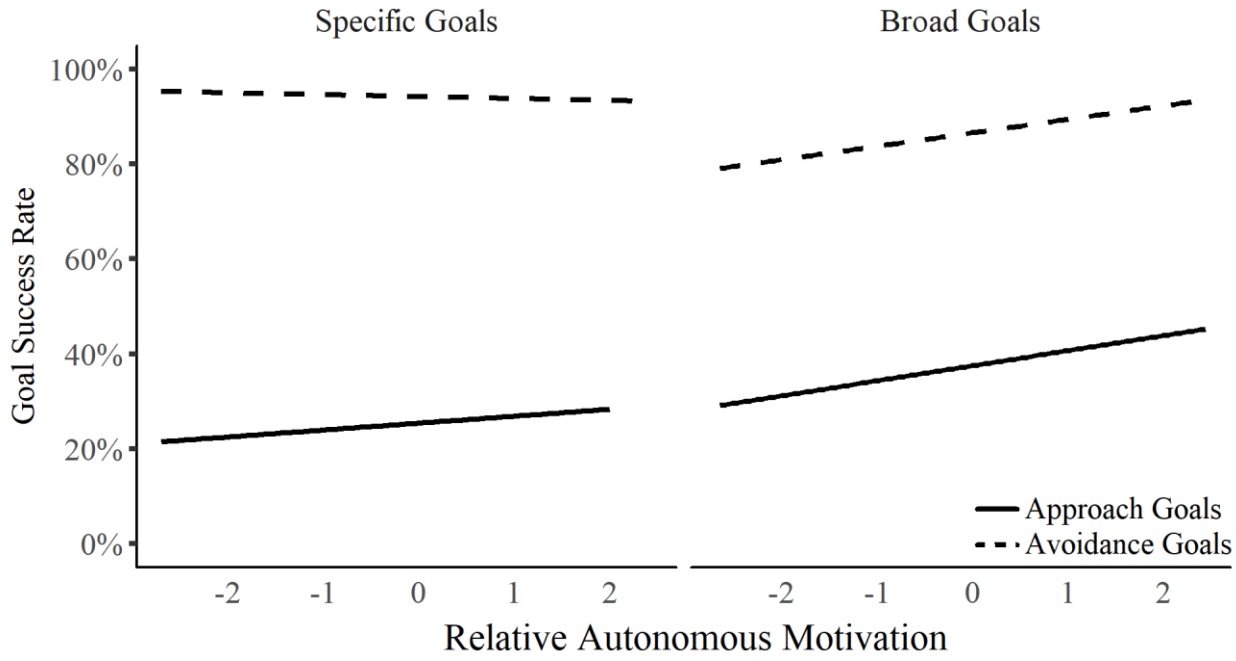

Figure 5. Goal success as a function of relative autonomous motivation and goal specificity for Study 2 for observations where lunch was eaten. Goal specificity values of (0), (-1), and (-2) coded as “Specific Goals”, and (+1) and (+2) as “Broad Goals”.

Supplemental Table

Supplemental Table 1
Goal Success/Failure as a function of RAM, Goal Type, and Goal Specificity for Study 2.

	Base model	Full model
Intercept	0.96 [0.08] ***	0.97 [0.08] ***
Goal Type	2.03 [0.05] ***	2.05 [0.05] ***
Specificity	-0.06 [0.04]	-0.06 [0.04]
RAM		0.02 [0.03]
Goal Type x Specificity	-0.53 [0.04] ***	-0.54 [0.04] ***
RAM x Goal Type		-0.02 [0.02]
RAM x Specificity		0.01 [0.01]
RAM x GT x Specificity		0.04 [0.01] **
Simple Effects		
Approach Goals		
Specificity		0.60 [0.09] ***
RAM		0.04 [0.03]
RAM x Specificity		-0.04 [0.02] *
Avoidance Goals		
Specificity		-0.51 [0.12] ***
RAM		0.04 [0.05]
RAM x Specificity		0.01 [0.03]
BIC	8,037.2	8,061.2
Marginal R^2	.471	.473
χ^2 model comparison (df)	12.50 (4) *	
Δ Person-level variance	+ 2.4%	
Δ Day-level variance	+ 2.6%	

Notes. Unstandardized coefficients and standard errors presented, Only involves observations where lunch was eaten, Outcome variable is Goal Success (+1) versus Failure (0), Goal Type coded -1 for Approach and +1 for Avoidance, RAM = Relative Autonomy Index, Specificity values range from (-2) to (+2) with larger values indicating broader goals, Marginal R^2 represents the variance accounted for by fixed effects following recommendations from Nakagawa and Schielzeth (2013), $p < .10$ †, $p < .05$ *, $p < .01$ **, $p < .001$ ***

Chapter 3: Learning During the Covid-19 Pandemic:

How Motivational Interferences Impact Students' Motivation for Schoolwork

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Contributions

I planned the series of studies in this manuscript in collaboration with Dr. Grouzet. We both conducted the studies and I performed the data analysis. I wrote the first draft of the manuscript and made several revisions as suggested by Dr. Grouzet. Some edits on different versions of the manuscript were made by Dr. Grouzet.

Abstract

A common challenge students face when doing schoolwork is the variety of distractions, temptations, and obligations that arise, especially given the shift to learning and working from home due to the Covid-19 pandemic. These instances can create motivational interference that has been shown to lead to negative affect and impair academic performance (Fries & Dietz, 2007; Grund et al., 2015) and may impact students' motivation towards their schoolwork. Among students enrolled in online (Study 1) and in-person classes (Study 2), we used daily diary methods to test the hypothesis that motivational interference would increase students' more salient form of motivation towards their schoolwork. These studies provided mixed evidence for this hypothesis, but showed that relative autonomous motivation (RAM) promotes persistence with schoolwork when interference occurs. We propose possible explanations for the mixed findings regarding the impact of motivational interference on situational motivation.

Keywords: situational motivation, motivational interference, self-determination theory, academics

Learning during the Covid-19 pandemic:

How motivational interferences impact students' motivation for schoolwork

The Covid-19 pandemic led to a dramatic increase in the number of students and employees who had to work and study from home. This shift introduced new challenges, such as difficulties maintaining a work-life balance and focusing while working from home (Rasheed et al., 2020; Rubin et al., 2020). For students, sitting down to study or write a paper at home involves managing various distractions (e.g., smartphone, roommates), temptations (e.g., playing video games, using social media), and obligations (e.g., cleaning the house, going for a run).

Prior research has demonstrated that these types of interference are common and can have negative affective and behavioural consequences (e.g., Bailis et al., 2011; Fries & Dietz, 2007; Grund et al., 2015; Riediger & Freund, 2004). However, less is known about how managing these types of interference could impact a student's motivation towards their schoolwork, and more specifically the type of motivation. According to self-determination theory (SDT; Ryan & Deci, 2000), a student's motivation could range from being more autonomous to more controlled, which could be influenced by motivational interferences. While Vallerand (1997) proposed some general predictions, research on pre-decisional (e.g., Houston & Sherman, 1995) and post-decisional processes (e.g., Brehm, 1956; Gerard & White, 1983) provides some insight into how the type of motivation for schoolwork (i.e., autonomous vs. controlled) might shift when a student experiences motivational interference and decides to continue (vs. quit) working. Under the framework of SDT, we conducted two daily diary studies to examine how motivation interference impacted students' situational motivation, and to test hypotheses that were originally proposed by Vallerand (1997).

Students' Motivation to Learn When At Home

With the increase in online learning and the challenges students face while working from home, especially with COVID-19 pandemic, it is important to understand how students remain motivated while engaging with their schoolwork. Students often report motivational and self-regulatory barriers in their academic pursuits (e.g., Klassen et al., 2008), and for some students, these barriers may be stronger when working from home compared to a campus setting (Aragon & Johnson, 2008; Chen & Jang, 2010). Considering students' degree of autonomous and controlled forms of motivation may provide insight into how they manage these challenges.

Autonomous and Controlled Forms of Motivation

According to SDT (Deci & Ryan, 2000) *autonomous motivation* is characterized by interest, enjoyment, and personal endorsement of a behaviour, whereas *controlled motivation* involves feelings of guilt, contingent self-worth, or is guided by external incentives. Compared to controlled motivation, autonomous motivation is typically associated with more positive outcomes in a range of domains, such as education (Black & Deci, 2000), work (Fernet et al., 2012), and health (Ng et al., 2012). Although autonomous and controlled motivation are described as being categorically distinct, they are proposed to exist on a continuum of self-determined motivation, with subtypes of regulation within each. Specifically, intrinsic motivation, integrated regulation, and identified regulation represent autonomous forms of motivation whereas introjected regulation and external regulation are controlled forms of motivation (Ryan & Deci, 2000). As an alternative to conceptualizing them separately, some researchers opt to focus on a person's degree of autonomous relative to controlled motivation (i.e., RAM; e.g., Katz et al., 2008) as this reflects their general degree of self-determined motivation (for a review, see Howard et al., 2020).

Situational and Contextual Motivation

Vallerand (1997) proposed that motivation exists in a hierarchy where a person's motivation towards a specific sphere of life (e.g., school) is defined as *contextual motivation*, whereas and *situational motivation* reflects moment-to-moment fluctuations of motivation. Research has demonstrated that these levels of motivation are interrelated through both bottom-up and top-down influences (e.g., Blanchard et al., 2007; Ratelle et al., 2005). For instance, a student who frequently feels pressured to study by an instructor in their class (e.g., controlled situational motivation) may develop similar forms of motivation towards other academic activities more generally (i.e., contextual motivation) (bottom-up effect). Similarly, a student with higher (vs. lower) autonomous motivation towards academics would tend to experience more instances of autonomous situational motivation when engaging in school-related activities (top-down effect).

While contextual motivation is relatively stable, situational motivation may quickly and easily change over time and across situations. For example, research has shown how a person's situational motivation can be impacted by interactions with others (Deci et al., 1981; Guay et al., 2000) and by perceptions of goal progress (Koo & Fishbach, 2014). Similarly, Lepper and colleagues (1973) showed how external events, such as the presence of rewards for a leisure activity can undermine children's intrinsic motivation (i.e., shifting away from a form of autonomous motivation). Among students doing schoolwork, external events that create distractions and temptations could thus impact their situational motivation.

Interference During Learning

Interference can come in many forms, from distractions and temptations to obligations and conflicts, and may be especially common when working from home. These experiences are common among students (Grund et al., 2015), and although they are conceptually distinct, they

can all “interfere” with a student’s schoolwork by diverting attention and energy towards an alternative activity. For instance, a student may try to do schoolwork but have the temptation to log on to social media to connect with friends, get distracted by a notification from their smartphone, or become aware of responsibilities such as housework and cleaning. Most students do their schoolwork using a personal computer, which could also be a source of entertainment, cuing activities that conflict with the goal of completing schoolwork (e.g., playing video games, watching online videos, shopping online).

Interfering thoughts and distractions can occur spontaneously (Hollis & Was, 2016; Killingsworth & Gilbert, 2010), but it is widely recognized that the environment plays a key role in priming conflicting goals (Förster et al., 2007; Shah & Kruglanski, 2002) and guiding our actions (Thaler & Sunstein, 2009). This is also reflected in advice from parents and teachers to avoid studying in front of the television, and may be why some students often prefer to work in a campus library or study space than in their own apartment. Indeed, one of the greatest challenges to online learning reported by students is a lack of “self-regulation”, suggesting students may struggle managing competing activities and focusing on their schoolwork (e.g., Calderwood et al., 2014; Rosen et al., 2013).

Motivational Interference

The term *motivational interference* can be defined as “the process by which incentives of conflicting options destabilize the current activity” (Hofer & Fries, 2016). In other words, motivational interference reflects the extent that motivation towards a current activity (e.g., schoolwork) is impacted by the introduction of a motivational urge or tendency to engage in a goal-conflicting activity (e.g., video games). Using experience sampling methods, Grund and colleagues (2015) demonstrated that motivational interference is common among students, and that it tends to evoke negative affect and impair academic performance. In a similar line of

research, Fries and Dietz (2007) showed how the presence of an alternative activity (i.e., television) can impair learning during a reading task. Such findings are consistent with research highlighting the negative affective and behavioural outcomes of motivational interference (e.g., Ward et al., 2017). Motivational interference has also been likened to intrapersonal conflict and motivational conflict (e.g., Emmons & King, 1988; Riediger & Freund, 2008), and is similar to the concept of goal conflict (e.g., Locke et al., 1994; Kehr, 2003), albeit with a stronger focus on competing motivational tendencies than the organization of conflicting goals.

Although empirical evidence and meta-analyses have demonstrated negative outcomes of such conflicts (e.g., Boudreaux & Ozer, 2013; Gray et al., 2017), not all forms of interference are experienced the same way. Some researchers have made the distinction between Want-Conflicts (i.e., wanting to do something else) and Should-Conflicts (i.e., feeling a pressure or obligation do something else; e.g., Grund et al., 2015; O'Connor et al., 2002; Riediger & Freund, 2008), which highlights differences in the motivational tendency towards the activity causing the interference. A number of competing motivational tendencies could introduce a *Want-Conflict* when a student tries to engage in an activity such as studying.[17] For example, in an interview by Schmid and colleagues (2005), one student stated: "…I sit down on my bed with my exercise-book, and ten minutes later I suddenly find myself in the kitchen, eating something, drinking something, then I play at my PlayStation for half an hour, and then I go back and continue studying" (p. 251). In contrast, a *Should-Conflict* may be more likely to arise when a person in engaged in a leisure task

[17] At a phenomenological level, a Want-Conflict resembles a self-control conflict. Self-control conflicts have historically been portrayed as decisions between a "cold", controlled option and a "hot", automatic option, with the former option being more conducive to attaining a long-term goal (Baumeister et al., 2007; James, 1890; Metcalfe & Mischel, 1999). Researchers have made connections between the experience of desire associated with the immediate, short-term temptation, and the affective experiencing of "wanting" (e.g., Kotabe & Hofmann, 2015), highlighting the similarities of self-control dilemmas and want-conflicts.

and feels pressure to spend time on their work or studies – a scenario that reflects the challenge of maintaining a work-life balance and "switching off" among those who work from home (Pontefract, 2020). In Schmid and colleagues' study (2005), another student reported a clear should-conflict by stating: "… I'm sitting there [in the cinema] and say to myself: 'To watch this movie now, what's the use of it?' … if I don't get a good mark in the test, or fail in the exam or something like that, what's the use of that movie?" (p. 251).

