

**HOW AUTOMATIC ARE AUTOMATIC THOUGHTS? EXPLORING THE ROLE OF
POSITIVE AND NEGATIVE MENTAL HABITS IN WELL-BEING**

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Content of Dissertation and Contributions of Authors

This dissertation was written in a multiple article format and includes three articles. The first article “The Automaticity of Positive and Negative Thinking: A Scoping Review of Mental Habits” was published in the peer-reviewed journal *Cognitive Therapy and Research* (Colvin, Gardner, Labelle, & Santor, 2021). I (Eamon Colvin) am the first author of this manuscript, with Dr. Darcy Santor (thesis supervisor), Dr. Benjamin Gardner (collaborator), and Mr. Patrick Labelle (collaborator), as co-authors. Studies 2 and 3 have not been submitted for publication. When they are submitted, I will be the first author and Dr. Santor and Dr. Gardner will be listed as co-authors. Curtis Gough, Harry Morris, Katrina Waytowich, Luana Ackaouy, Maria Vieira, and Whitney Gitaari helped with data collection and analysis at various stages of this dissertation.

For all three studies, my contributions included the theoretical formulation of research, completing research and ethics proposals (when applicable), literature reviews, collecting and analyzing data, and preparing and revising manuscripts. Dr. Santor and Dr. Gardner provided input and expertise at each phase of the research process. Dr. Gardner also coordinated the data collection in the United Kingdom. Mr. Labelle provided expertise in formulating and executing the scoping review in Study 1.

I use the phrases “I” and “we” throughout this dissertation. When I say “I”, I am referring to the author of this dissertation (Eamon Colvin) and when I say “we”, I am referring to the research team involved in that project, which includes co-authors and research assistants.

Abstract

This dissertation investigated the role of mental habits in well-being. There has been extensive research on how people form behavioural habits related to their physical health (e.g., diet and exercise), but there have been fewer theoretical and empirical attempts to understand how the same habitual processes might underlie mental health. By better understanding the role of habits in mental health, particularly habitual thinking, clinicians and researchers might be able to improve the treatments offered for mental health concerns (e.g., depression and anxiety). In the three studies presented in this dissertation, I aimed to integrate habit research with the study of mental health by examining the extent to which thoughts can be considered habitual.

In Study 1, we conducted a scoping review to describe and summarize the existing literature on mental habits (as they relate to mental health). We screened 2817 articles and included 20 in the review. Of these 20 articles, we examined 24 separate studies and 4 commentaries on mental habits. When defining habits, researchers emphasized the importance of automaticity (described in 80% of articles) as a key factor in differentiating mental habits from other thinking processes. Most research studies used correlational research designs (71%) with university student samples (75%) measuring various constructs including negative self-thinking, worry, self-critical thinking, self-stigma, negative body image thinking, and emotion regulation. We found no articles that measured positive mental habits. Lastly, the concept of mental habits has been poorly integrated with related psychological constructs (e.g., automatic thinking, repetitive negative thinking).

In Study 2, we developed two new measures of mental habits, the Positive Thought Automaticity Index (PTAI) and Negative Thought Automaticity Index (NTAI), that integrated the strengths of existing mental habit and automatic thought questionnaires. We then used these two

measures to tease apart the roles of automaticity and frequency in predicting well-being outcomes. Based on two samples of participants from the United Kingdom and Canada, these new measures demonstrated predictive and concurrent validity, internal consistency reliability, and test-retest reliability. Positive and negative thought automaticity predicted well-being outcomes over and above thought frequency. Thought automaticity partially mediated the relationship between thought frequency and how much participants believe thoughts to be true. Overall, the results of Study 2 provided evidence of the utility of automaticity as a distinct thinking process compared to frequency.

In Study 3, we examined a key component of mental habits that has been under-explored in the literature: the cues that precede automatic thoughts. Participants from the United Kingdom completed a questionnaire about the recent and past cues that have preceded their automatic thoughts. We analyzed the results using both qualitative and quantitative methods. Using thematic analysis, we coded participants responses using the PERMA (Positive Emotion, Engagement, Relationships, Meaning, and Achievement) framework. We coded 92% of situations preceding negative thoughts and 97% of situations preceding positive thoughts as fitting within the PERMA framework. Participants described multiple cues preceding the same thought, with a median of five cues reported for both positive and negative thoughts. Participants also endorsed experiencing internal (e.g., emotions) and external (e.g., situations) cues as preceding thoughts in similar proportions. The results from Study 3 contribute to the mental habit literature by providing important information about the nature of the events preceding automatic thinking.

Overall, this program of research connects several disparate areas of study (e.g., mental habits, automatic thinking) and provides new insights about how the conceptual framework of mental habits may be useful to both clinicians and researchers. By summarizing the existing

research on mental habits (Study 1), distinguishing automatic from frequent thinking (Study 2), and better understanding the cues that precede automatic thoughts (Study 3), this dissertation attempts to clarify the role of habitual thinking in mental health. My intention is that the ideas in this dissertation will stimulate further discussions amongst habit researchers and clinicians, which will improve our understanding of mental health problems and how we treat them.

Chapter 1: General Introduction

“The chains of habit are too weak to be felt until they are too strong to be broken.”

—*Samuel Johnson*

Think about what you did this morning. What time did you get out of bed? Did you get dressed right away or did you eat breakfast first? Did you even eat breakfast? Now consider your morning commute (if such a thing exists anymore). Did you walk, take public transit, drive, or shuffle in your pyjamas to your kitchen table? If you are like most people, your morning routine is not an effortful cognitive process—almost no one conducts a cost-benefit analysis before deciding which sock to put on first, when to have breakfast, or how to get to work. Instead, these behaviours happen automatically, without intensive thinking and (in many cases) without any thinking at all. These automatic processes, which we can understand as “habits”, underlie many of the behaviours that define our lives. They may also underlie our thoughts.

Think back to your morning. What was the first thought that went through your head when you got out of bed? Were you fretting about the tasks of the day? Did you express gratitude for waking up? Were you kind or harsh to yourself when you looked in the bathroom mirror? In this dissertation, I explored how these “mental habits” impact our well-being. In the same way that our morning behaviours can be automatic, I investigated the degree to which positive thoughts (e.g., “my future looks bright”) and negative thoughts (e.g., “I am worthless”) are automatic and how framing thoughts as habits might inform our understanding of mental health. To borrow the words of Samuel Johnson, bad mental habits might “enchain” us by insidiously corroding our mental health through small, but cumulatively destructive, automatic thoughts. Likewise, cultivating good mental habits may liberate us from these chains.

Objectives

This dissertation consists of three studies in manuscript format. Study 1 (Chapter 2) was recently published (Colvin, Gardner, Labelle, & Santor, 2021). Together, the studies in this dissertation sought to build upon existing mental habit research by accomplishing four new research objectives:

1. Systematically chart the existing research on mental habits and describe the current research landscape (Study 1; Chapter 2)
2. Develop a new measure of mental habits that integrates insights from research on habits, automatic thoughts, and positive thinking (Study 2; Chapter 3)
3. Expand on existing mental habit research by exploring the cues that precede positive and negative mental habits (Study 3; Chapter 4)
4. Propose a conceptual distinction between habits and related constructs based on this program of research and discuss their relevance for clinicians and researchers (General Discussion; Chapter 5)

Before tackling these objectives, it is necessary to first describe what habits are, why they are important, and how they relate to mental health.

Background

What is a habit?

Historical perspective

The study of habit is as old as Western psychology itself. William James, a pioneer in psychology, devoted an entire chapter to habit in his foundational “Principles of Psychology” textbook. In fact, it is an unwritten rule within the habit research community that article introductions must mention James at least once and share one of his pithy quotes to situate one’s

research within the hallowed history of psychology. Clever remarks by playwrights (like Samuel Johnson), novelists, or other famous people are also welcome.

With this disclaimer in mind, James (1918) described the essential (and diverse) roles that habits play in regulating our day-to-day by stating that habits are the “enormous flywheel of society, its most precious conservative agent” (p.121). In fact, exploring the automatic versus conscious aspects of human behavior is a recurrent theme in the Western intellectual tradition. Gendler (2012) described how musings about the relationship between automatic versus conscious mental processes is an intellectual thread that connects various thinkers over the millennia. The early Greek philosophers considered automaticity as a core element of the human condition. Plato described the “tripartite” human soul as a charioteer (our minds) wrangling two horses, one representing our Passion and the other Reason. Scottish philosopher David Hume also described how the human mind can be understood as divided into two parts, Reason and Passion, wherein our reasonable mind (logic) is a slave to the passions (desire). Sigmund Freud, the trailblazing early psychoanalyst of the late 19th and early 20th century, famously described the fundamental units of the human mind: the “id” (our innate, automatic drive) and the comparatively reflective “ego” and “superego” which regulate our primal instincts (Gendler, 2012).