The central distinction between Want-Conflicts and Should-Conflicts is in the phenomenology of the motivational pull towards the alternative activity. In other words, people may feel that they "want to", or "should" do something. Compared to controlled forms of motivation, autonomous motivation is experienced as a relatively internal motivational pull, which may be why it is sometimes referred to as "want-to" motivation (e.g., Ernst et al., 2018; Milyavskaya et al., 2015; Werner & Milyavskaya, 2019). Similarly, controlled motivation has been called *have-to* motivation, denoting a similar experience as *should* motivation. Although the use of this colloquial terminology conflates the quality of a person's motivation with their affective experience, parallels regarding the locus of causality suggest it is reasonable to make this connection. However, the distinction between Want-Conflicts and Should-Conflicts overlooks a person's motivation for their current activity, a consideration we feel is vital for understanding antecedents, consequences, and the phenomenology of motivational interference.

Situational Motivation for Schoolwork and an Interfering Activity

A more complete picture of interference emerges when considering a person's motivation towards both a current activity (e.g., schoolwork) and an alternative activity (e.g., video games, household chores). For students learning from home, situational motivation towards schoolwork could range from more controlled to more autonomous, just as interference from an alternative activity could evoke motivation that varies in degree of self-determination. For example, a

student may endorse mostly controlled forms of motivation towards their schoolwork (e.g., studying solely because of an upcoming exam), and experience interference stemming from activities evoking either autonomous (e.g., wanting to hang out with friends), or controlled forms of motivation (e.g., feeling pressured to join friends). Moreover, the phenomenology and consequences of interference may be different for a student with more autonomous motivation towards their schoolwork (e.g., being interested in the course content).

Although the relative frequency of these types of motivational interference differ across populations and contexts, some research suggests they most commonly result from autonomously motivating activities, such as those that evoke desires and temptations (Hofmann et al., 2012; Riediger & Freund, 2008). Nonetheless, research by Gorges and colleagues (2014) provides some evidence that considering the degree of self-determined motivation towards both one's current activity and an alternative activity is a meaningful way to study this phenomenon. Findings from her research showed that autonomous motivation towards both a current and alternative activity is associated with feelings of positive affect (e.g., excitement), while controlled motivation towards both activities is more likely to evoke negative affect (e.g., frustration). Thus, it is important to examine the motivational tendency towards both activities, as these findings suggest not all forms of interference lead to the same outcomes.

Furthermore, some research suggests autonomously motivated individuals may be less likely to experience interference than those with more controlled forms of motivation (e.g., Ratelle et al., 2005; Senécal et al., 2003). Across four studies, Milyavskaya and colleagues (2015) demonstrated that autonomous motivation is associated with fewer experiences of temptation, as well as reduced attraction to them. Other studies have shown that people with more (vs. less) autonomous motivation experience fewer distractions (Baumann & Kuhl, 2005),

find goal pursuit less depleting (Moller et al., 2006; Muraven, 2008), and may be more likely to persist when self-regulation is difficult (Ntoumanis et al., 2014).

How Motivational Interference Could Impact Situational Motivation

A number of studies have examined affective and behavioural effects of interferences, but considerably less research has focused on motivational consequences. Fries and colleagues (2007) found the presence of temptations to negatively impact achievement motivation and intrinsic motivation, but intrinsic motivation is only one form of autonomous motivation, and no measure of controlled motivation was used. Also, participants were only exposed to one type of temptation (i.e., television) in a lab setting, which may pose a threat to the generalizability of these findings because the experimenter-created task was likely less relevant to participants than their own personal academic goals.

Indirect evidence from other research suggests that motivational interference may increase more controlled (relative to autonomous) forms of motivation. For example, impaired well-being (Riediger & Freund, 2004) and reduced goal commitment (Slocum Jr. et al., 2002) are consequences of interference, which are also correlated with more controlled forms of motivation (Koestner et al., 2008; Nix et al., 1999; Sheldon & Elliot, 1998). However, this indirect evidence is limited, and the motivational consequences of interference may depend on a person's motivation towards both activities (e.g., Gorges et al., 2014).

In describing the hierarchical model of motivation, Vallerand (1997) discussed a number of relationships between each motivation at each level, including how situational motivation might be impacted when contextual motivation towards alternative activities are primed. For example, when motivation towards a current activity and interfering activity are both relatively autonomous (i.e., harmonious), this could enhance situational autonomous motivation (Senécal et al., 2001). In contrast, when motivation towards an activity is mostly controlled, such as for

schoolwork, Vallerand (1997) proposed that the presence of an intrinsically motivating activity (e.g., video games) would result in an increase in a student's motivation being "further diminished" (p. 342), or in other words, towards being more controlled. Taken together, these predictions provide a framework for considering the mechanisms that underly possible changes in motivation, such as, the processes involved *before* and *after* making the decision to continue with (vs. quit) one's current activity.

Pre-Decisional Motivation Change

When making a decision, people compare and contrast their options, typically focusing on key differences between them (Kahneman & Tversky, 1984; Tversky, 1977). For a student experiencing motivational interference, this could involve focusing on *why* they are motivated to pursue each activity, emphasizing the most salient (i.e., dominant) form of motivation for each, and contrasting their options. Research in consumer psychology shows that contrasting options can influence the perceived value of each, such that the preferred (or chosen) option is perceived as more valuable and the second option as less valuable (Simonson & Tversky, 1992). Some researchers have also likened subjective "value" to motivation (e.g., Berkman et al., 2017), in that within-person differences in motivation correspond to the perceived value of different courses of action. Thus, we suspect that experiencing motivational interference, and *deciding* to continue working could increase students' endorsement (i.e., valuation) of their salient (relative to non-salient) form of motivation. For example, if a student feels that they are doing their schoolwork because of upcoming deadlines and pressures, interference from a competing activity (e.g., wanting to play video games) may accentuate this form of controlled motivation towards schoolwork. In contrast, a student who rejects an alternative activity (e.g., cleaning the kitchen) and continues studying because they enjoy learning may experience an increase in autonomous motivation.

Importantly, however, this shift relies on the person comparing and contrasting the *types* of motivation they endorse towards the current and interfering activity. Given that people tend to compare and contrast the *unique* features of each option (e.g., Dhar & Sherman, 1996), we suspect that motivational interference will only (or more strongly) increase students' relative salient motivation when the types of motivation towards each activity differ in type. Across three experiments, Houston and colleagues (1989) demonstrated how people tend to focus on the unique features of each option when deciding between them, and we suspect that these processes extend to students' decision making while doing schoolwork. If motivations to engage in schoolwork and an interfering activity were both controlled (or both autonomous), the decision to continue or quit schoolwork may involve comparing choices based on features other than the motivational tendency for each. Thus, motivational interference may only (or perhaps more strongly) increase students' relative salient motivation when the type of motivation towards each activity is different (e.g., one autonomous, the other controlled).

Post-Decisional Motivation Change

Focusing on what happens *after* a student decides to continue working leads to similar predictions about how situational motivation might shift. After rejecting the motivational tendency towards an interfering activity, a student may experience post-decisional dissonance (Elliot & Devine, 1994; McGrath, 2017). This dissonance occurs because the student was motivated to engage in both activities, but rejected one of them, which represents a missed opportunity that could be temporary or more permanent. In other words, this decision creates a discrepancy between what one is currently doing, and what they may have wanted to do, or felt that they should be doing instead.

Research on cognitive dissonance theory (Festinger, 1957) has shown that people strive to reduce post-decisional dissonance (Elliot & Devine, 1994; McGrath, 2017), often by

increasing how much they value the selected option and decreasing their valuing of the rejected option (e.g., Brehm, 1956). This "spreading of alternatives" was clearly demonstrated by Gerard and White (1983) in an experiment that required participants to rank their preferences for a set of paintings both before and after given a choice between two paintings. After selecting their preferred painting, rankings of the selected and not selected paintings increased and decreased, respectively. Similar findings have emerged from other studies (e.g., Brehm, 1956; Steele & Liu, 1983)[18], and may extend to students who are managing motivational interference during schoolwork. After deciding to continue with schoolwork instead of pursuing an alternative activity, a student may reduce post-decisional dissonance by further endorsing their dominant form of motivation towards their schoolwork. Although it would be difficult to observe mechanisms and distinguish between changes in situational motivation that happen *before* or *after* students make a decision, both perspectives suggest students would experience an increase in their salient (relative to non-salient) form of motivation for doing schoolwork.

Current Research

The goal of the current research is to enhance our understanding of how motivational interference impacts a person's situational motivation for an activity. The first study was conducted while students were studying and learning from home during the Covid-19 pandemic, which made more salient the challenges they often face while doing schoolwork (Rasheed et al., 2020). The second study followed the changes in public health guidelines due to Covid-19 as students returned to campus, which offered opportunities to examine a different palette of distractions, temptations, and obligations for students.

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[18] Although the outcome is the same, some researchers propose that this shift in valuing occurs during decision-making, and not after (e.g., Jarcho et al., 2011).

Following Vallerand (1997) and research on pre- and post-decisional processes, we hypothesized that motivational interference accentuates students' most salient form of motivation for engaging with their schoolwork, and that this motivation change is stronger when the type of motivation towards the interfering activity is opposite. We also expected that greater RAM towards schoolwork would be associated with fewer reported interferences, and in the case of interference, a greater likelihood of persisting with schoolwork (vs. switching to an alternative activity). In addition, we examined whether students with stronger (vs. weaker) habits for doing schoolwork experienced interferences differently, given recent findings showing a negative relationship between habit strength and experiences of motivational interference (e.g., Stojanovic et al., 2020).

In order to test these hypotheses, we used daily diary methods to observe students' experiences while doing schoolwork. This approach allowed us to observe the types and frequency of interferences that students' experience, and to minimize retrospective bias by observing instances of motivational interference and changes in situational motivation shortly after they occurred (Maner et al., 2016).

Study 1

Methods

Participants

During March 2021, a total of 43 undergraduate students (34 female, 9 male) were recruited from a psychology participant pool while enrolled in online courses at a Canadian university. All participants were between 18 and 27 years of age (M_{age} = 20.35, SD_{age} = 2.06) and most participants were enrolled in a psychology program (53%). Participants were provided course credit for participating.

Procedure

Participants first complete an initial survey about their academic motivation, their motivation for a variety of activities that could interfere with their schoolwork, and their habit strength. Then, for two weeks, they were invited to complete a brief survey before starting a schoolwork session and then another one when they have finished working. For the purposes of this study, we defined a schoolwork session as at least one-hour period during which a participant will focus on asynchronous schoolwork activities (e.g., studying, reading, writing, working on an assignment) and not synchronous learning (e.g., attending an online class or lab).

Measures

Contextual Motivation Towards Academics

We used the Academic Motivation Scale (AMS; Vallerand et al., 1992) as a measure of contextual motivation to examine the extent that situational motivation during schoolwork reflected contextual motivation more broadly. Participants were proposed 28 items as possible answers to the question: "Why do you do schoolwork in university?", and each item were rated on a scale from (1) "does not correspond at all" to (7) "corresponds exactly". The AMS is comprised of four items each for intrinsic motivation to know, intrinsic motivation for stimulation, intrinsic motivation for achievement, identified regulation[19], introjected regulation, external regulation and amotivation. Correlations between the behaviour regulation subscales reflected the simplex structure of self-determined motivation, with higher positive correlations between types of behaviour regulation that are closer (vs. more distant) on the continuum. We calculated a RAM score for doing schoolwork by subtracting each participant's average

[19] Due to a technical error, one of the identified regulation items was missing, so we calculated an identified regulation score using the average of three items instead of four.

controlled motivation score (i.e., introjected regulation and external regulation, Cronbach's α = .87) from their average autonomous motivation score (i.e., intrinsic motivation and identified regulation, Cronbach's α = .94).

Contextual Motivation Towards Interfering Activities

As a measure of autonomous and controlled motivation towards various activities that could interfere to schoolwork, participants were presented with a list of activities and asked to indicate why they engage in each one by responding to the prompt: "In general, why do you […] ?" The list of activities included "using social media," "watching media (e.g., videos)," "shopping online," "playing video games," "reading or watching news," "hanging out with friends and family (physically or virtually)," "exercising," "doing work other than schoolwork," "doing a hobby," "doing personal care (e.g., hygiene)," "engaging in intimacy/sex with a partner," "doing household chores," and "resting, relaxing, or napping." For each activity, participants responded on a 7-point Likert scale ranging from (1) "Does not correspond at all" to (7) "Corresponds exactly" to four statements that correspond to intrinsic motivation ("Because I enjoy doing it"), identified regulation ("Because it is important to me"), introjected regulation ("Because I would feel guilty if I did not do it"), and external regulation ("Because I feel that I have to").

We developed the list of activities by reviewing results of the most recent American Time Use Survey (U.S. Bureau of Labor Statistics, 2019), and by reviewing similar measures from other studies of day-to-day behaviours and experience (e.g., Hofmann et al., 2012; Riediger & Freund, 2008). We used a measure of contextual motivation for each activity as a proxy for participants' situational motivation during the diary study to minimize participant burden and because directly measuring participants' situational motivation for these activities could have been influenced by their experiences during the work session (e.g., quitting early). For each type

of activity we computed a measure of autonomous motivation by taking the mean of the intrinsic and identified regulation subscales, and computed a measure of controlled motivation by taking the mean of the introjected and external regulation subscales. The average correlation between intrinsic and identified items for each activity was r = .58, and between introjected and external items was r = .63. We then computed an RAM score for each activity for each participant by subtracting the controlled motivation score from the autonomous motivation score.

Habit Strength for Schoolwork

Participants were asked to complete the Self-Report Habit Index (Verplanken & Orbell, 2003) as a measure of their habit strength for online learning. The measure involved participants responding to the prompt, "Doing schoolwork online is something…", for 12 items such as "I do frequently" and "I do without thinking." Participants responded to each item using a 7-point scale ranging from (1) "Strongly disagree" to (7) "Strongly agree." The scale demonstrated good reliability (Cronbach's α = .88) and we z-transformed scores to facilitate interpretation prior to analysis.

Situational Motivation Towards Schoolwork

Upon starting a schoolwork session, participants reported their current situational motivation towards their schoolwork by completing the situational motivation scale (SIMS; Guay et al., 2000) that was adapted by Guérin and Fortier (2012) with the inclusion of introjected regulation. The scale includes 20 statements reflecting autonomous motivation (i.e., intrinsic motivation, identified regulation; 8 items), two types of controlled motivation (i.e., introjected and external regulation; 8 items), and amotivation (4 items). Example of items include "Because I believe it is important for me" and "Because it is something that I have to do". Participants were asked to indicate how much each statement corresponded to their current reasons for doing schoolwork with response options range from (1) "Does not correspond at all" to (7)

"Corresponds exactly". At the end of the work session, participants were asked to complete the SIMS again, but with a different prompt that stated: "Think about the schoolwork you were doing 10 minutes before you finished your study session. At that moment, why were you working on schoolwork?"

A multilevel confirmatory factor analysis demonstrated good fit for the five-factor structure of the scale at both the beginning of schoolwork sessions, $\chi^2(196) = 410.76$, $p < .001$, CFI = .93, SRMR (within-person) = .055, RMSEA = .055 [90% CI: .047, .062], and the end of schoolwork sessions, $\chi^2(196) = 375.51$, $p < .001$, CFI = .94, SRMR (within-person) = .054, RMSEA = .049 [90% CI: .042, .057]. Each behaviour regulation subscale also showed good reliability across each day, with average Cronbach's α ranging from .86 to .93 for pre-work surveys, and between .87 and .92 for post-work surveys, and within-person correlations between subscales reflected the proposed simplex structure of self-determined motivation.

We calculated a RAM score to reflect the degree of autonomous (relative to controlled) motivation for engaging with schoolwork both at the beginning and end of schoolwork sessions. Specifically, we subtracted the average of the introjected and external regulation subscales from the average of the intrinsic and identified regulation subscales. The intraclass correlation coefficients (ICC) were moderately high at both pre-work (*ICC* = .64) and post-work measurements (*ICC* = .70), suggesting that much of the variance in SIMS scores across each day was between-person.

In order to measure the changes in salient and non-salient forms of motivation, we first identified whether autonomous or controlled motivation was more salient during the work session by determining which type had a higher score for a participant at the start of the

schoolwork session. The other form of motivation was coded as non-salient.[20] Then, we computed a change score for both the salient and non-salient forms of motivation to reflect the shift from pre- to post-work sessions. Finally, we created a *relative salient motivation* score by subtracting changes in the non-salient motivation from changes in the salient motivation. Higher (and positive) scores for *relative salient motivation* represent an increased endorsement of a student's salient form of motivation towards their schoolwork from the pre- to post-work measurement.

Interference During Online Learning

At the end of the schoolwork session, participants were asked whether there were any activities they found challenging to resist because they wanted to do them or felt they should have been doing them, and responded by selecting the corresponding activity or activities (if any) from the same list of activities presented during the initial survey. If none were selected, we considered that no motivational interference took place (coded "0"), and if at least one was selected, we considered that a motivational interference occurred (coded "1"). If more than one activity was selected, the participant was asked to indicate the activity they found the most challenging to resist doing and was thus identified as the interfering activity. For this interfering activity, participants were asked how conflicted they felt between engaging in this activity and continuing their schoolwork, with response options ranging from (1) "Not at all conflicted" to (5) "Very conflicted".

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[20] There were five instances of ties between autonomous and controlled motivation scores, which we coded as missing data for all analyses involving changes in relative salient motivation.

Difference Between Motivation Types for Competing Activities

We created a *motivation difference* variable to reflect the extent that the types of motivation students' endorsed towards schoolwork and an interfering activity were similar or different. First, we classified motivation for any activity as being more autonomous or more controlled, depending on which form of motivation had a higher score. Then, we coded cases where situational motivation and the interfering activity were qualitatively similar as "0", and cases where they were different as "1". For example, a case would be coded as "1" if a student endorsing primarily controlled motivation towards schoolwork and mostly autonomous motivation towards an interfering activity.

Disengaging from Schoolwork

During a work session, a participant may have disengaged from their schoolwork by either taking a break or quitting earlier than they initially intended to, so we asked participants to indicate whether either of these instances occurred. If a student took a break, they were asked to indicate what they did during their break by selecting options from the list of activities, or to indicate whether they did another activity not listed. In addition, whether they quit early or not, participants reported what they intended to do (or did) shortly after their schoolwork session by selecting the corresponding activity or activities.

Persisting with Schoolwork

If the participant experienced motivational interference and did not quit working earlier than planned, they were asked to indicate their main reason for continuing to do their schoolwork. Specifically, participants selected their reason for persisting with response options that corresponded to intrinsic, identified, introjected, external motivation, amotivation, or they could specify another reason for persisting (e.g., for "Because I found my schoolwork interesting", "Because I felt that I had to do my schoolwork"). To facilitate analysis, we

collapsed responses for intrinsic and identified reasons as autonomous reasons, and introjected and external reasons as controlled reasons for persisting.

Details of the Schoolwork Session

Before starting their schoolwork, participants were asked where they were working (e.g., at home, at school, in a public place, etc.), what type of schoolwork would be their main focus (e.g., studying, reading, writing), and whether they were working with anyone else physically present. After each schoolwork session, we asked participants how long their work session was, and whether they had just finished their session or were returning to the study website after some time elapsed. We allowed a grace period until the following day at noon to provide participants the opportunity to complete the post-work portion of the survey in case they forgot to or were unable to complete it shortly after their work session.

Results

Data Screening

Prior to conducting any inferential analyses, we carefully screened the data and only included observations and participants that met our inclusion criteria. Specifically, we did not include daily surveys where participants completed only the pre-work portion of the survey (43 daily surveys), spent fewer than 20 minutes on schoolwork (14 daily surveys, based on timestamps), and where self-reported work duration exceeded the timestamp between the pre- and post-work portions of the survey by at least 30 minutes (18 daily surveys). We also included only daily surveys where participants completed at least 75% of the items on each situational motivation subscale (two daily surveys not included). We applied the same rule to participants' responses on the academic contextual motivation and habit strength measures, but all participants completed these fully. In addition, we did not include daily surveys if participants failed to report the type of schoolwork they were doing (37 daily surveys), if they reported engaging in

synchronous schoolwork activities (two daily surveys), or if this information was unclear (e.g., participant only specified the course they were working on; 17 daily surveys). Lastly, after applying the above criteria, we only included data from participants who were sufficiently engaged with the study, which we defined as having five or more completed daily surveys (eight participants' data not included).

None of the continuous variables demonstrated skewness exceeding |1.50| or kurtosis values exceeding |3.00|, and the distributions of categorical variables were reasonable. We also examined Mahalanobis distance to identify potential multivariate outliers based on responses to the contextual academic motivation and habit strength measures and found no multivariate outliers using either a $p < .001$ cut-off or visual inspection of Mahalanobis distance scores. The resulting sample consisted of 32 participants and a total of 297 daily surveys (*Mdn* = 10 surveys per person).

Descriptive Statistics

Over half of the schoolwork sessions were between one to two hours in duration (61%), and 31% of schoolwork sessions lasted longer than two hours (*ICC* = .34). Students reported working from home most of the time (94%), and most schoolwork sessions involved students working by themselves (83%, *ICC* = .79).[21] Motivational interference was often reported during the schoolwork sessions (91%, *ICC* = .55), and tended to be moderately conflicting for students (*M* = 2.90, *SD* = 1.26, *ICC* = .48). It was also fairly common for students to take a break (59%, *ICC* = .16) or quit working earlier than planned (28%, *ICC* = .34). The most frequent activities students engaged in during breaks were using social media and making a phone/video call. After

[21] We initially intended to analyze how the presence of other people influenced experiences of motivational interference and changes in situational motivation, but this was not possible because too few participants reported ever working in the presence of another person during the study.

finishing a work session, watching online media and resting, relaxing, or napping were the most commonly reported activities (see Table 1 for details).

Students' salient form of motivation at the beginning of schoolwork sessions was more often controlled (80%) than autonomous (20%). Also, consistent with the hierarchical model of motivation (Vallerand, 1997), contextual academic motivation (RAM) was moderately associated with the average of students' situational motivation scores (RAM) both at the start (r = .40) and end of work sessions (r = .44). Means (or percentages), standard deviations, ICCs and correlations between variables are presented in Table 2.

How Does Motivational Interference Impact Situational Motivation?

First, we aimed to test our hypothesis that motivational interference increases a student's relative salient motivation. To this aim, we fit a series of multilevel models with random intercepts to account for the nested structure of the data (Level-1 = Day-level, Level-2 = Person-level), starting with a null model and adding predictors sequentially. Throughout this manuscript we report unstandardized regression coefficients, standard errors, and the proportion of variance explained by significant fixed effects (e.g, $Pseudo\text{-}R^2_{\text{Level-1}}$), and conducted all analyses using the "psych" (Revelle, 2021) and "lme4" packages in R (Bates, et al., 2015).

However, limited data were available to examine how relative salient motivation changed when interference occurred (vs. did not occur). Of the 32 participants, 21 reported experiencing motivational interference during every schoolwork occasion, leaving data for only 11 participants (n = 109) to examine within-person changes. Further, 33 of these observations involved participants quitting work earlier than planned, which we did not include in this analysis because we suspected it would impact how motivation changed across the work session.

To address this limitation of these data, we first fit the intended model using only this subset of data from participants who reported both experiencing and not experiencing

interference during the study when they did not quit working early (n = 76). The intercept of the model showed that participants experienced a decrease in their Relative Salient Motivation across a work session, B = -0.27 [0.09], p = .003, and adding Motivational Interference as a predictor significantly improved model fit, $\chi^2(1) = 4.97$, p = .026. Among this subset of participants, Motivational Interference was associated with an increase in Relative Salient Motivation, B = 0.45 [0.20], p = .026, *Pseudo-*$R^2_{\text{Level-1}}$ = 6.3%. Further analysis indicated that the effects of Motivational Interference were within-person, B = 0.44 [0.21], p = .043, *Pseudo-*$R^2_{\text{Level-1}}$ = 5.1%, and not between-person, B = 0.47 [0.46], p = .312. Thus, these participants demonstrated a decrease in their relative salient motivation across schoolwork sessions, which was buffered when motivational interference occurred.

In addition, we sought to determine how relative salient motivation changed across work sessions for all participants by examining the intercept for two null models that included observations where interference either did or did not occur. Accordingly, when participants did not quit working early, they experienced a decrease in their Relative Salient Motivation when interference did not occur, B = -0.56 [0.19], p = .028, and a lesser decrease when it did occur, B = -0.19 [0.08], p = .020. Thus, the pattern of findings was consistent with the results of the within-person analyses of the subset of participants, showing a decreased in relative salient motivation across work sessions, which was buffered by experiencing motivational interference.

Next, we tested whether the magnitude of shift in relative situational motivation was associated with the difference in motivational quality towards schoolwork and the competing activity. Only observations where motivational interference occurred and where the student did not quit working earlier than planned were included in the analysis (n = 192). Adding the Motivation Difference variable did not improve fit compared to the null model, $\chi^2(1) = 0.01$, p =

.907, and the coefficient for this variable was non-significant, B = -0.02 [0.13], p = .907. See Table 3 for more details.

Relative Autonomous Motivation and Experiences of Interference and Persistence

Next, we tested whether relative autonomous motivation (RAM) towards schoolwork led to fewer experiences of motivational interference, or when it occurred, whether RAM towards schoolwork or a competing activity was linked to persistence (vs. disengagement). For dichotomous outcomes such as experiencing (or not) motivational interference or quitting early (vs. not), ~~we report~~ we report odds ratios and 95% confidence intervals for each predictor, as well as the total variance explained by fixed effects (i.e., *Marginal* R^2; Nakagawa & Schielzeth, 2013). Among the subset of participants who reported both experiencing and not experiencing interference, neither Situational RAM (person-mean centered) or Contextual RAM were related to the experiencing Motivational Interference, OR = 1.07 [95% CI = 0.71, 1.61], p = .733, and OR = 1.18 [95% CI = 0.77, 1.82], p = .440, $\chi^2(2) = 0.68$, p = .711, respectively. Similarly, neither Situational RAM (person-mean centered), OR = 0.96 [95% CI = 0.70, 1.32], p = .809, or Contextual RAM for schoolwork, OR = 0.70 [95% CI = 0.41, 1.18], p = .173, or RAM for the competing activity were related to Quitting Early, OR = 1.03 [95% CI = 0.87, 1.22], p = .695, $\chi^2(3) = 2.00$, p = .573. Taking a Break was also unrelated to Situational RAM (person-mean centered), OR = 0.87 [95% CI = 0.67, 1.12], p = .273, and Contextual RAM, OR = 1.15 [95% CI = 0.82, 1.60], p = .406, $\chi^2(2) = 1.89$, p = .389.