More recently, the cognitive revolution of the latter half of the 20th century progressed the discussion of the automatic and conscious nature of the human mind. During this wave, the human mind was no longer considered an impenetrable black box, but instead an unexplored area of empirical research. Since then, philosophers and cognitive scientists have popularized dual process theories, which propose that cognitive processes can be understood in terms of two relatively distinct types: one mind that is automatic and effortless (Type 1) and another that is reflective and deliberate (Type 2; Evans, 2009). Although the precise features of these two types of thinking are

hotly debated amongst researchers, this model has been influential in the fields of memory, reasoning, decision making, clinical psychology, and social cognition (Evans, 2009). For example, the well-documented research of Daniel Kahneman and Amos Tversky has highlighted how the human mind, when making decisions, regularly undertakes mental shortcuts (heuristics) that often need to be corrected by our conscious, rational minds (Kahneman, 2011).

Plato's "Tripartite soul", Hume's "Reason and Passions", Freud's "Ego, Id, Superego" and modern dual process models seek to capture the distinction between automatic and controlled human cognition. The historical continuity of these ideas suggests that studying the automaticity of thinking is a fundamental aspect of our humanity. This humbling fact provides important context for the scientific research on habits that has emerged in recent decades.

Modern Conceptualizations of Habit

Recently, researchers have continued investigating the habitual nature of behaviour and have distinguished *habitual* behaviours from *frequent* behaviours. There have been many attempts to conceptualize "habit" and differentiate it from related constructs, like frequency (e.g., Lally & Gardner, 2013; Verplanken & Orbell, 2003; Wood & Neal, 2007; Wood & Rünger, 2016). A conceptual challenge in this field has been to arrive at a concrete definition of habit, since—as Gardner (2015) described—some authors have defined habit as a type of behaviour (e.g., Gardner, Abraham, Lally, & de Bruijn, 2012), a tendency *towards* behaviour (e.g., Ouellette & Wood, 1998), and a type of automaticity (e.g., Wood & Neal, 2009).

After reviewing explicit definitions of "habit" in eight literature reviews and 136 empirical studies, Gardner (2015) synthesized these definitions to create a comprehensive definition: habit is a "process by which a stimulus automatically generates an impulse towards action, based on learned stimulus-response associations" (Gardner, 2015, p. 280). This definition addresses several

of the logical inconsistencies that existed amongst previous definitions of habit. For example, it is a logical fallacy for a habit to be both a behaviour and a tendency towards behaviour since “a habit cannot be both the behaviour and the cause of behaviour” (Maddux, 1997, p. 335-336) Thus, to rectify this discrepancy, habit can be considered as a *process* from which certain behaviours emerge.

In contrast to this definition, habits are often described in day-to-day language as frequent behaviours. With Gardner’s (2015) definition, however, habitual behaviour can be viewed as automatic responses that emerge from a cue in the environment. It is the *automaticity*, rather than frequency, of habitual behaviours that distinguish them from frequent behaviours (Gardner, 2012). Automatic responses are conducted immediately (following a cue) with a lack of awareness, intention, conscious control, and with little effort (Bargh, 1994). More precisely, the strength of the relationship between a cue in the environment and a behavioural response determines the strength of a habit, not how frequently a behaviour is performed. As an example of how a behaviour can be habitual, but infrequent, imagine that you have a secret handshake with your best friend. Even if you see this friend (the cue eliciting a response) rarely, you will still automatically perform your secret handshake (the response). The friend-handshake habit can be strong independent of how often you see your friend. Another example of an infrequently executed, yet habitual, behaviour is the habit of saying “amen” at the end of public prayer in certain Christian faiths (Gardner, 2012). This habit persists both for weekly churchgoers and those who only attend church once a year. Thus, habitual behaviours will occur frequently only to the extent that the environmental cues that elicit them are encountered frequently. Other authors have expanded on the features of habits rather than trying to come up with a single definition. For example, Harvey, Callaway, Zieve, Gumport, and Armstrong (2022) outlined six elements of habits that are

particularly notable for practitioners of evidenced-based psychotherapies. They argue that habits are independent of goals, cued by specific contexts, learned via repetition, automatic, promoted by reinforcers, and take time to develop (Harvey et al., 2022).

In this dissertation, I define habit as a “cue-dependent automatic response acquired through repetition.” While no definition of “habit” will lead to perfect consensus amongst researchers, I consider this definition to be parsimonious while capturing the essential features of habits widely agreed upon in the habit literature: *automaticity* and *cue-dependence*. Importantly, this definition allows both thoughts and behaviours to be conceptualized as habits. Although there are other relevant features of habits, including being goal independent and taking time to develop (Harvey et al., 2022), these are still active areas of empirical habit research, with differing opinions amongst researchers (e.g., Phillips, 2020). In contrast, there appears to be consensus that habits are automatic (to some degree) and cued by specific contexts (Gardner, 2015; Lally & Gardner, 2013; Wood & Rünger, 2016). With this definition in mind, we can now explore why habits are important to distinguish from other thoughts and behaviours. In recent decades, health psychology researchers have led the empirical and theoretical investigations of the importance of changing habits.

The case for making health behaviours habitual

Researchers have investigated a broad range of habitual health behaviours, including physical activity (de Bruijn, 2011; de Bruijn, Gardner, van Osch, & Sniehoff, 2014; de Bruijn, Rhodes, & van Osch, 2012), smoking (Orbell & Verplanken, 2010), binge-drinking (Gardner, de Bruijn, & Lally, 2012), and dental flossing (Judah, Gardner, & Aunger, 2013), among many others. I believe there are three main reasons why habits are often studied in the context of health behaviour change: 1) a significant proportion of daily behaviours are habitual, 2) habits are

(relatively) simple and pragmatic, and 3) habits (should) persist despite intentions. Just as these features make habits appealing to health behaviour researcher, they are also good reasons to investigate mental habits in the context of mental health.

A significant proportion of daily behaviours are habitual. Let us return to the exercise presented in the opening sentence of this dissertation: think back to what you did this morning. For most people, this exercise highlights how much of our daily lives are consumed by habit. This anecdotal experience is consistent with one of the most widely cited articles in the habit literature. Using a diary sampling procedure, Wood, Quinn, and Kashy (2002) estimated that between 35-43% of daily behaviours can be considered habitual in that they are performed almost every day in similar locations. Many preventative health behaviours fit this description, such as tooth-brushing, fruit and vegetable consumption, and physical activity, as do unhealthy behaviours like smoking, drinking alcohol, and eating unhealthy foods. As a result, Marteau, Hollands, & Fletcher (2012) argued that targeting automatic processes in behaviour is essential for tackling the global disease burden because many diseases (e.g., diabetes, cancer, heart disease) are perpetuated by daily habits. The fact many daily behaviours are habitual presents unexpected risks. For example, dozens of children die each year from being forgotten in hot cars (McLaren, Null, & Quinn, 2005). These deaths are often not due to willful negligence but rather parents running errands that they habitually do alone and, as a result, forgetting that they have left their children unattended. The abundance of daily habits, and their cumulative impact on physical health, have highlighted their importance to health researchers, policymakers, and clinicians.

Habits are (relatively) simple and pragmatic. Many physical health problems (e.g., obesity, cancer, heart disease) and mental health problems (e.g., depression, anxiety) have complex etiologies. This fact can be paralyzing to clinicians and policymakers: if these problems have

multifaceted causes, what interventions should governments focus on? A habit perspective offers a pragmatic solution. Even though the causes of these problems are complex, a series of simple changes will often be beneficial. For people with obesity, going for a short walk every morning will benefit their overall health. For people with depression, engaging in daily activities that give a sense of pleasure or mastery will incrementally improve their mood (Jacobson, 2001). From a habit formation perspective, performing these behaviours frequently will increase the probability that they become less effortful and more automatic—in other words, these behaviours will become habitual. Habit change not only offers clinicians and policymakers tangible solutions to complex problems, but also empowers the people experiencing these concerns to enhance their well-being. Patients may struggle to grasp the complex bio-psycho-social interactions that have caused their condition, but they can understand that performing a handful of simple behaviours daily will be helpful. For these reasons, clinicians are often encouraged to help patients form goals that are Specific, Measurable, Attainable, Realistic, and Time-sensitive (SMART; Shaw, Pattison, Holland, & Cooke, 2015). Habit interventions often meet all five of these SMART criteria. Consider common mental health interventions encouraged by clinicians, such as completing a 3-item gratitude exercise before bed every night or doing a brief 3-minute mindfulness meditation session each morning.