Post-Hoc: Do Reasons for Persisting with Schoolwork Correspond to Shifts in Motivation?

When interference occurred and students persisted with schoolwork~~,~~ we expected to observe an increase in the type of motivation that corresponded to their self-reported decision for persisting with schoolwork. We fit two null models on observations where motivational interference occurred and students continued working, one model with Autonomous Motivation

Shift as the outcome (*ICC* = .08), and the other model with Controlled Motivation Shift as the outcome (*ICC* = .11). For each model, we added the predictor that corresponded to whether students' reasons for persisting was an Autonomous Reason or Controlled Reason (coded 1 if so, and 0 if not). Including students' corresponding reasons for persisting with schoolwork did not improve fit over a null model for either Autonomous Motivation Shift, $\chi^2(1) = 0.25$, $p = .617$, $B = -0.04$ [0.08], $p = .620$, or Controlled Motivation Shift, $\chi^2(1) = 0.01$, $p = .941$, $B = -0.01$ [0.07], $p = .941$.

Post-Hoc: Does Habit Strength Influence Experiences of Motivational Interference?

For the subset of participants reporting schoolwork sessions with and without interference, we tested habit strength for doing schoolwork influenced changes in relative salient motivation when interference occurred. Adding Habit Strength and the associated interaction with Motivational Interference did not significantly improve model fit, $\chi^2(2) = 3.87$, $p = .144$, and the main effect of habit strength was non-significant, $B = 0.06$ [0.08], $p = .470$. However, the inclusion of these effects accounted for 4.9% of the Level-1 variance in changes in relative salient motivation and the interaction term approached statistical significance, $B = -0.46$ [0.25], $p = .061$, so we conducted an analysis of simple effects. Accordingly, students with stronger habits (above the mean) for schoolwork may have been less likely to experience changes in relative salient motivation when interference occurred, $B = 0.29$ [0.22], $p = .194$, compared to students with weaker habits for schoolwork (below the mean), $B = 0.46$ [0.33], $p = .166$. We also expected that Habit Strength would be associated with fewer experiences of motivational interference, but adding this predictor did not improve fit over a null model, $\chi^2(1) = 1.10$, $p = .294$, $OR = 0.58$ [95% CI = 0.19, 1.74], $p = .324$.

Post-Hoc: How Does Disengaging from Schoolwork Influence Situational Motivation?

Given that students occasionally disengaged from their work, either by taking a break or quitting earlier than planned, we wanted to examine whether this influenced how situational motivation changed over time. Building on a null model, Quitting Early was associated with an increase in Relative Salient Motivation $\chi^2(1) = 6.91$, $p = .009$, $B = 0.29$ [0.11], $p = .009$, *Pseudo-*$R^2_{\text{Level-1}} = 2.5\%$, but taking a Break was not, $\chi^2(1) = 1.04$, $p = .307$, $B = 0.10$ [0.10], $p = .305$. Further analyses showed the effect of Quitting Early on changes in Relative Salient Motivation was at the within-person level, $B = 0.31$ [0.12], $p = .010$, *Pseudo-*$R^2_{\text{Level-1}} = 2.6\%$, and not the between-person level, $B = 0.13$ [0.30], $p = .436$. Not surprisingly, students seemed to report longer schoolwork sessions when not Quitting Early (*Mdn* = 2 hours, 71% of sessions over 1 hour) compared to when they did (*Mdn* = 1 hour, 40% of sessions over 1 hour).

Brief Discussion

Multilevel analyses revealed some evidence that motivational interference led to an increase in student's salient (relative to non-salient) form of motivation towards their schoolwork. However, this effect acted more as a "buffer" against a gradual reduction in relative salient motivation across time. Moreover, we did not find evidence that the shift in motivation due to interference was associated with the difference (vs. similarity) in the types motivation towards schoolwork or the interfering activity. Also, we failed to find evidence of any protective effects of relative autonomous motivation in this context, such as reducing experiences of interference or increasing the chance of persistence when it occurred.[22]

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[22] During Summer 2021 we aimed to replicate these findings in a larger sample of undergraduate and graduate students who were enrolled in online courses. However, low participation rates limited our ability to collect data during this time, and the return to in-person classes in Fall halted our progress. Therefore, we were able to collect a sample of 29 participants, but too few of them were sufficiently engaged with the study to warrant analysis of this data (i.e., completing only one or two of the daily surveys).

Study 2

In Fall 2021, changes in public health guidelines due to Covid-19 meant ~~a return~~ returning to a more traditional, in-person learning context for students. As a result, we were presented an opportunity to test our hypotheses in an in-person learning context. We suspected that students would then be more likely to do schoolwork on campus, and that different types of motivational interference may become more common. For example, working on campus (vs. at home) could induce a stronger temptation for a student to hang out with friends or engage in group leisure activities. Likewise, students who are studying on campus are also likely to do so in the presence of others, which could lead to more positive (e.g., social support, shared learning) or more negative experiences (e.g., distractions, peer pressure to do other things). Students also tend to prefer working in dedicated quiet spaces during certain times of the academic year (e.g., exam periods; Applegate, 2009), suggesting that motivational interference may less common for students working on campus compared to working from home.

Nonetheless, we suspect there are more similarities than differences regarding motivational interference for students doing schoolwork in these two contexts. Students taking courses on campus may still choose to do their courses at home, and regardless of where they work, students often do schoolwork with a computer and a smartphone nearby – which we observed as a common source of interference in Study 1 (e.g., social media, online shopping, watching media). We expect that the impact of interference on situational motivation will be consistent both for students working at home or on campus – resulting in an increase in relative salient motivation.

Methods

Participants

The sample consisted of 44 undergraduate students who were enrolled in at least one course at a Canadian university (34 female, 8 male, one identified as both, and one who did not report). All participants except one were between 17 and 29 years of age (M_{age} = 20.75, SD_{age} = 3.60). We recruited participants from a psychology participant pool and provided course credit for their participation. Most participants were enrolled in a psychology program (n = 80%), and participants identified as either white (n = 28), South East Asian (n = 4), Chinese (n = 3), Japanese (n = 2), South Asian (n = 2), Indigenous (n = 1), Filipino (n = 1), or mixed (n = 3).

Design and Procedure

We used a similar design and procedure as in Study 1, which involved an initial survey and two weeks of daily schoolwork surveys, but for students enrolled in in-person classes during September and October 2021.[23] We made several small changes to the measures and design, such as ensuring participants were only completing the daily schoolwork surveys when they were doing asynchronous schoolwork by explicitly asking them at about the type of schoolwork they were going to do at the start of the pre-work survey. If they responded with "synchronous", then they were asked to return to the study later in the day if/when they intended to spend time on asynchronous schoolwork. Each diary survey included the same descriptive measures as in Study 2 regarding students' work location, type of schoolwork they were doing, presence of other people, how long their work session was, and whether they had just finished schoolwork or were returning to complete the post-work survey after some time elapsed.

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[23] Although we included the Self-Report Habit Index as measure of habit strength (Verplanken & Orbell, 2003), we later realized that, since students were just starting the new school year, most students have likely not developed their schoolwork habits yet. Therefore, we opted to not use this measure in any analyses.

Measures

Contextual Motivation Towards Academics

We used the Academic Motivation Scale (Vallerand et al., 1992) to measure participants' contextual motivation towards schoolwork during the initial survey. Correlations between the behaviour regulation subscales reflected the simplex structure of self-determined motivation and we computed an RAM score for each participant by subtracting their average controlled motivation score (Cronbach's α = .94) from their average autonomous motivation score (Cronbach's α = .74).

Contextual Motivation Towards Interfering Activities

We presented participants with the same list of behaviours as in Study 1 to measure their autonomous and controlled motivation towards various activities. However, based on our observations from Study 1 we added "spending time with a pet" and "helping or assisting other people" to this list, and we revised the "video game" item to also include other types of games more generally. Participants reported their degree of autonomous and controlled forms of motivation towards each activity using the same prompt and response options as in Study 1. The average correlation between intrinsic and identified items for each activity was r = .65, and between introjected and external items was r = .61. We then computed a~~n~~ RAM score for each activity for each participant by subtracting the controlled motivation score from the autonomous motivation score.

Situational Motivation Towards Schoolwork

At the start and end of each schoolwork session, participants were asked about their current situational motivation towards schoolwork using the revised version of the situational motivation scale (Guérin & Fortier, 2012). However, we modified two of the amotivation items

for the pre-work measurement because they focused on what participants were doing, as opposed to what they were going to do.

A multilevel confirmatory factor analysis demonstrated good fit for the five-factor structure of the scale at both the beginning of schoolwork sessions, $\chi^2(196) = 281.1$, $p < .001$, CFI = .96, SRMR (within-person) = .06, RMSEA = .04 [90% CI: .03, .05], and the end of schoolwork sessions, $\chi^2(196) = 258.2$, $p < .001$, CFI = .97, SRMR (within-person) = .05, RMSEA = .03 [90% CI: .02, .04]. Each behaviour regulation subscale also showed good reliability across each day with average Cronbach's α ranging from .83 to .91 for pre-work surveys and between .82 and .93 for post-work surveys. Moreover, within-person correlations between subscales reflected the proposed simplex structure of self-determined motivation.

We calculated a RAM score to reflect the degree of autonomous (relative to controlled) motivation for engaging with schoolwork both at the beginning and end of schoolwork sessions by subtracting the average of the introjected and external regulation subscales from the average of the intrinsic and identified regulation subscales. Also, instead of inferring participants' most salient form of motivation from their responses on the SIMS as we did in Study 1, we explicitly asked participants what their main reason for doing schoolwork was. Response options corresponded to either an autonomous reason (i.e., intrinsic motivation or identified regulation) or a controlled reason (i.e., introjected or external regulation). Our approach to creating a variable to reflect changes in *relative salient motivation* was the same. That is, we determined salient and non-salient forms of motivation at the start of the schoolwork session (i.e., autonomous or controlled), computed a relative salient motivation score at both the start and end of the work session, and then calculated a variable to reflect changes in relative salient motivation across the work session.

Interference During Schoolwork

After the work session, participants were asked whether there were any activities that they found challenging to resist while working because they wanted to do them, or felt that they should have been doing them. If the participant responded "No" (coded 0), they were not asked any further questions about motivational interference. If the participant responded "Yes" (coded 1), they were then provided with the list of activities from the initial survey and asked to select the activity or activities that they found challenging to resist during the schoolwork session. If more than one activity was selected, we asked them to specify which of the activities they found the most challenging to resist, which we considered the interfering activity. For the interfering activity, we also asked participants to indicate how conflicted they felt between engaging in this activity and continuing their schoolwork, with response options ranging from (1) "Not at all conflicted" to (5) "Very conflicted".

Difference Between Motivational Type for Competing Activities

We used the same approach as in Study 1 to conceptualize the difference in motivation type between schoolwork and the interfering activity. This involved first classifying motivation for each activity as being "relatively autonomous" or "relatively controlled" and creating a dummy-coded variable to distinguish between cases where motivation type towards schoolwork and the competing activity were qualitatively different (coded 1), or similar (coded 0).

Disengaging from Schoolwork

At the end of the session, participants were asked to report whether they took a break from schoolwork or quit working earlier than planned. If a student reported having taken a break, they were asked to indicate what they did during their break by selecting options from the list of activities, or to indicate whether they did another activity not listed. In addition, participants reported what they intended to do (or did) shortly after their schoolwork session by selecting the

corresponding activity or activities. We added "Eating or snacking" to the list of activities based on our observations from Study 1. Furthermore, to better understand why students ended their work session, we asked them to report whether this was because they finished or mostly finished their schoolwork, wanted to or felt they should pursue a different activity, were too tired or drained to continue working, or if there it was another reason not listed here.

Persisting with Schoolwork

If the participant experienced interference and did not quit working earlier than planned, or if they took a break while working, they were asked to indicate their main reason for persisting with their schoolwork. Each measure provided them with response options that corresponded to intrinsic motivation, and identified, introjected, and external forms of behaviour regulation, as well as amotivation and an option to specify a different reason for persisting. For analysis purposes, we collapsed responses for intrinsic and identified reasons as autonomous reasons, as well as introjected and external reasons as controlled reasons for persisting.

Results

Data Screening

First, we carefully screened the data and only included data for observations and participants that met our inclusion criteria. Specifically, we did not include data from daily surveys where participants completed only the pre-work portion of the survey (32 daily surveys), spent fewer than 20 minutes on schoolwork (13 daily surveys, based on timestamps), and where self-reported work duration exceeded the timestamp between the pre- and post-work portions of the survey by at least 30 minutes (11 daily surveys). We did not include data from five daily surveys where participants responded to fewer than 75% of the items on any situational motivation subscale, but all participants fully completed the measure of contextual academic motivation. Finally, data from two participants was not included because they had fewer than

five completed daily surveys, and were deemed to have been insufficiently engaged with the study.

Then, we examined the distributions of each variable that was involved in the analysis. None of the continuous variables demonstrated skewness exceeding |1.50| or kurtosis values exceeding |3.00|, and the distributions of categorical variables were reasonable. We also examined Mahalanobis distance to identify potential multivariate outliers based on responses to the contextual academic motivation and found no multivariate outliers using either a $p < .001$ cut-off or visual inspection of Mahalanobis distance scores. The resulting sample consisted of 38 participants and a total of 311 daily surveys (*Mdn* = 8 surveys per person).

Descriptive Statistics

Most schoolwork sessions were between one to two hours in duration (61%), and one third of schoolwork sessions lasted longer than two hours (*ICC* = .37). Even though students were taking courses on campus, they more often did schoolwork from home (65%) than on campus (23%), and typically by themselves (77%, *ICC* = .21). Motivational interference was reported during half of the schoolwork sessions (47%, *ICC* = .22), and tended to be moderately conflicting for students (*M* = 3.41, *SD* = 1.04, *ICC* = .31). Notably, participants in Study 2 reported motivational interference less often than participants in Study 1, which may be attributable to the use of a different measure for detecting when interference occurred. It was also fairly common for students to take a break (49%, *ICC* = .17) or quit working earlier than planned (26%, *ICC* = .13). The most frequent activities students engaged in during breaks were using social media and eating or having a snack, while doing other work, resting, relaxing, or napping, and eating or having a snack were the most common activities after finishing a work session (see Table 4 for details). Students commonly reported ending their work sessions because the finished or mostly finished their schoolwork (38%), and less often because they were too tired or drained

to keep working (23%), or because they felt there was something else they either wanted to (12%) or felt they should be doing instead (11%).

Students' salient form of motivation at the beginning of schoolwork sessions was more often controlled (59%) than autonomous (41%)[24], and contextual academic motivation (RAM) was moderately associated with the average of students' situational motivation scores (RAM) both at the start (r = .31) and end of work sessions (r = .33). Comparing students situational RAM scores with those from Study 1 (coded 0) indicated that participants in Study 2 (coded 1) tended to report more self-determined motivation towards schoolwork both before, B = 1.05 [0.29], p < .001, and after work sessions, B = 1.09 [0.31], p < .001, but there was no difference in contextual academic motivation between samples, B = 0.08 [0.23], p = .722. Descriptive statistics for each study variable are presented in Table 5.

How Does Motivational Interference Impact Situational Motivation?

First, to test our main hypothesis, we only included data from participants who reported both experiencing and not experiencing motivational interference during the study (to allow for within-person comparisons). Therefore, data from two participants was not included because they reported interferences during every schoolwork session. As in Study 1, we fit a series of multilevel models with random intercepts to test each hypothesis (Level-1 = Day-level, Level-2 = Person-level). When participants did not quit working earlier than planned, the intercept of the null model showed that they experienced a decrease in their Relative Salient Motivation across a work session, B = -0.17 [0.06], p = .010, but adding Motivational Interference as a predictor did

[24] Categorizing participants' salient form of motivation as either autonomous or controlled based on responses on the SIMS (as we did in Study 1) led to a similar result, with controlled motivation being salient on 65% of occasions and autonomous motivation on 35% of occasions.

not impact model fit, $\chi^2(1) = 0.08$, $p = .773$, and it was not related to changes in Relative Salient Motivation, $B = 0.04$ [0.13], $p = .773$.

Then, we tested whether any changes in relative salient motivation were associated with the difference (or similarity) in quality for the competing motivational tendencies. Only observations where motivational interference occurred and where students did not quit working earlier than planned were included in the analysis ($n = 79$). Adding the Motivation Difference variable did not improve fit compared to the null model, $\chi^2(1) = 0.09$, $p = .772$, and the coefficient for this variable was non-significant, $B = 0.06$ [0.22], $p = .773$. See Table 6 for more details.

Relative Autonomous Motivation and Experiences of Interference and Persistence

Our second aim was to determine whether relative autonomous motivation influenced students' experiences of interference or quitting early during schoolwork sessions. As in Study 1, the likelihood of Motivational Interference was unrelated to either Situational RAM (person-mean centered), $OR = 0.87$ [95% CI = 0.68, 1.14], $p = .321$, nor Contextual RAM, $OR = 0.86$ [95% CI = 0.55, 1.34], $p = .486$, $\chi^2(2) = 1.48$, $p = .478$. However, when interference occurred, Situational RAM for schoolwork was negatively associated with Quitting Early, $OR = 0.67$ [95% CI = 0.45, 0.99], $p = .039$, *Marginal* $R^2 = 8.5\%$, while Contextual RAM towards school or towards the interfering activity were not, $OR = 0.75$ [95% CI = 0.49, 1.16], $p = .187$, and $OR = 0.92$ [95% CI = 0.78, 1.08], $p = .296$, $\chi^2(3) = 8.52$, $p = .036$, respectively. In contrast, neither Situational RAM or Contextual RAM towards schoolwork predicted taking a Break, $OR = 1.05$ [95% CI = 0.83, 1.35], $p = .660$, and $OR = 1.09$ [95% CI = 0.75, 1.58], $p = .643$, $\chi^2(2) = 0.41$, $p = .815$, respectively.

To refine our understanding of why relative autonomous motivation was negatively related to the likelihood of quitting early when interference occurred, we conducted two follow-

up analyses. Namely, we examined whether Situational RAM and Contextual RAM towards schoolwork were related to the chance of quitting early specifically to Pursue Another Activity (1 if so, 0 if not), and, when interference occurred, the chance of finishing a work session because of being Too Depleted to Continue. Results showed that quitting early to Pursue Another Activity was unrelated to Situational RAM (person-mean centered), *OR* = 0.70 [95% CI = 0.42, 1.16], $p = .154$, $\chi^2(2) = 4.39$, $p = .115$. However, Contextual RAM explained a reasonable portion of the total variance in Pursuing Another Activity (*Marginal* R^2 = 12.9%), although the effect did not reach statistical significance, *OR* = 0.61 [95% CI = 0.35, 1.04], $p = .062$~~, *Marginal* R^2 = 12.9%~~. In contrast, feeling Too Depleted to Continue after interference occurred was unrelated to Contextual RAM, *OR* = 0.99 [95% CI = 0.55, 1.78], $p = .976$, but negatively related to Situational RAM (person-mean centered), *OR* = 0.51 [95% CI = 0.28, 0.91], $p = .020$, $\chi^2(2) = 6.86$, $p = .032$, *Marginal* R^2 = 8.6%.

Post-Hoc: Do Reasons for Persisting with Schoolwork Correspond to Shifts in Motivation?

Similar to Study 1, we tested whether students' reasons for persisting with schoolwork, either when interference occurred or after taking a break, led to a corresponding increase in their autonomous or controlled forms of motivation. Accordingly, persisting after interference for an Autonomous Reason led to an increase in Autonomous Motivation Shift, *B* = 0.26 [0.15], $p = .094$, $\chi^2(1) = 2.86$, $p = .091$, explaining 2.8% of the Level-1 variance. Likewise, continuing after a break for an Autonomous Reason led to an increase in Autonomous Motivation shift, *B* = 0.26 [0.13], $p = .047$, $\chi^2(1) = 4.03$, $p = .045$, that explained 2.5% of the Level-1 variance. In contrast, Controlled Motivation Shift was not influenced by endorsing a Controlled Reason for persisting after interference, *B* = 0.09 [0.13], $p = .516$, $\chi^2(1) = 0.35$, $p = .554$, or for continuing after a break, *B* = 0.12 [0.13], $p = .374$, $\chi^2(1) = 0.82$, $p = .365$.

Post-Hoc: How Does Disengaging from Schoolwork Influence Situational Motivation?

We found that changes in Relative Salient Motivation were not influenced by Taking a Break, B = -0.46 [0.11], p = .678, $\chi^2(1) = 0.173$, p = .678, but may have been influenced by Quitting Early, B = 0.24 [0.13], p = .060, $\chi^2(1) = 3.52$, p = .061, although this effect only explained 1.4% of the Level-1 variance. As it would be expected, students seemed to report shorter schoolwork sessions when Quitting Early (*Mdn* = 1.5 hours, 57% of sessions over 1 hour) compared to when they did not (Mdn = 2 hours, 68% of sessions over 1 hour).

Post-Hoc: How Does the Environmental Context Influence Experiences of Interference?

Lastly, we sought to explore the impacts of the environmental context on students' experiences of interference. Specifically, we examined whether the presence of Other People (vs. being alone), or doing schoolwork at School vs. Home influenced the likelihood of experiencing motivational interference. Some participants' data was not included in these analyses if they either only reported working by themselves (11 participants), or only worked from home during the study (14 participants). Neither Other People, *OR* = 1.34 [95% CI = 0.71, 2.53], p = .354, $\chi^2(1) = 0.86$, p = .354, nor working School vs. Home influenced Motivational Interference, *OR* = 0.57 [95% CI = 0.27, 1.19], p = .128, $\chi^2(1) = 2.33$, p = .127.

Discussion

The aim of this research was to understand how students' situational motivation for schoolwork could be impacted by motivational interference. Following from Vallerand (1997), we proposed that motivational interference would increase students' salient form of motivation for doing schoolwork (i.e., autonomous or controlled motivation), and this increase would be greater when the types of motivational tendencies towards schoolwork and the interfering activity were opposite. Across two studies, we found mixed evidence for our main hypothesis. However, we found some evidence for the protective effects of RAM during schoolwork

sessions. As well, other individual and situational factors were shown to impact experiences of motivational interference and changes in situational motivation, some of which being consistent with our main hypothesis. Below, we discuss these findings in relation to previous research to further understand when and why types of situational motivation may shift over time and how motivational interference may (or may not) influence these changes. Then, we consider the role of students' relative autonomous motivation when schoolwork is difficult and propose possible explanations for some of the mixed findings we observed in these studies.

Changes in Situational Motivation During Schoolwork

In both studies, we observed a decrease in students' relative salient motivation in the absence of motivational interference. Although this was unexpected, we see a plausible explanation. Presumably, when a student starts doing schoolwork, they have a sense of what they are aiming to accomplish during that time (e.g., making progress on an assignment, reading a textbook chapter). If the student made progress towards their goal, they may begin to shift their efforts and attention elsewhere, such as to other goals, wants, or responsibilities. Similarly, if a student made little or no progress during that time they may temporarily disengage from their current academic goal and plan to return to it later (e.g., "I will just do this tomorrow"). In both cases, this might look like a decrease in students' relative salient motivation. Instead, it may simply be the result of disengaging from schoolwork, whereby students perceive their academic goal as less important or urgent than they did at the beginning of the schoolwork session. Consistent with view, we observed a lessened decrease in students' relative salient motivation when they quit working earlier than planned and work for a shortened duration of time.

How Motivational Interference Might Impact Situational Motivation

We proposed that an increase in salient (relative to non-salient) motivation could be the result of processes involved before (i.e., contrast effects) or after deciding to continue with schoolwork instead of pursuing an alternative activity (i.e., reducing post-decisional dissonance). Specifically, we expected that an increase in relative salient motivation could be due to students comparing and contrasting their options when making this decision, or resolving post-decisional dissonance afterwards (i.e., "spreading the alternatives"). Of course students could focus on a number of aspects when making this decision (e.g., urgency, goal progress), but research suggests that people tend to focus on what is unique to each option (e.g., Dhar & Sherman, 1996). Thus, we expected this increase in students' relative situational motivation to occur only (or more strongly) when motivational tendencies towards schoolwork and the competing activity were of different types.

We found that students often reported interferences while doing schoolwork, and as predicted, this led to an increase in a student's relative salient motivation – at least in Study 1. In other words, a student who was doing schoolwork mostly because of external pressures would feel this even more so after trying to resist engaging in another activity that they wanted to, or felt they should have been doing instead. However, we did not find evidence that a change in motivation corresponded to the difference in type between competing motivational tendencies. It is possible that other factors involved in students' decisions to persist or quit were more salient, such as the opportunity to engage in an activity after they finish their schoolwork (e.g., hanging with friends) or how much progress they had made with their schoolwork. If students focused on factors other than the type of motivation towards schoolwork and an interfering activity this could explain why we failed to observe changes in relative salient motivation the corresponded to the difference between types of motivation towards each activity.

However, we did not observe this increase in students' relative salient motivation following interference in Study 2, which may have provided a more robust test of this hypothesis for two reasons. First, this effect emerged in Study 1 among a reduced sample of observations (n = 76). In contrast, a change to the measures in Study 2 appeared to reduce the threshold for reporting interference, which led to motivational interference being reported on 46% of occasions, resulting in a more robust within-person test of this hypothesis (n = 221). Second, students' salient form of situational motivation towards schoolwork during online learning was much more likely to be controlled (80%) than autonomous (20%), while this distribution was more balanced during in-person learning (59% controlled, 41% autonomous). Although a number of factors could explain this difference (e.g., online vs. in-person courses, timing of the semester, sampling variability), our prediction that motivational interference would increase students' relative salient motivation was agnostic to whether their salient form of motivation was autonomous or controlled. Therefore, we place greater weight on the findings from Study 2 than Study 1.