Habits (should) persist despite intentions. Habits are also an attractive intervention target because of their potential to be performed in the absence of intentions. Several prominent theories of behaviour propose that intentions are an important factor that will predict behaviour (e.g., Ajzen, 1991). One of the key takeaways from the habit literature is that habits affect the *intention-behaviour gap*—the phenomenon that people often want to perform a behaviour but fail to perform this behaviour regularly (e.g., Rhodes & de Bruijn, 2013). For example, many people have strong

intentions to exercise yet fail to act on these intentions. Specifically, habits have been found to moderate the relationship between intentions and behaviour such that the stronger the habit, the less of an impact that intentions have on behavioural frequency. When a behaviour becomes habitual, one's intention to perform the behaviour is no longer a useful predictor of how often that behaviour is performed. In a meta-analysis of physical exercise and nutrition habits, habits were shown to moderate the intention-behaviour relationship in eight of nine studies (Gardner, de Bruijn, & Lally, 2011). In each of these cases, as the habitual nature of the behaviour increased, the effect of intention on behavioural frequency decreased. However, these intention-behaviour moderation effects may have been inflated due to analyses in which the statistical assumptions were not fully met (Rebar, Rhodes, & Gardner, 2019).

Considering that habits, by definition, require less effort and conscious awareness to perform, they are desirable for long-term behaviour change (Marteau et al., 2012). In this way, habits can be conceptualized within the dual process models described above, which propose that our cognitive faculties operate under two "systems" or "types" (Evans & Stanovich, 2013). Type 1 is the automatic system: it is fast, effortless, unconscious, and immediate. Habitual behaviours can be understood as emerging from Type 1, given their automatic nature. Type 2, meanwhile, is reflective, slow, effortful, and conscious (Kahneman, 2011). (It should be noted that habits can also be conceptualized using the more archaic models from Plato, Hume, or Freud). Under Type 1-Type 2 model, habits may be influenced by conscious control but since cognitive resources are finite, habits will theoretically endure even when an individual seeks to change them. For instance, there exists evidence that habits consistent with one's goals persist even when self-control is low (Neal, Wood, & Drolet, 2013). Thus, the theoretical justification for why we should focus on changing habits (rather than behaviours in general) is that cultivating good habits and eliminating

bad habits ensures that health behaviours are maintained with minimal cognitive effort (Marteau et al., 2012). However, while habit change should theoretically persist for longer than other behaviours, there is limited definitive empirical research about how long habits last. Instead, extensive theoretical and empirical research has focused on how long it takes for habits to form in the short to medium term.

How long does it take to form a habit? The principles of habit formation

After the early behaviourists, the first modern estimate of how long it takes to form a habit came from an esoteric area of research—cybernetics (Maltz, 1960). Maxwell Maltz, a cosmetic surgeon, noted that it took approximately 21 days (three weeks) for patients to become adjusted to their new appearance after a cosmetic nose surgery. The proposition that it “takes 21 days to form a habit” has been widely regurgitated by popular media outlets ever since.

Fortunately, there has been more rigorous empirical research on habit formation. A foundational study in the field investigated habit formation of everyday health behaviours related to eating, drinking, and physical activity (Lally, Van Jaarsveld, Potts, & Wardle, 2010). In this study, Lally and colleagues (2010) asked participants to select a behaviour that they did not already perform regularly and that was performed in response to a daily cue, once a day, every day. The authors operationalized a habit being “formed” as when the curve flattened for scores on a self-report questionnaire that was completed daily, the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The authors argued that a habit was formed when the scores on this questionnaire, which measured the habitual aspects of the chosen behaviour, stabilized over time. While many media reports of this study fixate on the median number of days (66 days) required to form a habit in this study, the number of days needed to form a habit ranged widely from 18 to 254 days, which is significantly more variability than Maltz' (1960) observation of 21 days.

Habit formation strategies seek to establish context-dependent repetition of behaviours, with the goal being that these behaviours become automatic (Lally & Gardner, 2013). A recent systematic review investigated the habit formation techniques used in health behaviour change interventions (Gardner & Rebar, 2019). One inclusion criterion for this review was that the interventions established context-dependent repetition of behaviours (i.e., repeatedly performing a behaviour in response to a cue) and thus all included studies applied this technique. Other popular strategies included using cues/prompts to facilitate behaviour (73% of studies), action planning (53% of studies), instruction on how to perform a behaviour (53% of studies), setting goals (53% of studies), and self-monitoring behaviour (53% of studies). In total, the authors found 32 discrete behaviour change strategies in the included studies. The majority of techniques in the included studies facilitated action planning in some way—by identifying cues, setting goals, and learning to perform a behaviour—and few of these studies explicitly sought to increase motivation to change behaviour (Gardner & Rebar, 2019). An example of action planning is a popular technique called *implementation intentions* (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011; Gollwitzer, 1999). This technique requires individuals to explicitly state the cue-dependent response that they hope to become habitual: “Whenever situation x arises, I will initiate the goal-directed response y!” (Gollwitzer, 1999). The rationale for this intervention is that most people have strong intentions to act in certain ways (e.g., a strong desire to exercise regularly), but often fail to implement these intentions through concrete planning. Implementation intentions require individuals to specify where, when, and how individuals will accomplish their goals (Gollwitzer, 1999). A meta-analysis of 23 health behaviour implementation intentions interventions found a medium-to-large effect size ($d = 0.59$) for changing health behaviours, such as healthy eating and physical activity (Gollwitzer & Sheeran, 2006).

Thus, the techniques in habit formation interventions have tended to focus on interventions that teach the skills to initiate or repeat a behaviour, encourage context-consistent repetition of the behaviour, and strengthen the context-behaviour association that forms as a result of context-dependent repetition. The studies that Gardner & Rebar (2019) identified focused solely on physical health behaviours: diet and physical activity, sedentary behaviour, dental hygiene, and food safety. While physical health habits are well-studied, there has been comparatively limited research on how behavioural and mental habits impact mental health.

The potential of applying habit insights to mental health

Despite this lack of research, there have been several attempts to integrate the science of habit formation into the study of mental health in the past decade. Recently, Harvey et al. (2022) summarized the untapped applications of habit research for evidence-based psychotherapies: “it is clear that an implicit goal of many [evidence-based psychotherapies] is to disrupt unwanted habits and to develop new desired habits” (p. 573) and that “an intensive and sustained focus on individual habits will be the fundamental building block to more successful [evidence-based psychotherapies]” (p.584). I share this view; I believe that we can improve the quality of psychotherapy by incorporating the insights from existing habit research, which would help alleviate the suffering of millions of people worldwide who currently do not experience lasting benefits from psychological interventions (Glenn et al., 2013; Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012). More specifically, a growing number of researchers have argued that many people would stand to benefit from changing both behavioural and mental habits related to their well-being.

Behavioural habits and mental health. Clinicians and researchers have argued that changing automatic human behaviours (e.g., habits) is essential to prevent the diseases that bear

the largest burden on societies around the world (Marteau et al., 2012). Among these preventable diseases are mental illnesses. There are two main ways that habitual behaviours relate to mental health: 1) many mental disorders are characterized by maladaptive habitual behaviours and 2) many evidence-based psychotherapies (EBPTs) emphasize breaking unhelpful habits and forming beneficial automatic behaviours in their place.

In a recent textbook summarizing the existing literature on habits, the concept of habit was reviewed in the context of numerous mental disorders, including depression (Watkins, Owens, & Cook, 2018), substance use (Arnaudova, Amaro, & Monterosso, 2018), and autism (Russell & Brosnan, 2018). In many influential models of mental disorders, daily automatic behaviours triggered by specific cues often become entrenched and self-perpetuating. People with depression habitually avoid pursuing activities that give them a sense of pleasure (e.g., seeing friends) or mastery (e.g., physical exercise), which worsens mood (Greenberger & Padesky, 2016). People with insomnia habitually stay in bed when they are not tired, or go to bed too early, which increases the association between bedtime and restlessness (Harvey et al., 2022). People struggling with alcohol use habitually drink in response to negative emotions, withdrawal symptoms, or in particular social settings (Arnaudova et al., 2018). People with obsessive-compulsive disorder habitually perform compulsive behaviours (e.g., handwashing) to neutralize feelings of anxiety (Abramowitz, 2006). People with anorexia nervosa habitually restrict food intake in response to food cues (Uniacke, Timothy Walsh, Foerde, & Steinglass, 2018). Though the list of mental health problems characterized by unhelpful habitual behaviours could continue, skin picking (excoriation), hair pulling (trichotillomania), tics, and nail biting (Azrin & Nunn, 1973) all fall into this category.

The automatic nature of maladaptive behaviours in mental disorders is offset in evidence-based psychotherapies by interventions that encourage forming alternative habitual behaviours (Verhoeven & de Wit, 2018). A common goal in Cognitive Behavioural Therapy for depression, for example, is to regularly perform pleasurable activities or engage in behaviours that give an individual a feeling of mastery (Jacobson, 2001). Behavioural activation is rarely encouraged to be done once, but rather again and again, until the vicious cycle of avoidance (in which negative emotions beget more negative ones) becomes a virtuous cycle of engagement (in which positive emotions beget more positive ones). These behaviours might include engaging in physical exercise, engaging with others socially, and performing regular mindfulness meditation or relaxation breathing exercises (Linehan, 2015). Clinicians often encourage these behaviours, particularly as activities that should be engaged in consistently and regularly, often with the goal that they will become automatic and effortless aspects of one's day-to-day life. For people with insomnia, stimulus control interventions seek to form the new habit of getting out of bed after 20 minutes if one cannot fall asleep (Bootzin & Epstein, 2011). In habit reversal therapy for tic disorders, trichotillomania, and skin-picking, clinicians help clients form new habits that are incompatible with these unhelpful behaviours (Azrin & Nunn, 1973; Deckersbach, Rauch, Buhlmann, & Wilhelm, 2006). For example, clients with hair-pulling might be encouraged to habitually form a fist when experiencing the urge to pull their hair, which prevents hair-pulling.

Even though mental health clinicians routinely seek to change behavioural habits, there have been few empirical trials that examine the formation of habits related to mental health and measure the resultant effects on mental health (Harvey et al., 2022). However, emerging research is demonstrating the benefits of infusing EBPTs with habit formation techniques. One trial recently investigated a habit intervention for individuals with anorexia nervosa (Steinglass et al., 2018).

The authors developed a new behavioural therapy for anorexia nervosa, Regulating Emotions and Changing Habits (REaCH), which emphasized becoming aware of cues (e.g., mirrors, dining room tables), creating new routines (e.g., finishing one's meal), suppressing maladaptive habits (e.g., checking nutritional facts), and regulating emotions. Compared to supportive psychotherapy, REaCH led to significant reductions in maladaptive eating habits and eating disorder symptoms post-treatment.

Mental habits, mental health, and the need for conceptual clarity

The same mental disorders described above in terms of habitual behaviours can also be characterized by automatic thinking patterns triggered by specific cues; in other words, mental habits. For example, people with depression consistently ruminate when experiencing external stressors or sad mood (Nolen-Hoeksema, Morrow, & Fredrickson, 1993). People with generalized anxiety disorder habitually worry when they encounter uncertainty (Brewer & Roy, 2021). People with insomnia automatically have catastrophic thoughts (e.g., “I will never fall asleep”) while lying in bed (Bootzin & Epstein, 2011). People struggling with alcohol use often have thoughts like “I can't handle this situation without drinking” when encountering stressful events (Kadden, 1994). People with obsessive-compulsive disorder automatically ruminate on the meaning of intrusive thoughts (e.g., “I must be a pedophile”) when encountering an environment that triggers the thought (e.g., a playground; Julien, O'Connor, & Aardema, 2007). These cue-dependent automatic thinking patterns fit the definition of habits provided above. However, these thoughts are rarely framed as habitual and, if they are, are often done implicitly and poorly integrated within the formal study of habit formation and evidence-based psychotherapy.

Despite the pervasiveness of mental habits in mental health, there has been surprisingly little formal research that has delineated them from related constructs. Nonetheless, a habit

framework is consistent with the historical progression of cognitive models of mental disorder, particularly in the context of Cognitive Behavioural Therapy (CBT). Dr. Aaron T. Beck, a founder of modern CBT, considered “automatic thoughts” to be a central aspect of mental disorder and his early writings described automaticity as a defining feature of depressive thinking (Beck, 1963). These cognitions were elicited by “particular kinds of ‘external situations’” (i.e., a cue) that lead to a “stereotyped response [that was] completely irrelevant and inappropriate to the situation as a whole” (i.e., an automatic response; Beck, 1963, p.38). Beck’s early discussions about the automatic nature of thought are consistent with the automatic processes described by modern dual process and habit theories. For example, these thoughts were described as appearing “without any apparent antecedent reflection or reasoning” (Beck, 1963, p.41) and appeared to have an “involuntary quality” (Beck, 1963, p.41).

Clinicians also often use the term “habit” colloquially, yet rarely (if ever) distinguish them theoretically from related constructs. Habits are part of the daily clinical language for clinicians, despite not often specifying their precise role in perpetuating mental health problems. For instance, using the ‘find’ function on a PDF reader reveals that Burns’ (1980) best-selling book “Feeling Good” uses the term *habit* 52 times. As one example, Burns described how, in the context of depressed individuals being unable to enjoy accomplishments, the “bad habit of saying ‘it doesn’t count’ torpedoed any sense of fulfilment” (p. 83). However, Burns does not distinguish “habits” from other types of thinking (e.g., automatic thinking).

Many researchers have, however, attempted to disentangle how different transdiagnostic thinking patterns, such as rumination (Nolen-Hoeksema, 2000), influence well-being (Ehring, Zetsche, Weidacker, Wahl, Schönfeld, et al., 2011). Transdiagnostic thinking patterns can be described based on *content* (what we think) and *process* (how we think). Examples of thought

content include worries about the future (e.g., “I will fail out of university”) versus depressive reflections on the past (e.g., “I have nothing to be proud of”). Thought process, in contrast, distinguishes whether thoughts require effort or deliberation, or are automatic and immediate. Habitual thinking is one such process, although there have been few attempts to distinguish concepts like automatic thinking (Hollon & Kendall, 1980) or repetitive negative thinking (Ehring & Watkins, 2008). Given this lack of conceptual clarity, in this dissertation I sought to review the literature on mental habits (Study 1) to summarize patterns in the literature and identify unexplored research opportunities. Then, I conducted two empirical studies (Studies 2 and 3) that addressed the gaps in the mental habit literature identified in Study 1.

Investigations in this Dissertation

This dissertation contains three studies (Chapters 2, 3, and 4) that address previously unanswered theoretical and empirical questions in the study of mental habits.

In Chapter 2 (Study 1), I conducted a scoping review of mental habits to better understand the research landscape of habitual thinking and the extent to which it was integrated with other related concepts. This was the first comprehensive review of mental habits as they relate to mental health.

In Chapter 3 (Study 2), I developed a new measure of habitual thinking that addressed the measurement shortcomings identified in Study 1. In doing so, Study 2 also tested new hypotheses about the relationship between habitual thinking and frequent thinking and the unexplored role of positive mental habits in predicting well-being.

In Chapter 4 (Study 3), I explored which types of cues tend to precede positive and negative automatic thoughts. Despite the emphasis on the importance of cues in habit formation, there has been limited research on which cues trigger automatic thoughts.

Together, these studies addressed several conceptual and empirical gaps in the study of mental habits, which I discuss in Chapter 5 (General Discussion). In the process, this program of research attempted to bridge several previously disconnected areas of research, including mental habits, health habits, automatic thinking, CBT, and mental health.

Chapter 2: The Automaticity of Positive and Negative Thinking: A Scoping Review of Mental Habits (Study 1)

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I made major changes to the Introduction to reduce redundancy with Chapter 1.

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Abstract

Background: Our thoughts impact our mental health and there is a distinction between thought content (what we think) and thought process (how we think). Habitual thinking has been proposed as one such process. Habits, which are cue-dependent automatic responses, have primarily been studied as behavioural responses.

Methods: The current scoping review investigated the extent to which the thinking patterns important for mental health have been conceptualized as habits. Using systematic search criteria and nine explicit inclusion criteria, this review identified 20 articles and 24 empirical studies examining various mental habits, such as negative self-thinking, self-criticism, and worry.

Results: All of the included empirical studies examined maladaptive (negative) mental habits and no study investigated adaptive (positive) mental habits. We categorized the characteristics of each study along several dimensions including how mental habits were defined, measured, and which constructs were studied as habitual.

Conclusions: Although mental habits appear to be relevant predictors of mental health, habitual thinking has not been well-integrated with psychological constructs related to mental health, such as automatic thoughts. We discuss the implications of mental habits for future research and clinical practice.

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The Automaticity of Positive and Negative Thinking: A Scoping Review of Mental Habits

Given the potential theoretical and clinical benefits of treating negative thinking patterns as habits, a review of the existing literature on mental habits as they relate to mental health is warranted. Despite existing systematic reviews on behavioural habits (Gardner, 2015; Gardner, De Bruijn, & Lally, 2011), there have been no reviews of the literature for mental habits. The current study presents a scoping review investigating the extent to which a “habit lens” has been applied to mental processes. Given the exploratory and broad nature of this research topic (mental habits), we conducted a scoping review to assess the extent of relevant literature and describe its features (Grant & Booth, 2009). Unlike systematic reviews—which are used to summarize all existing evidence on a specific and similar topic, scoping reviews can be used to clarify concepts and definitions within a literature, to identify knowledge gaps, to identify the characteristics of a particular theory or concept and can serve as a precursor to systematic reviews (Munn, 2018). Scoping reviews are broader and more exploratory than systematic reviews, especially when a research area is complex or has yet to be comprehensively reviewed (Arksey & O’Malley, 2005). Scoping reviews are thus useful for understanding themes within a broad research area, the definitions of similar concepts within this research, and how these concepts are measured. The current review sought to answer three research questions (RQs):

- 1) Have mental habits been defined and, if so, are these definitions consistent with the behavioural habit literature?
- 2) Where mental processes have been framed as habitual, how have mental habits been measured?
- 3) Where mental processes have been framed as habitual, how has the concept of mental habit been applied to mental health?