Despite mixed evidence for our initial hypothesis, other findings suggested pre-decisional and post-decisional processes might play a role in understanding changes in situational motivation. For instance, we found some (albeit weak) evidence that students with stronger (vs. weaker) habits for schoolwork showed fewer changes in situational motivation following motivational interference. This may be because they process decisions to continue with schoolwork more automatically (Aarts et al., 1998; Hagger, 2019). However, unexpectedly, habit strength was unrelated to the odds of experiencing interference, which suggests that all students may experience interference but the strength of students' habits towards schoolwork may impact how they manage these experiences. Also, when interference occurred we observed an increase in students' autonomous situational motivation when they decided to continue with schoolwork

for a reason that corresponded to either intrinsic motivation (i.e., “because I found my schoolwork interesting”) or identified regulation (i.e., “because it was important for me to do my schoolwork”). This provides some evidence that pre- and/or post-decisional processes are involved in changes in situational motivation. However, endorsing a controlled reason for persisting with schoolwork did not lead to an increase in controlled motivation. It may be that changes in situational autonomous and controlled motivation involve different processes, which could help explain why we found a change in students’ situational motivation following interference in Study 1 but not Study 2 (i.e., because these samples differed in their situational motivation towards schoolwork). Further research is needed to determine whether this is the case, and if so, to explore possible mechanisms underlying changes in each form of situational motivation.

It remains unclear whether (and if so, how) motivational interference might impact situational motivation. We suspect that the key processes are those evoked when people decide to persist in the face or interference, or when they strive to reduce dissonance after deciding to continue with an activity (vs. quit). Of course, other mechanisms might also explain how motivational interference impacts situational motivation. For example, satisfaction of psychological needs for autonomy, competence, and relatedness have been shown to promote the development of more autonomous forms of motivation (Ryan & Deci, 2000). Experiences of motivational interference may impact (or make students more aware of) their goal progress and perceived locus of causality, which could lead to shifts in autonomous and controlled forms of motivation. Similarly, we focused on only one way to operationalize changes in motivation, but there are other ways to study this phenomenon (e.g., changes in specific types of behaviour regulation, shifts in approach-avoidance motivation).

Motivation and the Challenges of Doing Schoolwork

Schoolwork can pose a range of challenges, such as the difficulty of connecting with other students (e.g., Hamza et al., 2021), and physical strain due to continually looking at screens (e.g., Colley et al., 2020). In this study, we focused on difficulties involved in managing motivational interference. We suspected that motivational interference would be a major (or at least frequent) source of difficulty for students, given that other studies with intensive longitudinal designs have highlighted the ubiquity of this obstacle for students (e.g., Grund et al., 2015; Senker et al., 2020). Notably, however, we did not find the likelihood of experiencing interference to be any more common among students working from home compared to on campus (Study 2).

Milyavskaya and colleagues (2015) demonstrated that autonomous (but not controlled) motivation is associated with fewer experiences of temptations and perceived obstacles during goal pursuit. Accordingly, we expected that students with greater RAM would experience fewer instances of motivational interference – but we did not find evidence for this. One possibility is that motivational interference encompassed activities that are often described as tempting (e.g., social media, playing games) and activities that evoke other phenomenological experiences such as responsibilities and expectations (e.g., doing other work, household chores, personal care, etc.). Given the growing body of research on how autonomous (opposed to controlled) motivation benefits goal striving, we suspect these findings would emerge in a replication of this study involving a larger sample of participants.

Nonetheless, in Study 2 we found that RAM led to a greater chance of persisting with schoolwork when interference occurred, as opposed to quitting early to pursue the competing activity. This finding is consistent with research highlighting the role of autonomous (but not controlled) motivation for effort and persistence (e.g., Howard et al., 2021). In addition, when

interference occurred, we found situational RAM to be negatively related to the chance of ending a schoolwork because of feeling too drained to continue working (Study 2). In other words, managing motivational interference may have been draining for students, and those with lower RAM are more likely to quit because of feeling depleted. Previous studies by Muraven (2008) and Moller and colleagues (2006) have demonstrated similar findings, suggesting that autonomous motivation is less depleting (or perhaps more energizing; Nix et al., 1999) than controlled motivation. In sum, Study 2 revealed the possible benefits of higher RAM in this context. As well, it seems likely that RAM offers other behavioural and affective benefits to students doing schoolwork that we did not measure here, such as for productivity and well-being.

Limitations

Several participants in each study did not follow study instructions and so we did not use their data, which limited our capacity to test our hypotheses. Furthermore, some of our tests involved only a subset of participants, such as for our main hypothesis in Study 1, so findings should be interpreted with caution. Although most participants were highly engaged with the study and completed the majority of the daily surveys, the inclusion of more participants would have enhanced our ability to compensate for this loss of data and detect some of the predicted effects. Moreover, many of the effects we observed were relatively small and typically explained no more than 5-10% of the variance in an outcome. Although this is not uncommon in daily diary research (Maner, 2016), in part due to the "noise" of observing effects in everyday life, it highlights the presence of factors other than motivation that could (perhaps more strongly) impact students' experiences while doing schoolwork. That said, university students often spend time on schoolwork, so even small influences on their persistence and focus could have lasting cumulative impacts on their academic performance and well-being.

Alternative approaches to conceptualize motivational interference also warrant further exploration. Here, we focused on whether or not motivational interference occurred, but understanding its impact on situational motivation might be better understood by also considering the *degree* or *salience* of how it is experienced. Similarly, it could be fruitful to consider how many instances or types of motivational interference a student experiences while doing schoolwork, as well as when they occurred (e.g., early during the session).

Conclusion

Many events and experiences could impact situational motivation, and this study provides some evidence that motivational interference might be among them. Although we observed changes in situational motivation due to interference in Study 1, this was not the case in Study 2, which we feel provided a more robust test of our main hypothesis. Nevertheless, some findings still hint at the impact of pre- and post-decisional processes when students manage motivational interference, but the effect may be more complex or different than we anticipated (e.g., different processes for autonomous and controlled forms of motivation). In line with previous research, we found evidence that relative autonomous motivation offers protective benefits for students doing schoolwork, both by increasing the likelihood of persistence when interference occurs, and by reducing the chance of being too tired or depleted to continue working. Taken together, these findings contribute to our understanding of how people experience motivational interference and the role of relative autonomous motivation for managing the challenges of working and learning in everyday life.

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Tables

Table 1
Motivation Towards Schoolwork and Other Activities that Interfered, or were engaged in During or After Work Sessions (Study 1)

Activity	*RAM* M (SD)	*Number of Times Reported as Interfering*	*Number of Times Engaged in During a Break*	*Number of Times Pursued After Quitting*
Schoolwork (start of session)	-1.48 (1.85)	–	–	–
Schoolwork (end of session)	-1.40 (1.84)	–	–	–
Using social media	1.08 (1.73)	149 (55%)	96 (55%)	37 (12%)
Watching media	3.10 (1.42)	86 (32%)	25 (14%)	51 (17%)
Shopping online	2.00 (1.50)	27 (10%)	5 (3%)	2 (1%)
Playing video games	1.81 (1.55)	19 (7%)	2 (1%)	9 (3%)
Reading/watching news	0.71 (1.86)	30 (11%)	12 (7%)	12 (4%)
Making phone/video call	1.61 (1.74)	63 (23%)	40 (23%)	31 (10%)
Doing other work	-0.48 (1.84)	40 (15%)	6 (3%)	42 (14%)
Exercising	-0.05 (2.05)	30 (11%)	9 (5%)	34 (11%)
Engaging in sex/intimacy	2.81 (1.96)	7 (3%)	0 (0%)	1 (0%)
Doing a hobby	3.22 (1.64)	27 (10%)	5 (3%)	20 (7%)
Doing personal care	0.44 (1.90)	31 (11%)	11 (6%)	33 (11%)
Doing chores	-0.89 (1.99)	43 (16%)	19 (11%)	57 (19%)
Resting/relaxing/napping	2.06 (2.14)	94 (35%)	27 (15%)	55 (19%)

Notes. RAM for "Schoolwork" refers to scores on the Situational Motivation Scale across the study. RAM for other activities refers to scores on measures of contextual motivation for these activities. Percentages do not add to 100% because multiple activities could be selected.

Table 2
Descriptive Statistics for Study 1 Variables

Variable	*M* (*SD*) or *n* (%)	ICC	1	2	3	4	5	6	7	8
1. Situational academic motivation (RAM) before work	-1.48 (1.85)	.64	–	.66	.08	.02	-.19	-.05	-.07	
2. Situational academic motivation (RAM) after work	-1.40 (1.84)	.70	.97	–	-.23	-.04	-.07	-.09	-.01	
3. Change in relative salient motivation	-0.15 (0.84)	.16	.12	.03	–	.12	.01	.16	.08	
4. Motivational interference[a]	270 (91%)	.55	-.19	-.18	-.01	–	.00	.04	.13	
5. Different (vs. same) motivation type between schoolwork and interfering activity[b]	169 (57%)	.33	-.62	-.56	-.13	.05	–	.00	.00	
6. Quitting early[a]	84 (28%)	.34	-.10	-.07	.09	.05	.01	–	.06	
7. Taking a break[a]	176 (59%)	.16	.11	.13	-.18	.26	-.06	.02	–	
8. Contextual academic motivation (RAM)	-0.31 (1.16)	–	.43	.47	.06	.14	-.20	-.22	.13	–
9. Habit Strength for doing schoolwork	4.07 (1.02)	–	.46	.38	.29	-.08	-.38	-.22	-.36	.31

Notes. ICC = intraclass correlation coefficient; RAM = relative autonomous motivation; Between-person correlations are presented below the diagonal, and within-person correlations above the diagonal.
[a] Coded 1 if occurred and 0 if not.
[b] Coded 1 if motivational tendencies differed in type, and 0 if they were the same

Table 3

Changes in Salient (Relative to Non-Salient) Motivation as a Function of Motivational Interference and Difference Between Motivation for Schoolwork and Interfering Activity (Study 1)

	Null Model	*Model w/ Motivational Interference*	*Null Model*	*Model w/ Motivation Difference*
	$n = 76$[a]	$n = 76$[a]	$n = 190$[b]	$n = 190$[b]
Intercept	-0.27 [0.09] **	-0.60 [0.17] ***	-0.19 [0.08] *	-0.18 [0.11] *
Motivational Interference[c]		0.45 [0.20] *		
Within-Person		0.44 [0.22] *		
Between-Person		0.47 [0.46]		
Motivation Difference				-0.02 [0.13]
Level-1 Variance	0.628	0.588	0.575	0.574
Level-2 Variance	0.080	0.080	0.093	0.093
Model Comparison		$\chi^2(1) = 4.97$ *		$\chi^2(1) = 0.14$

Notes. Unstandardized coefficients and standard errors reported; Includes only observations where students did not quit working earlier than planned; $p < .10$ †, $p < .05$ *, $p < .01$ **, $p < .001$ ***

[a] Includes only observations from the subset of participants who reported both experiencing and not experiencing interference in at least one work session during the study, and only for cases participants did not quit working earlier than planned.

[b] Includes only observations where motivational interference occurred and participants did not quit working earlier than planned.

[c] Within- and Between-Person components were disaggregated in a separate model but are reported here for clarity; model fit information corresponds to the model with Motivational Interference as an uncentered predictor.

Table 4
Motivation Towards Schoolwork and Other Activities and Activities that Interfered, or were engaged in During or After Work Sessions (Study 2)

Activity	*RAM* M (SD)	*Number of Times Reported as Interfering*	*Number of Times Engaged in During a Break*	*Number of Times Pursued After Quitting*
Schoolwork (start of session)	-0.48 (1.44)	–	–	–
Schoolwork (end of session)	-0.39 (1.52)	–	–	–
Using social media	1.11 (2.32)	85 (58%)	70 (46%)	53 (17%)
Watching media	3.16 (1.44)	47 (32%)	23 (15%)	36 (12%)
Shopping online	2.07 (1.56)	19 (13%)	10 (7%)	3 (1%)
Playing games	2.62 (1.98)	15 (10%)	5 (3%)	12 (4%)
Reading/watching news	0.72 (1.77)	7 (5%)	6 (4%)	3 (1%)
Hanging out w/others	2.64 (1.94)	55 (38%)	33 (22%)	56 (18%)
Phone/video call w/others	1.18 (2.19)	28 (19%)	15 (10%)	21 (7%)
Doing other work	-0.04 (2.34)	39 (27%)	15 (10%)	81 (26%)
Helping/assisting others	1.49 (1.96)	7 (5%)	8 (5%)	9 (3%)
Exercising	0.58 (2.06)	26 (18%)	10 (7%)	18 (6%)
Doing a hobby	2.93 (1.88)	34 (23%)	9 (6%)	16 (5%)
Spending time with a pet	2.28 (2.34)	18 (12%)	9 (6%)	12 (4%)
Engaging in sex/intimacy	2.66 (2.17)	6 (4%)	2 (1%)	5 (2%)
Doing personal care	0.32 (2.24)	16 (11%)	18 (12%)	37 (12%)
Doing household chores	-1.51 (1.90)	38 (26%)	23 (15%)	42 (14%)
Resting/relaxing/napping	1.55 (2.07)	55 (38%)	12 (8%)	75 (24%)
Eating/Snacking	–	–	61 (40%)	94 (30%)

Notes. RAM for "Schoolwork" refers to scores on the Situational Motivation Scale across the study. RAM for other activities refers to scores on measures of contextual motivation for these activities. Percentages do not add to 100% because multiple activities could be selected.