Answers to these research questions would be useful to both clinicians, who seek to help clients improve their mental health, and researchers, who seek to understand the underlying nature of mental processes. Identifying the terms used to define *mental habits* (RQ1), and the strategies used to measure them (RQ2), will help to clarify whether mental habits and behavioural habits are conceptualized similarly. Answering RQ3 will elucidate whether the concept of mental habit has been successful in explaining phenomena related to mental health and, if so, which thinking patterns have been framed as habitual.

Methods

Search methodology and screening procedures

In line with established scoping review methodologies (Peters et al., 2015), we undertook a systematic search to identify literature on mental habits related to mental health using two databases (PsycINFO, MEDLINE). The search strategy sought to capture a broad swathe of articles related to the research questions and included keywords such as mental habits, repetitive thinking, perseverative thinking, automatic thinking, rumination and recurrent thinking, among others. Search terms can be found in Appendix A, along with a checklist of scoping review standards (Tricco et al., 2018).

Empirical articles, review articles, and commentaries were included in the review where they met nine criteria. Prior to screening, the search strategy only included articles 1) in English, 2) published in peer-review journals, and 3) featuring human participants, for articles based on empirical data. No date limits were set for the search. Articles captured by the search strategy were screened in two phases: title and abstract screening, and full-text screening. In the title and abstract screening phase, articles were included if they also met four further criteria: 4) a psychological construct was measured that 5) related to mental health, 6) the article included a term related to

the *process* of the construct, using any variant of the terms “automatic”, “repetitive”, “perseverative”, “recurrent”, or “habitual”, and 7) the construct was the primary focus of the article (i.e., articles were excluded if the potentially habitual construct was only mentioned as a secondary outcome measure in an unrelated analysis). Where it was uncertain whether a title or abstract met these criteria, the article was retained for full-text screening. In the full-text screening phase, articles were included if they also met two further criteria: 8) the term “habit” was mentioned anywhere in the article; and 9) the authors provided a definition of habit or cited an article that either defined habits (e.g., Gardner, 2015) or developed a measure of habit (e.g. Verplanken et al., 2007; Verplanken & Orbell, 2003). Any articles discovered through other means (i.e., reference lists of included articles) that met all of these criteria, but were not captured by the search strategy, were retained in the review.

The first author (EC) conducted all screening. An independent coder screened a random sample (10%) of all titles and abstracts and another random sample (10%) of all full-text articles. Following independent coding, no additional articles were included.

Data extraction and analysis

Eligible articles were categorized in various ways to answer each research question using a narrative approach. To assess how mental habits were defined in each article (RQ1), a coding scheme was developed and applied to the definitions provided in the articles. The definition of “habit” was coded based on whether: 1) habit was defined at all by the authors, 2) the definition was explicit (the authors provided a clear definition) or implicit (whether the features of habits were described, but not defined explicitly), 3) automaticity was a defining feature, 4) repetition was a defining feature, 5) an external cue or situational context evoking the thought was a defining feature, 6) mental habits were framed as distinguishing thought process and content.

To examine how mental habits have been measured (RQ2), we categorized the psychometric measures and the experimental methods used to operationalize mental habit. We also categorized research designs and sample types to identify themes related to how mental habits have been studied.

We investigated the extent to which the concept of mental habit has been applied to mental health (RQ3) by cataloguing the types of constructs measured as habits. In addition, we categorized the “role” mental habits played in research designs such as whether habit was used as a predictor of a variable or as mediator/moderator of a relationship between other constructs.

Results

Search Results

Of 2817 articles screened, 19 met our inclusion criteria. An additional relevant article was obtained from a manual search of reference lists (Chan & Mak, 2015). Of these 20 articles, 16 were empirical articles (reporting 24 discrete studies) and 4 were review and commentary papers (see Table 1).

Table 1. Study 1 features of included empirical articles

Study	Sample	Habitual construct	Hypothesized role of habit	Study aim	Non-habit constructs	Study design	Main finding regarding habit
Armstrong et al. (2014)	45 older adults, 60 undergraduates (non-clinical)	Negative self-thinking (HINT)	Outcome variable (DV); Mediator	To compare various psychological features (including habitual negative self-thinking) in younger versus older adults.	Worry, Depression, Coping style	Cross-sectional	-Older adults engaged in less habitual negative self-thinking than younger adults; -Habitual negative self-thinking partially mediated the age-worry relationship - Habitual negative self-thinking fully mediated the age-depression relationship
Chan & Mak (2015)	161 adults with diagnosed mental disorder (clinical)	Self-stigma (STARS)	Independent dichotomous variable	To examine the potential contributory role of attentional bias in habitual self-stigma.	Stigma-related words, positive words, non-words, Self-stigma content, Depression,	Quasi-Experimental: (IVs: Habitual self-stigma, word-type, DV: Response latency)	-Participants with strong (but not weak) habitual self-stigma colour-named stigma-related words faster than non-affective words.
Chan & Mak (2017)	189 adults with diagnosed mental disorder (clinical)	Self-stigma (STARS)	Potential bivariate correlate of related constructs; Independent variable in a hierarchical regression	To develop and validate a psychometric measure of habitual self-stigma in a clinical population.	Self-stigma content, Experiential avoidance, Mindfulness, Self-esteem, Life Satisfaction, Personal recovery	Cross-sectional	-The STARS demonstrates qualities of a valid and reliable measure of habitual self-stigmatization with a 2-factor structure (repetition and automaticity) that correlates with related measures and outcomes
Chan & Lam (2018)	424 parents of children with autism (clinical)	Self-stigma (STARS)	Potential bivariate correlate of related constructs; Independent variable in a hierarchical regression	To validate a psychometric measure of habitual self-stigma for parents of children with autism.	Self-stigma content, Life Satisfaction, Depression, Caregiving gain, Caregiving burden	Cross-sectional	- STARS was validated in a sample of parents of children with autism -STARS replicated its reliability and validity findings and demonstrated incremental validity in predicting relevant constructs.

Christou-Champi et al. (2015)	27 university staff and students (non-clinical)	Emotion regulation (SRHI; SRBAI)	Outcome variable (DV)	To examine whether structured emotion regulation practice could improve emotion regulation efficiency (including habitual use of emotion regulation).	Heart rate variability, Baseline emotion valence of images, Current emotional state	Experimental (IV: Emotion regulation training, DV: Habitual emotion regulation)	-Participants trained in emotion regulation experienced increased habitual emotion regulation use at a two-week follow-up.
Dundas et al. (2017)	158 undergraduates (non-clinical)	Negative self-thinking (HINT)	Outcome variable (DV)	To assess the impact of a two-week self-compassion course on various psychological outcomes (including habitual negative self-thinking).	Personal growth, Self-control, Self-judgment, Self-compassion, Trait anxiety, Depression	Experimental; Randomized controlled trial (IV: Compassion course, DV: Habitual negative self-thinking)	-Participants randomized to undergo a two-week self-compassion course experienced significant reductions in habitual negative self-thinking at six-month follow-up compared to a control group.
Fisher et al. (2017)	632 adults participants (233 meditators, 321 non-meditators) (non-clinical)	Negative self-thinking (HINT)*	Potential bivariate correlate of related constructs; Mediator	To examine the psychological mechanisms (including habitual negative self-thinking) underlying the relationship between mindfulness and reward motivated eating.	Mindfulness, Uncontrolled eating, Emotional eating, Emotion Dysregulation	Cross-sectional	-Lower levels of dispositional mindfulness was associated with increased habitual negative self-thinking -Habitual negative self-thinking and emotion dysregulation mediated the relationship between dispositional mindfulness and uncontrolled/emotional eating.
James et al. (2015)	381 adults (non-clinical)	Self-critical thinking (HINT)	Potential bivariate correlate of related constructs; Mediator	To investigate the cognitive processes (including habitual self-critical thinking) that mediate the relationship between unhealthy perfectionism and distress.	Depression, anxiety stress, Perfectionism Beliefs about Emotion, Rumination, Mindfulness, Self-compassion	Cross-sectional	-Higher levels of habitual self-critical thinking was associated with unhealthy perfectionism and psychological distress -Habitual self-criticism mediated the relationship between unhealthy perfectionism and psychological distress.