Table 5
Descriptive Statistics for Study 2 Variables

Variable	*M* (*SD*) or *n* (%)	ICC	1	2	3	4	5	6	7	8
1. Situational academic motivation (RA~~I~~M) before work	-0.48 (1.44)	.44	–	.60	.12	-.06	-.26	-.13	.03	-.12
2. Situational academic motivation (RAM~~I~~) after work	-0.39 (1.52)	.48	.95	–	-.21	-.13	-.06	-.20	.06	-.17
3. Change in relative salient motivation	-0.09 (0.97)	.01	-.01	-.07	–	.05	-.01	.13	-.04	.07
4. Motivational interference[a]	146 (47%)	.22	.18	.06	.18	–	.00	.21	.21	.15
5. Different (vs. same) motivation type between schoolwork and interfering activity[b]	99 (68%)	.53	-.50	-.44	-.05	-.26	–	.06	-.09	.06
6. Quitting early[a]	80 (26%)	.13	.10	.10	-.01	.29	-.28	–	-.02	.20
7. Taking a break[a]	153 (49%)	.17	.11	.10	.07	.46	-.09	-.21	–	.11
8. Quitting (or not) because of being depleted	73 (23%)	.14	-.09	-.16	-.09	.22	-.05	.37	.08	–
9. Contextual academic motivation (RAM)	-0.26 (0.82)	–	.28	.30	.16	-.19	-.15	-.26	.09	-.09

Notes. ICC = Intraclass correlation coefficient; Between-person correlations are presented below the diagonal, and within-person correlations above the diagonal.
[a] Coded 1 if occurred and 0 if not.
[b] Coded 1 if motivational tendencies differed in type, and 0 if they were the same

Table 6

Changes in Salient (Relative to Non-Salient) Motivation as a Function of Motivational Interference and Difference Between Motivation for Schoolwork an Interfering Activity (Study 2)

	Null Model	*Model w/ Motivational Interference*	*Null Model*	*Model w/ Motivation Difference*
	$n = 221$[a]	$n = 221$	$n = 79$[b]	$n = 79$[b]
Intercept	-0.17 [0.06] *	-0.18 [0.17] *	-0.16 [0.10]	-0.20 [0.18]
Motivational Interference[c]		0.04 [0.13]		
Within-Person		0.03 [0.14]		
Between-Person		0.07 [0.25]		
Motivation Difference				0.06 [0.22]
Level-1 Variance	0.836	0.835	0.842	0.842
Level-2 Variance	0.002	0.002	0.001	0.001
Model Comparison	$\chi^2(1) = 0.08$		$\chi^2(1) = 0.09$	

Notes. Unstandardized coefficients and standard errors reported; Includes only observations where students did not quit working earlier than planned; $p < .10$ †, $p < .05$ *, $p < .01$ **, $p < .001$ ***

[a] Includes only observations where participants did not quit working earlier than planned, and excludes observations from two participants who reported interference during every schoolwork session.

[b] Includes only observations where motivational interference occurred and participants did not quit working earlier than planned.

[c] Within- and Between-Person components were disaggregated in a separate model but are reported here for clarity; model fit information corresponds to the model with Motivational Interference as an uncentered predictor.

Chapter 4: General Discussion

From desires and temptations to social pressures and environmental constraints, people regularly experience difficulties in their goal pursuit. Despite these challenges, some people are still able to progress and attain their goals. Given the ubiquity of the challenges people face, and nascent challenges (e.g., managing eco-anxiety), it is increasingly important to understand when and why people differ in their capacity to manage these difficulties in their daily life. Critically, research grounded in self-determination theory (Ryan & Deci, 2000) suggests that understanding the type of motivation may be of particular importance (e.g., Ntoumanis et al., 2014).

The objective of this program of research was to examine the role of motivation when self-regulation is difficult. Across two manuscripts I employed a series of daily diary designs to observe difficulties in everyday life. In the first manuscript, *Healthy eating in daily life: The role of relative autonomous motivation when it is difficult*, some evidence emerged that relative autonomous motivation (RAM) is positively associated with (1) goal success for more difficult food goals, (2) perceived availability of healthy and unhealthy foods and perceived difficulty in trying to eat and avoid these foods, and (3) the use of more approach-based healthy-eating strategies. The second manuscript, titled, *Learning during the Covid-19 pandemic: How motivational interferences impact students' motivation for schoolwork*, I found (1) mixed evidence that situational motivation is impacted by motivational interference, and (2) some evidence that RAM promotes persistence when interference occurs.

Below, I discuss these findings in relation to the broader literature on motivation and difficulties in daily life. First, I consider the mechanisms that can explain how RAM influences self-regulation when it is difficult, and discuss possible reciprocal impacts of difficulty on motivation. Second, I briefly discuss how the findings highlighted in this program of research may contribute to the ongoing debate surrounding the ego-depletion effect. Third, I explore how

self-regulation is especially suited to being studied *in daily life* by emphasizing findings from these studies as they relate to the dynamic nature of self-regulation. Finally, I explore practical applications of these findings in terms of changing and shaping human behaviour.

Relative Autonomous Motivation and Difficulty

What Does it Mean for a Task to be "Difficult"?

Difficulties are everywhere in day-to-day life, and they tend to fall into one of a few categories. In this program of research, the types of self-regulatory challenges I focused on spanned multiple categories. Most notably, *desires and temptations* were reflected in both manuscripts – as the presence and allure of unhealthy foods (e.g., pastries, fast food), and the temptation to pursue activities that conflict with the goal of completing schoolwork (e.g., hanging with friends). Desires and temptations tend to be a common focus for researchers (e.g., Williamson & Wilkowski, 2020), which may reflect their ubiquity in daily life (Hofmann et al., 2012) Indeed, Manuscript 2 illustrated how frequently students experience motivational interference while doing schoolwork. Challenges associated with the *physical environment* and *social influences* were also reflected in these manuscripts. Namely, the difficulty of a healthy eating goal was shown to be influenced by how available (or not) certain foods were in the environment. For students learning online or in-person, a common source of interference was the desire to connect with other people, whether through physical (e.g., hanging out) or virtual means (e.g., video call, social media). Indirect observations of the difficulty associated with *limited resources* also emerged, in that students may have been more likely to end their schoolwork sessions after experiencing interference and feeling too drained or depleted to continue (Manuscript 2). An important observation from both Manuscripts, however, is how much overlap there is in these categories of difficulties. Although categorical definitions of these types of difficulties may seem clear, these manuscripts illustrate how much overlap exists

between them. For example, students who pack a lunch to bring to campus could make it easier to choose what they eat for lunch (or whether they even do), potentially reducing some difficulties associated with resisting the tempting but unhealthy foods on campus (Manuscript 1). Likewise, students who are doing schoolwork and have to resist temptations or pressures to engage in goal-conflicting behaviours (i.e., motivational interference) may be more likely to quit working because of feeling too depleted to continue (Manuscript 2).

However, an area of difficulty that received little attention in these studies are challenges associated with self-monitoring and goal setting. To date, a handful of studies have provided insights into difficulties associated with self-monitoring (e.g., Wilkowski et al., 2018) but historically this areas of focus has received less attention than other types of difficulties. A key aspect of self-regulation involves recognizing that a desire is indeed incompatible with a person's goal (i.e., conflict-monitoring; Hofmann & Kotabe, 2012), but this tends to be more challenging to observe than the presence of a desire itself. Given the subjective nature of the measurements use in the current program of research, it may be possible that students lapsed on their healthy eating or schoolwork goals in this way, but that this was not captured. This type of lapse could appear as an intentional (or planned) decision to eat a certain food or end a work session early. Some changes to the designs of the current studies, such as the use of more explicit and objective measures of goal setting and evaluation (e.g., quantity-based measure of food consumption and healthy eating intentions in Manuscript 1, recording academic goals at daily and weekly intervals in Manuscript 2), could have allowed for observing difficulties associated with self-monitoring in this program of research as well.

Another important aspect when operationalizing difficulty lies in considering it a more or less *subjective* phenomenon. Most simply, asking participants to rate the *perceived difficulty* of a behaviour allows comparing different behaviours (or the same behaviour at different times) in

terms of their perceived difficulty. For instance, in Manuscript 2, students reported their own subjective experiences of interference and conflict while doing schoolwork, and in Manuscript 1, I asked participants to rate the difficulty of various healthy eating goals. A similar approach was used in earlier studies by Green-Demers and colleagues (1997) and Aitken and colleagues (2016) regarding difficulties associated with certain pro-environmental behaviours. Alternatively, a task could be considered more or less *objectively* difficult. For instance, Manuscript 1 did not involve students rating the perceived difficulty of their own goals, but instead the difficulty of these (approach and avoidance) goals was based on difficulty ratings provided by a separate group of students. In other words, difficulty was defined by the collective more as opposed to the individual. Determining difficulties in self-regulation has also been achieved by reviewing prior literature (e.g., on motivational interference), or through shared understanding. Consider research by Ntoumanis and colleagues' (2014) where participants were instructed to persist as long as possible on exercise tasks that became increasingly physically demanding, thus reflecting increasing difficulty.

While these conceptualizations of difficulty have often led to similar results – that autonomous (vs. controlled) motivation is positively associated with goal attainment – findings from Manuscript 1 highlight a critical issue. Namely, difficulty and effort are inherently subjective, and the type of motivation seems to be related to *perceived difficulty*. More specifically, students with higher (vs. lower) relative autonomous motivation to eat healthy were more likely to perceive food goals as easier to pursue, and were more likely to perceived healthy foods are easier to access, and unhealthy foods as less available. Prior research has found similar results (e.g., Milyavskaya et al., 2015). Because motivation and perceived difficulty are not orthogonal, subjective ratings of difficulty could cloud our understanding of how autonomous (vs. controlled) motivation might promote goal striving. Therefore, when designing studies on

motivation and goal difficulty, it is essential to explicitly consider how difficulty is operationalized to be able to interpret any findings involving motivation.

Why Relative Autonomous Motivation Might be Beneficial When Self-Regulation is Difficult

The benefits of autonomous (but not controlled) motivation for goal achievement have received considerable attention across a range of contexts (e.g., Howard et al., 2021; Ng et al., 2012), and several mechanisms have been proposed to explain this relationship (e.g., Werner et al., 2019). As suggested by Manuscript 1, one possibility is that RAM leads people to exert, or increases willingness to exert greater effort in goal striving. In a healthy eating context, I found some evidence that RAM was positively related to goal success for more difficult healthy eating goals (e.g., longer-term goals, striving to eat more of certain foods). However, both manuscripts provided an alternative explanation for these findings which may be more likely – that autonomous self-regulation feels easier (i.e., less effortful) than more controlled forms of self-regulation. Specifically, students' RAM to eat healthy was negatively related to perceptions of goal difficulty, and with perceiving fewer difficulties associated with availability of healthy and unhealthy foods. Similarly, in Manuscript 2, students with lower (vs. higher) RAM towards schoolwork were more likely to quit because they felt too tired or depleted after experiencing interference, suggesting that autonomous self-regulation *feels easier* than controlled self-regulation. Consistent with this view, a recent study involving students showed that personal goals which were more self-concordant (i.e., relatively autonomous) reportedly felt easier to strive for over an academic semester (Werner et al., 2016). Other studies have demonstrated similar findings (Leduc-Cummings et al., 2015; Milyavskaya et al., 2015), indicating that RAM promotes goal attainment not through greater effort, but through perceived ease. Moreover, if autonomous (vs. controlled) self-regulation feels easier, this could contribute to the link between

motivation and well-being (Deci & Ryan, 2008b), since effort is thought to be aversive (Kurzban et al., 2016).

Furthermore, findings from this program of research highlight another possibility of how relative autonomous motivation may benefit goal striving. In Manuscript 1, RAM was positively associated with more approach-based strategies to eat healthy (i.e., eating vs. skipping lunch, packing a lunch), which is consistent with findings from another study in a healthy eating context (Otis & Pelletier, 2008). Thus, RAM may promote goal attainment because of the use of more effective (i.e., approach-based) strategies. Other explanations have also been proposed to understand how RAM promotes goal attainment, such as by the facilitating the formation of habits (Gardner & Lally, 2013), and through increased mindfulness and effective goal setting (Smyth et al., 2020). In sum, this program of research provides evidence that subjective ease and strategy selection are two of the ways RAM is beneficial for attaining personal goals, but there are likely other means as well.

How Difficulty Impacts Motivation

Of course, just as the type of motivation can impact self-regulation when it is difficult, difficulties in self-regulation may impact motivation. Understanding this reciprocal impact was a focus of Manuscript 2, where I aimed to observe how difficulties involving motivational interference during students' schoolwork could impact their situational motivation. However, I found mixed evidence that such changes occurred, making it difficult to draw any conclusions. Drawing from research in other areas, such as the literature on cognitive dissonance (Festinger, 1957), it seems likely that difficulties do indeed influence motivation, but perhaps the processes involved are more complex (or at least different) than those discussed in Manuscript 2.

As a popular alternative to the strength-energy model (Baumeister et al., 1998), Inzlicht and colleagues' (2012) proposed the process model of depletion. From this view, exerting self-

control is thought to increase the chance of subsequent self-control failure – not by reducing limited resources – but by shifting motivation and attention. In other words, managing difficulties (e.g., resisting temptations, overriding impulses) is thought to lead to changes in motivation, and some evidence has supported these predictions (e.g., Schmeichel et al., 2010). For example, research on self-licensing has demonstrated that people are more willing to "justify" engaging in an impulsive (i.e., tempting) behaviour after exerting effort (De Witt Huberts et al., 2021). Thus, the process model provides some support for the notion that difficulties invoke changes in motivation, and may provide a useful framework for understanding these changes.

Self-Regulation and Difficulty in Other Domains: On the Generalizability of Findings

I focused here on difficulties associated with healthy eating and focusing during schoolwork, but does the relationship between motivation and difficulty extend to other domains, and to other types of difficulties? Although further research is clearly needed to address this question, the extent that these findings generalize beyond these studies warrants discussion. First, these studies involved a high degree of ecological validity from the use of idiographic daily diary designs. Observations took place in the real-world, including participants' pursuit of their own personal healthy eating goals (Manuscript 1), and completion of daily surveys around students' own schoolwork schedules (Manuscript 2). Second, these findings are consistent with a handful of other studies that have demonstrated the role of RAM for difficulties in other domains. Outside of healthy eating and academic contexts, similar findings have emerged for physical activity (Ntoumanis et al., 2014), pro-environmental behaviours (Aitken et al., 2016; Green-Demers et al., 1997), and for pursuit of personal goals (Werner et al., 2016). Of course, people live their lives many other contexts (e.g., driving, socializing, working), but positive associations have emerged between RAM and outcomes in a number of these domains. Thus, it seems

plausible that the resulting benefits in these domains can be, at least partly, attributed to self-regulation that *feels easier*. Nonetheless, more research is needed to determine the extent that this is true.

Perhaps more importantly, findings from this research (and much of the prior research in this area) only involved samples of students. Although self-regulatory processes are thought to apply similarly to all individuals, limited sampling from just one population has received criticism (e.g., "WEIRD" samples; see Henrich et al., 2010 for a review). Future studies in other populations would greatly enhance the generalizability of these findings. For instance, a similar design to that used in Manuscript 2 could be implemented with employees either working from home or at the office, and the procedures used in Manuscript 1 could be used in research on people enrolled in health-based programs (e.g., weight loss, dieting). A last limitation to the generalizability of these studies is the narrow focus on only certain types of difficulties, such as desires and temptations. These findings should be replicated for other types of difficulties, such as social influences (e.g., peer pressure) and lapses in self-monitoring (e.g., when consuming alcohol) and types of resource limits other than ego-depletion (e.g., time pressure).

Difficulty and Motivation within the Ego-Depletion Debate

Although technically defined as a "state", ego-depletion involves considerable overlap with difficulties involving self-regulation. More specifically, efforts required to overcome difficulties (e.g., temptations) can tax limited resources and lead to ego-depletion. As well, self-regulation can be more challenging when a person is in a state of ego-depletion. Thus it seems fruitful to consider how a consideration of difficulty may provide insights into the ongoing debate surrounding ego-depletion (c.f., Friese et al., 2019).

While not all difficult tasks are depleting (e.g., math problems), it can be argued that depleting tasks are difficult. A central critique of large-scale efforts to replicate the ego-depletion

effect have focused on the difficulty of the manipulation tasks that were selected (Wimmer et al., 2019). In a commentary and re-analysis, Dang (2016) argued that the difficulty of the "depleting" task used in the meta- analysis by Hagger and colleagues (2016) was not actually depleting, and among those who did find it difficult, the hypothesized ego-depletion effect was present. The task required participants to cross off the letter "e" from a series of pages in an online document, with additional rules for the "depleting" condition. Although manipulation checks showed significant differences between conditions in terms of effort and difficulty, mean ratings hardly crossed the midpoint of the scale for the so-called "depleting" condition. Similar findings emerged from a more recent replication attempt by Vohs and colleagues (in press), suggesting that at least some of the heterogeneity in ego-depletion effects is due to the difficulty of the manipulation tasks.

In addition to task difficulty, motivation has been recognized as a key moderator of ego-depletion effects (Baumeister et al., 2007; Hagger et al., 2010). In one study Muraven (2008) demonstrated that resisting the temptation to eat cookies was more depleting for people using more controlled (and less autonomous) self-regulation. A similar finding emerged in this program of research (Manuscript 2) whereby people with more controlled (and less autonomous) forms of self-regulation for schoolwork were more likely to quit working because of feeling depleted after experiencing interference. Ostensibly, the notion that autonomous regulation *feels easier* than controlled regulation is synonymous with this interpretation.

Moving forward, a promising approach for studying ego-depletion has been through the use of intensive longitudinal methods. One example comes from a study in a healthcare setting (Dai et al., 2015), showing how work demands (and breaks) can impact handwashing compliance among workers. Diary methods allow researchers to move beyond lab-assigned tasks to observe the impact of self-regulation for people's own personal goals, and to observe possible real-world

impacts of ego-depletion. Moreover, intensive longitudinal methods could allow researchers to parse out other potential explanations for the ego-depletion effect, such as changes in motivation, goals, or capacity for conflict-monitoring (e.g., Milyavskaya et al., 2021).

Studying Self-Regulation in Daily Life

In this program of research, I conducted a series of studies that provide insight into day-to-day experiences of self-regulation in both healthy eating (Manuscript 1) and student learning contexts (Manuscript 2). Accordingly, conducting these studies involved a significant focus on observing difficulties and changes in motivation where (e.g., at school, at home) and when they happen (e.g., each day, under certain circumstances), and provides findings that contribute to a growing body of research on self-regulation in daily life (e.g., Carey et al., 2019).

Focusing on Components in the Process of Self-Regulation

Self-regulation involves multiple components, and the focus of this program of research was largely on the role of goal striving as difficulties arise, whether in the form of obstacles to healthy eating goals (Manuscript 1), or as challenges in completing schoolwork (Manuscript 2). That is, much of my focus was on the role of motivation for promoting effort and persistence when self-regulation is difficult. In addition, some findings provided insight into another aspect of self-regulation. In Manuscript 2, motivation was shown to influence the types of strategies that students may have used to eat healthy (i.e., approach- and avoidance-based approaches).

While these nuanced daily diary designs can allow us to observe the interplay between these processes, a key aspect of self-regulation received little attention here. How do people evaluate their goal progress, and how might motivation influence these evaluations? In each diary study we left it up to participants to report on their progress, but it seems plausible that people's motivation for goal striving impacts how they perceive their progress. Ferris and colleagues (2013) found strong relationships between job satisfaction and both approach

motivation (positive association) and avoidance motivation (negative association), and associations between autonomous-controlled and approach-avoidance motivation (Otis & Pelletier, 2008) may imply that perceived goal progress was impacted by participants' motivations in the current studies. However, more research on whether (and if so, how) autonomous and controlled motivation influence evaluations of goal progress is warranted.

Considerations for Studying Self-Regulation with Intensive Longitudinal Designs

Given the complexity of both self-regulation and daily life, designing an effective diary study requires a number of considerations. Managing desires and temptations as they arise in daily life warrants multiple (ideally random) measurements per day (e.g., Hofmann et al., 2012), while studying challenges within a specific domain requires measurements during or near those occurrences. In Manuscript 1, this meant focusing on food goals that participants set (and evaluated progress on) each day, and in Manuscript 2, the use of daily measurements, both immediately before and after students spent time on schoolwork. In part, the need for appropriate timing of assessments is to minimize errors in recall from participants, especially among experiences that are easily forgotten, such as mundane and common self-regulatory phenomena in daily life (e.g., eating habits, interference during schoolwork).

At first glance, more measurements may sound better than less, but this is not always the case. Estimating power is notoriously challenging when using intensive longitudinal methods, in part because of the uniqueness of each study design, and the added complexity of between- and within-person levels of analysis. Simulation-based methods can be effective at estimating power, but require an initial study that is essentially equivalent in design and measurements to subsequent studies (Manuscript 1), because even slight changes in key measures can limit their use (Manuscript 2).

Beyond power, measurement reactivity presents another key consideration because intensive longitudinal methods can often appear as a form of intervention for participants. This was especially notable in the feedback from participants from studies in Manuscript 1 (e.g., seeing this as a "healthy eating challenge"), and may have also occurred during the studies in Manuscript 2 (e.g., students using the daily surveys to plan when and for how long to do schoolwork). As a result of daily goal-relevant measurements, participants might change their behaviour simply because of their participation in the study, possibly due to increased self-awareness (Barta et al., 2012), or through viewing participation as an interaction with the researcher (Shrout et al., 2018). By repeatedly answering surveys (e.g., on smoking habits), measurement reactivity could result in a change in behaviour (e.g., smoking less often) or a shift in participants' interpretation and responses to survey items (e.g., a change in interpretation of what it means to try "very hard" to resist the temptation to smoke). Thus, the risk of measurement reactivity represents a threat to the validity of intensive longitudinal methods that warrants careful consideration.

In addition to mitigating measurement reactivity the use of alternative study designs can provide advantages over intensive longitudinal methods. For example, experimentally manipulating motivational interference in-lab could allow researchers to more directly observe mechanisms responsible for changes in situational motivation. Or, observing students' eating behaviours in a cafeteria could remove the subjectivity associated with self-reports. Of course, measuring motivation could be challenging in this context, but researchers are working on new possibilities (e.g., facial recognition; Furley et al., 2019; Santos et al., 2018).

Lastly, most findings in Manuscripts 1 and 2 were relatively small, at least compared to similar findings from some experimental and lab-based studies. Indeed, this is often the case with intensive longitudinal studies (Maner, 2016), in part due to the complexity of daily life (i.e.,

noise). Meaningful outcomes can come from even small impacts of relative autonomous motivation on persistence with schoolwork when interference occurs (Manuscript 2), or in promoting goal striving when healthy eating is difficult (Manuscript 1). This is because these effects can occur daily, or perhaps more often, and cumulative small effects can lead to sizable long-term outcomes in academic achievement and health, among other areas.

Practical Applications

All else being equal, people tend to prefer the easier route (Kool et al., 2010). However, individuals and organizations sometimes prefer when people do not just take the easy route, and sometimes use different strategies to influence people's behaviour in a more positive direction (at least in their view). This typically involves encouraging people to take a more challenging or effortful course of action, such as recycling more products, exercising more regularly, focusing more on the road (than a smartphone) while driving, or shopping locally more often. This "encouragement" frequently takes the form of incentives, rewards, threats, or punishments.[25] Examples can be seen everywhere, from incentivizing children to study in school (Marques et al., 2007), enticing new employees with generous bonuses (Levin, 2021), installing point-to-point cameras to reduce speeding on roadways (Freeman et al., 2017), and more recently, financially rewarding people for getting vaccinated against Covid-19 (Dubois, 2021).

Indeed, these approaches may be effective in certain cases, such as for one-time behaviours (e.g., getting screened for prostate cancer; Tannenbaum et al., 2015), but in other cases their efficacy has been criticized (Kok et al., 2018). More effective approaches have been

[25] The tendency to think that other people are mostly motivated by extrinsic incentives (vs. intrinsic incentives such as interest, personal growth, etc.) has long been recognized as a form of cognitive bias. This *extrinsic incentive bias* (Heath, 1999) may partly explain the widespread use of such strategies for attempting to motivate others.

proposed, which focus more on fostering sustained behaviour change and less on immediate compliance (Martela et al., 2021; Pope et al., 2018). Furthermore, an important consideration is that the "carrot and stick" approach tends to promote controlled forms of motivation, such as introjected (e.g., feelings of guilt) and external regulation (e.g., acting solely to get a reward), which have shown to be weakly (or not at all) associated with persistence and goal striving (Howard et al., 2021; Koestner et al., 2008).

Consistent with prior research, findings from these two manuscripts suggest that strategies designed to promote autonomous forms of motivation may be a more promising for encouraging people to shift their behaviours in day-to-day life. In an early example, Geller and colleagues (1987) conducted a meta-analysis to compare the impact of programs aimed at increasing seatbelt use among workers. The authors compared the outcomes from reward-based interventions (e.g., immediate, delayed) to programs aimed at increasing awareness and providing information, which is one means (among others) to support people's autonomy (Martela et al., 2021). Although seatbelt use is now widespread in North America, this was not always the case, and it was once considered a behaviour that involved some difficulties, such as managing the discomfort of wearing it (Fhaner & Hane, 1973). In their analysis, Geller and colleagues found that, although all interventions initially increased seatbelt compliance, the longer-term impacts on seatbelt use following the interventions were greatest among the information-based programs. Reward-based and information-based programs may be promoting controlled or autonomous self-regulation (respectively), which can help explain the difference in drivers' persistence with wearing seatbelts. More recently, similar findings have emerged from a number of studies (e.g., Legate & Weinstein, 2021; Williams et al., 1999) and provide further evidence that supporting peoples' autonomy may be a more effective strategy than using

incentives when trying to encourage sustainable behaviour change and persistence through difficulties.

As an alternative to influencing people's motivation, interventions designed to make a target behaviour easier have become increasingly popular.[26] For example, nudge theory (Thaler & Sunstein, 2009) involves shaping behaviour through design choices that encourage one behaviour over another, but without restricting any options of influencing their motives. In other words, nudges make a desirable behaviour easier to do. When the focal behaviour is made easier people are more likely to act and their motivations for doing so become less predictive of their behaviour. Nudges have shown to be widely effective for shaping behaviours such as healthy eating (John et al., 2009) and sedentary behaviour (Venema et al., 2018), among others (e.g., Pennycook et al., 2020). While nudges tend to make goal striving easier, other strategies have focused on reducing difficulties associated with self-monitoring and evaluation. For instance, systems designed to simply help people monitor their energy use can be effective at reducing it (Petersen et al., 2007).

Conclusion

Taken together, findings from this program of research contribute to our understanding of the role of motivation when self-regulation is difficult – and more specifically, on the benefits of autonomous self-regulation in daily life. Two manuscripts provide further evidence that RAM may promote goal attainment through subjective ease and use of effective strategies, but more research is needed to understand how difficulties might impact situational motivation.

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[26] Of course, promoting more autonomous (vs. controlled) forms of motivation can also make a behaviour easier to do, in the sense that relative autonomous motivation is negatively related to perceived effort.

Considering the wide range of perspectives on motivation and self-regulation makes it difficult to understand what a societal definition of "good" self-regulation might entail. Does it involve facing challenges and obstacles with effort and persistence, or not experiencing them in the first place? Difficulties are everywhere in day-to-day life, from resisting tempting pastries at a café to managing peer pressure in university. However, people with more autonomous forms of motivation might not share these perceptions.

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