Thew et al. (2017a)	26 adults with current major depressive disorder; 26 adults with current eating disorder; 26 participants with no current/historical mental health difficulties (clinical)	Self-critical thinking (HINT)	Potential bivariate correlate of related constructs; Independent variable in a multiple regression	To explore the impact of two experimental tasks designed to elicit self-critical thoughts on the endorsement of general negative self-views of clinical and non-clinical populations.	Perfectionism, Depression symptoms, Eating disorder symptoms, Overgeneralization of self-critical statements,	Experimental. Two tasks designed to elicit self-critical thoughts: a verbal ability task and body image task. (IV: Time, DV: Overgeneralization).	-Habitual self-criticism was significantly correlated with changes in self-criticism following an experimental task designed to induce self-criticism. -In a multiple regression analysis, habitual self-criticism did not predict overgeneralization, while task-related changes in self-criticism did significantly predict overgeneralization.
Thew et al. (2017b)	26 adults with current major depressive disorder; 26 adults with current eating disorder; 26 participants with no current/historical mental health difficulties (clinical)	Self-critical thinking (HINT)	Potential bivariate correlate of related constructs; Outcome variable (DV)	To explore the relationship between habitual self-criticism with rumination, perfectionism, and symptoms of mental disorders (eating disorders and depression).	Perfectionism, Depression symptoms, Eating disorder symptoms, Self-esteem, Rumination Self-compassion, Self-functioning	Cross-sectional; Mixed methods (Quantitative and Qualitative)	-Participants with major depressive disorder and participants with an eating disorder experienced higher levels of habitual self-criticism compared to controls -Habitual self-criticism was significantly correlated with decreased self-esteem, decreased self-compassion, increased rumination, and increased negative perfectionism.
Verplanken (2006) Study 2	194 undergraduates (non-clinical)	Negative self-thinking (HINT)	Potential bivariate correlate of related constructs; Independent variable in hierarchical regression	To examine the incremental contribution of habitual negative self-thinking in predicting self-esteem, depression, and anxiety over and above the frequency of negative thoughts.	Automatic thoughts, Self-esteem, Depression and anxiety	Cross-sectional	-Habitual negative self-thinking predicted variance in self-esteem, depression, and anxiety symptoms over and above the variance accounted for by past frequency of negative self-thinking.
Verplanken et al. (2007) Study 1	157 undergraduates (non-clinical)	Negative self-thinking (HINT)	Potential bivariate correlate of related constructs	To assess the content validity of the HINT.	Interpretation of an ambiguous story	Cross-sectional	-HINT scores significantly correlated with frequency of negative-self thoughts (as coded by two judges) generated following reading an ambiguous story.

Study 2	142 undergraduates (non-clinical)	Negative self-thinking (HINT)	Independent variable in a hierarchical regression	To examine the incremental contribution of habitual negative self-thinking in predicting explicit self-esteem over and above the frequency of negative thoughts (Automatic Thoughts Questionnaire).	Automatic Thoughts, Self-esteem	Cross-sectional	-HINT scores predicted variance in self-esteem scores over and above the variance accounted for by age and gender (Step 1), and automatic thoughts (Step 2).
Study 3	97 undergraduates (non-clinical)	Negative self-thinking (HINT)*	Independent variable in a hierarchical regression	To investigate whether habitual negative self-thinking predicted self-esteem over and above the Automatic Thought Questionnaire because of differences in content of the scales (rather than process).	Number of self-generated negative thoughts, Frequency of negative thoughts, Self-esteem	Cross-sectional	-HINT scores predicted variance in self-esteem scores over and above the variance accounted for by age, gender and questionnaire order (Step 1), and number and perceived frequency of thoughts (Step 2).
Study 4	155 undergraduates (non-clinical)	Negative self-thinking (HINT)	Independent variable in a hierarchical regression	To examine the discriminant validity of habitual negative self-thinking in predicting self-esteem compared to mental rumination and mindfulness.	Rumination, Mindfulness, Self-esteem	Cross-sectional	-HINT scores predicted variance in self-esteem scores over and above the variance accounted for by age gender (Step 1), and rumination and mindfulness (Step 2).
Study 5	125 undergraduates (non-clinical)	Negative self-thinking (HINT)	Independent variable in a hierarchical regression	To investigate whether negative self-thinking habit was related to implicit self-esteem.	Implicit self-esteem (Implicit association task), Automatic thoughts, Explicit self-esteem	Cross-sectional	-HINT scores predicted variance in implicit self-esteem scores over and above the variance accounted for by age, gender, and handedness (Step 1), block order and key designation (Step 2), automatic thoughts and explicit self-esteem (Step 3).
Study 6	206 undergraduates (non-clinical)	Negative self-thinking (HINT)*	Independent variable in a hierarchical regression	To replicate the finding that negative self-thinking habit is associated with implicit self-esteem.	Implicit self-esteem (Letter-number paradigm), Number of self-reported negative thoughts, frequency of negative thoughts	Cross-sectional	-HINT scores predicted variance in implicit self-esteem scores over and above the variance accounted for by age, gender (Step 1), number and perceived frequency of negative self-thoughts (Step 2).
Study 7	142 undergraduates (non-clinical)	Negative self-thinking (HINT)	Independent variable in a multiple regression	To examine whether habitual negative self-thinking is related to response latencies of positive versus negative self-related information.	Computer latency task, Automatic thoughts	Cross-sectional	-The HINT, but not the Automatic Thoughts Questionnaire, was related to the magnitude of differences in response latency for positive versus negative self-relevant information.

Study 8	1682 Norwegian citizens (baseline); 1102 participants at follow-up (non-clinical)	Negative self-thinking (HINT)	Independent variable in a hierarchical regression	To investigate whether habitual negative self-thinking predict future anxiety and depressive symptoms.	Stress, Depressions and anxiety, Dysfunctional attitudes, Negative life events	Longitudinal	-HINT scores predicted variance in depression and anxiety scores at baseline and at 9-month follow-up. For the 9-month follow-up HINT scores predicted variance over and above the variance accounted for by gender, age, baseline work stress, baseline home stress, baseline anxiety/depression symptoms (Step1), and negative life events since baseline (Step 2), and dysfunctional attitudes at baseline (Step 3).
Verplanken (2008)	285 high school students (non-clinical)	Negative body image thinking (HINT)	Independent variable in a hierarchical regression	To investigate whether habitual negative body image thinking affects low self-esteem and eating disturbance propensity over and above body dissatisfaction.	Body dissatisfaction, Self-esteem, Eating disturbance propensity, Body mass index	Cross-sectional	-Body image HINT scores predicted a small, but significant amount variance in self-esteem and eating disturbance propensity over and above the variance accounted for by gender and age (Step 1), and body dissatisfaction (Step 2).
Verplanken (2011)	303 university students (non-clinical)	Negative body image thinking (HINT)*	Independent variable in a hierarchical regression	To examine how habitual negative body image thinking relates to implicit and explicit body dissatisfaction, self-esteem, eating disturbance propensity, and snacking behaviour.	Explicit body dissatisfaction, Implicit body dissatisfaction, Eating disturbance propensity, Self-esteem, Snacking behaviour, Body mass index	Cross-sectional	-Body image HINT scores predicted variance in explicit and implicit body dissatisfaction above and beyond gender and body mass (Step 1), and number of negative body image thoughts and mean negativity of body image thoughts (Step 2). -Body image HINT scores predicted small, but significant variance in eating disturbance propensity, self-esteem, and snacking behaviour above and beyond gender and body mass (Step 1), number of negative body image thoughts and mean negativity of body image thoughts (Step 2), and implicit and explicit body dissatisfaction (Step 3).
Verplanken (2012)	192 students and adults (non-clinical)	Habitual worrying (HINT)*	Independent variable in a multiple regression; Moderator	To investigate whether nostalgia leads to feelings of anxiety and depression for participants with strong worry habit.	Anxiety and depression, Nostalgia Inventory, Positive and negative affect	Experimental (IVs: Induced nostalgia manipulation, HINT, positive and negative mood, DV: Anxiety and depression)	-There was a significant Condition x HINT interaction, with simple slopes analyses revealing no effect Condition for participants with weak worry habit. -Participants with strong worry habit in the nostalgia condition exhibited increased depression and anxiety symptoms compared to participants with strong worry habit in the control condition.

Verplanken
(2014)

Study 1	336 adults (non-clinical)	Habitual worrying (HINT)*	Independent variable in a hierarchical regression; Mediator	To assess whether dispositional mindfulness relates to habitual worry and test and whether mindfulness mediates the relationship between habitual worry and test anxiety.	Number of worries, Seriousness of worries, Dispositional mindfulness, Test anxiety	Cross-sectional	-Habitual worry scores predicted a small, but significant amount variance in test anxiety over and above the variance accounted for by gender and age (Step 1), and number and seriousness of worries (Step 2). -Dispositional mindfulness partially mediated the relationship between habitual worry and test anxiety.
Study 2	110 university students (non-clinical)	Habitual worrying (HINT)	Independent variable in a multiple regression; Moderator	To investigate whether experimentally induced mindfulness and dispositional habitual worry influenced tolerance to distress.	Positive and negative affect, Social desirability, Number of unpleasant images seen	Experimental (IV: Mindful breathing meditation, HINT, DV: Number of unpleasant images viewed)	-There was a significant Condition x HINT interaction: participants in the mindfulness condition with a strong worry habit viewed significantly more images than participants than participants with a strong worry habit in the control condition.

RQ1: Have mental habits been defined and, if so, are these definitions consistent with the existing habit literature?

Table 2 outlines the definitions of habits used in each included article. Most of the 20 articles provided an explicit definition of habit ($n = 13$, 65%). Automaticity was identified, either implicitly or explicitly, as a core feature of habits in 16 articles (80%) and was the most frequently cited characteristic of mental habits. The notion that mental habits were related to repetition was mentioned in 11 articles (55%). Habits were framed as a cognitive process, distinct from cognitive content, in ten articles (50%). Only four articles (20%) recognized the role of cues or stable contexts as defining features of habits.

The four review and commentary articles included in this review expanded on many of the defining features of habits. Two articles (Kang, Gruber, & Gray, 2013; Vago, 2014) discussed the automatic nature of mental habits and its relationship to mindfulness. Vago (2014) compared the role of mental habit in Western and Buddhist psychology, described the automatic nature of thought (habit) and mindfulness in these two traditions, and provided a series of detailed psychological models describing how various mental processes (including mental habits) interact with one another. These models attempted to unify Western neurocognitive models with Buddhist psychology under a single framework. Kang et al. (2013) presented a psychological model and argued that there are four elements of mindfulness—awareness, attention, focus on the present, and acceptance—which are involved in the de-automatization process. De-automatization was portrayed as the breaking of maladaptive mental habits. For both Vago (2013) and Kang et al. (2013), automaticity was the defining feature of habit, and was the psychological mechanism engaged by mindfulness.

The two other review and commentary papers focused on two transdiagnostic processes: repetitive negative thinking (Watkins, 2008) and depressive rumination (E. R. Watkins & Nolen-Hoeksema, 2014a). Watkins (2008) addressed the concept of mental habits in the context of repetitive thinking by reviewing the constructive (adaptive) and unconstructive (maladaptive) aspects of different types of repetitive thought. Watkins (2008) also catalogued the various types of thought patterns that can be viewed as repetitive thoughts, such as depressive rumination, worrying, and perseverative cognition. Habitual negative self-thinking was considered to be subsumed under the larger category of repetitive thoughts.

Watkins and Nolen-Hoeksema (2014) provided a framework in which depressive rumination is framed explicitly as a habit that occurs “frequently, unintentionally, and repetitively to the same emotional context (depressed mood)” (p. 25). In the proposed framework, depressive rumination was argued to be habitual based on three features: it is (1) contextually cued, (2) goal-independent, preceding without being mediated by one’s goals; and 3) conservative in that it does not change based on one’s current goals and persists over time. When framed as a habit, Watkins and Nolen-Hoeksema (2014) argued that treatment of depressive rumination might be improved by focusing on the cues that lead to rumination.

The qualitative interviews conducted by Thew, Gregory, Roberts, and Rimes (2017b) identified features of self-criticism, many of which coincide with the definitions of mental habit. For many participants, self-criticism was elicited by a *trigger* (cue) in the external environment: participants reported self-critical thoughts cued by ‘making a mistake’ and reported these thoughts after ‘failing at something’ (Thew et al., 2017b).

Table 2. Study 1 definitions of habit

Study	Definition of mental habit	Defined?	Implicit/ Explicit	Automatic	Repetitive	Cued	Process
Armstrong et al. (2014)	“Verplanken, Friborg, Wang, Trafimow, and Woolf, (2007) made a distinction between the content and process aspects of negative self-thinking. They argued that studying the automaticity of negative thoughts (a process aspect) tells us about both state and trait low self-esteem, which is associated with depression.”	Yes	Implicit	Yes “They argued that studying the automaticity of negative thoughts.”	No	No	Yes Verplanken, Friborg, Wang, Trafimow, and Woolf, (2007) made a distinction between the content and process aspects of negative self-thinking.
Chan & Mak (2015)	“limited research has been conducted to conceptualize and distinguish the habitual “process” of self-stigma from its cognitive “content” A mental habit refers to a thought that has acquired a certain degree of automaticity after repetition [20]. Likewise, a mental habit of self-stigma (a.k.a. habitual self-stigma) is characterized by the repeated and automatic occurrence of self-stigmatizing thought.”	Yes	Explicit	Yes “certain degree of automaticity after repetition.”	Yes “certain degree of automaticity after repetition. ”	No	Yes ‘distinguish the habitual “process” of self-stigma from its cognitive “content”’
Chan & Mak (2017)	“A mental habit refers to a thought that has acquired a certain degree of automaticity after repetition (Verplanken et al., 2007). Likewise, a mental habit of self-stigma (i.e., habitual self-stigma) is characterized by the repeated and automatic occurrence of self-stigmatizing thought.”	Yes	Explicit	Yes “A mental habit refers to a thought that has acquired a certain degree of automaticity ... characterized by... automatic occurrence of self-stigmatizing thought.”	Yes “A mental habit refers to a thought that has acquired a certain degree of automaticity after repetition ... characterized by... repeated and automatic occurrence of self-stigmatizing thought.”	No	No

Chan & Lam (2018)	“Stigmatized individuals, for example, may vary in not only the extent to which they endorse their self-stigmatizing thoughts, referred to as self-stigma “content”, but also the extent to which they think about their self-stigmatizing thoughts repetitively and automatically as a mental habit, referred to as self-stigma “process” (Chan & Mak, 2017)”	Yes	Explicit	Yes ‘self-stigmatizing thoughts repetitively and automatically as a mental habit, referred to as self-stigma “process”’	Yes ‘self-stigmatizing thoughts repetitively and automatically as a mental habit, referred to as self-stigma “process”	No	Yes ‘self-stigmatizing thoughts repetitively and automatically as a mental habit, referred to as self-stigma “process” ’
Christou-Champi et al. (2015)	““automatic” ER [emotion regulation] is taken to mean that people downregulate an unwanted emotional state using fewer resources and therefore decreasing the need for elevated cardiac outputs... After watching the film clips, participants completed the self-report habit index (SRHI; Verplanken & Orbell, 2003) to measure the extent to which ER had become a habitual process.”	Yes	Implicit	Yes “ “automatic” ER [emotion regulation]’	No	No	Yes “to measure the extent to which ER had become a habitual process. ”
Dundas et al. (2017)	No definition in the introduction. “(Verplanken, Friborg, Wang, Trafimow & Woolf, 2007) consists of 12 items and measures the tendency habitually to think negatively about oneself, called the habit of self-directed negative thinking in this study.”	No.	N/A	No	No	No	No
Fisher et al. (2017)	“The construct of ‘mental habit’ describes how we think (the process) rather than what we think (the content) that is characterised by automaticity, lack of awareness, mental efficiency, lack of control and lack of conscious intent (Verplanken, Friborg, Wang, Trafimow, & Woolf, 2007).”	Yes	Explicit	Yes “characterised by automaticity ”	No	No	Yes “The construct of ‘mental habit’ describes how we think (the process) rather than what we think (the content).”
James et al. (2015)	“Finally, whereas beliefs about the unacceptability of thoughts and emotions may be considered as “cognitive content”, our third facet of self-criticism pertains to the process of self-critical thinking...ing (Verplanken, Friborg, Wang, Trafimow, & Woolf, 2007). Negative self-thinking as “mental habit” has been identified	Yes	Implicit	No	No	No	Yes “our third facet of [habitual] self-criticism pertains to the process of self-critical thinking. ”

as a vulnerability factor with respect to psychological distress such as low self-esteem, depression (Verplanken et al., 2007), and anxiety (Verplanken, 2012).

Kang et al. (2013)	“We define automaticity as the ability to effortlessly engage in behaviours without paying conscious attention to their operational details... Automaticity is usually a desired result of learning that reflects a degree of habit or mastery, but automatized cognitive or emotional reactivity can lead to a wide range of detrimental consequences”	Yes	Implicit	Yes	No	No	No
				“We define automaticity as the ability to effortlessly engage in behaviours without paying conscious attention to their operational details”			
Thew et al. (2017a)	“Habit Index of Negative Thinking (HINT; Verplanken et al., 2007). A measure of habitual self-critical thinking as a cognitive process”	Yes	Implicit	No	No	No	Yes
							“A measure of habitual self-critical thinking as a cognitive process ”
Thew et al. (2017b)	“A measure of habitual self-critical thinking, the HINT was used to explore the cognitive process element of self-criticism”	Yes	Implicit	No	No	No	Yes
							“to explore the cognitive process element of self-criticism”
Vago (2014)	“habits refer to an incrementally acquired pattern of perceiving, feeling, thinking, or behavior that often occurs automatically in association with a particular stimulus or set of stimuli.”	Yes	Explicit	Yes	No.	Yes	No.
				“behavior that often occurs automatically ”		“in association with a particular stimulus or set of stimuli. ”	
Verplanken (2006)	“In other words, whereas repetition of behaviour is a necessary condition for a habit to develop, the defining quality of habit is the automaticity and efficiency of behaviour occurring in stable contexts”	Yes	Explicit	Yes	Yes	Yes	No
				“the defining quality of habit is the automaticity ”	“ repetition of behaviour is a necessary condition for a habit to develop”	“behaviour occurring in stable contexts. ”	

Verplanken et al. (2007)	“However, it can be argued that although a history of repetition is part of the habit concept, repetition alone is not enough to qualify a behavior as habit. Indeed, most conceptual definitions of habit contain other elements in addition to behavioral frequency, most notably the qualification of habit as behavior that has acquired a certain degree of automaticity. Automaticity may be broken down into a number of features: lack of awareness, mental efficiency, lack of control, and lack of conscious intent (“four horsemen of automaticity”; Bargh, 1994). The presence or absence of each of these features yields a variety of variants of automaticity. Applying this insight to habits, habit is behavior that has a history of repetition, is characterized by a lack of awareness and conscious intent, is mentally efficient, and is sometimes difficult to control... Following the distinction between mental content and process, we argue that the degree to which negative self-thinking is habitual can be considered as a process aspect, which can be distinguished from the content of negative self-thoughts.”	Yes	Explicit	Yes	“habit as behavior that has acquired a certain degree of automaticity”	Yes	No	“we argue that the degree to which negative self-thinking is habitual can be considered as a process aspect, which can be distinguished from the content of negative self-thoughts.”
Verplanken (2008)	“However, having negative body-related thoughts per se needs not be problematic or indicate chronic body dissatisfaction. The latter can only be expected under certain conditions. We suggest that one such condition is the frequency and automaticity of dissatisfied thinking. We refer to this quality of thinking as a mental habit....while repetition is necessary for habits to develop, it is the automaticity of repeated behavior that makes it a habit... The present study aims to contribute by investigating the significance of negative body image thinking habit as a process aspect of dissatisfied body image thinking”	Yes	Explicit	Yes	“it is the automaticity of repeated behavior that makes it a habit”	Yes	No	“investigating the significance of negative body image thinking habit as a process aspect of dissatisfied body image thinking”

Verplanken (2011)	“Similar to behavioural habits, mental habits are characterised by three ‘pillars’... The first is that a mental habit is a form of repetitive thinking... The second pillar is automaticity... Third, just like behavioural habits, mental habits are cued by features in stable contexts... Verplanken et al. (2007) distinguished cognitive content and process in mental habits. Cognitive content refers to the thoughts proper, such as negative self-beliefs or attributions (the ‘what’ of thinking), while the process in this case refers to the habitual quality (the ‘how’ of thinking).”	Yes	Explicit	Yes “The second pillar is automaticity ...”	Yes “The first is that a mental habit is a form of repetitive thinking...”	Yes “ Mental habits are cued by features in stable contexts”	Yes “Verplanken et al. (2007) distinguished cognitive content and process in mental habits.”
Verplanken (2012)	“worrying can be considered as a mental habit, that is, thoughts that occur repetitively and automatically”	Yes	Explicit	Yes “worrying can be considered as a mental habit, that is, thoughts that occur repetitively and automatically ”	Yes “worrying can be considered as a mental habit, that is, thoughts that occur repetitively and automatically”	No	No
Verplanken (2014)	“Worrying may thus turn into a mental habit, that is, thoughts that occur repetitively and automatically”	Yes	Explicit	Yes “worrying can be considered as a mental habit, that is, thoughts that occur repetitively and automatically ”	Yes “worrying can be considered as a mental habit, that is, thoughts that occur repetitively and automatically”	No	No
Watkins (2008)	Habitual negative self-thinking is negative self-thinking that has become a mental habit, defined as having “a history of repetition, characterized by a lack of awareness and conscious intent, mentally efficient, and sometimes difficult to control”	Yes	Explicit	Yes “characterized by a lack of awareness and conscious intent, mentally efficient, and sometimes difficult to control”	Yes “a history of repetition ”	No	No

Watkins & Nolen-Hoeksema (2014)	“Habits are behaviors that are performed frequently in stable contexts” “Wood and Neal (2007, p. 843) defined habits as “learned dis- positions to repeat past responses. They are triggered by features of the context that have covaried frequently with past performance, including performance locations, preceding actions in a sequence, and particular people.” “Habitual behavior typically involves some automaticity”	Yes	Explicit	Yes	Yes	Yes	No
				“Habitual behavior typically involves some automaticity ”	“Habits are behaviors that are performed frequently in stable contexts”	“Habits are behaviors that are performed frequently in stable contexts ”	

RQ2: Where mental processes have been framed as habitual, how have mental habits been measured?

Operationalizing mental habits. In all 24 empirical studies reviewed, mental habits were operationalized using an adapted version of the Habit Index of Negative Thinking (HINT; Verplanken et al., 2007) or Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The HINT has the same structure as the 12-item SRHI except that the stem at the beginning states “Thinking negatively about myself is something...” (Verplanken et al., 2007). Since the HINT is itself an adaptation of the SRHI, all studies operationalized habit in the manner proposed by Verplanken & Orbell (2003). A single study (Christou-Champi, Farrow, & Webb, 2015) also used the automaticity subscale of the SRHI, the Self-Report Behavioural Automaticity Index (SRBAI; Gardner, Abraham, Lally, & de Bruijn, 2012).). As seen in Table 3, 6 studies (25.0%) used self-generated thoughts, meaning that participants were able to organically provide their own personalized content for the HINT questionnaire, rather than content determined by researchers (such as “Thinking negatively about myself”). One study used the HINT and inferred “habit” from participants’ reflections on experiences of negative thinking patterns and their causes (Thew et al., 2017b).

Study designs. Of 24 empirical studies reviewed, most (17; 71%) used a cross-sectional, correlational design, 5 employed an experimental design (21%), one study had a longitudinal design (4%), and one had a quasi-experimental design (4%). A single study used both qualitative and quantitative analytic methods (Thew et al., 2017b).

Study samples. The samples used across research designs were predominantly non-clinical adults and university students (75%) with a single study using a nationally representative adult sample (Verplanken et al., 2007; Study 8). Four studies (17%) assessed mental habits in

clinical populations (Chan & Mak, 2017; Chan & Lam, 2018; Thew et al., 2017b; Thew, Gregory, Roberts, & Rimes, 2017a) and one study (4%) investigated habitual self-stigma in parents of children with autism (Chan & Lam, 2018). In a sample of 189 adults with various mental disorders, Chan & Mak (2017) developed and validated the Self-stigmatizing Thinking Automaticity and Repetition Scale (STARS), a measure which was later validated for parents of children with autism by Chan & Lam (2018). In a sample (N = 78) of 26 adults with major depressive disorder, 26 adults with an eating disorder, and 26 adult controls, Thew et al. (2017a) found that both clinical groups had significantly higher habitual self-critical thinking than control participants. In follow-up qualitative interviews, many participants across all three groups identified external triggers as causing self-critical thoughts.

Experimental studies. Each of the 5 experimental studies used a different paradigm to measure the causal relationship between different variables. Christou-Champi et al. (2015) randomly assigned participants to either receive emotion regulation training, control training (which did not involve any emotion regulation training), or no training. Participants in the emotion regulation condition experienced increased habitual use of emotion regulation. Dundas, Binder, Hansen, & Stige (2017) demonstrated, in a randomized controlled trial, that a two-week self-compassion course led to significant reductions in habitual negative self-thinking. Two experimental studies investigated habitual worry (Verplanken, 2012; Verplanken & Fisher, 2014). Verplanken (2012) found that participants with a strong worry habit who were experimentally induced to experience nostalgia experienced increased depression and anxiety symptoms compared to strong habitual worriers in a control condition. Verplanken (2014; Study 2) demonstrated that strong habitual worriers who underwent a mindfulness intervention viewed significantly more unpleasant images than strong worriers in a control condition. Habitual self-

criticism was significantly correlated with changes in self-criticism after an experimental verbal ability task that induced self-criticism (Thew et al., 2017a). In the sole quasi-experimental design, Chan and Mak (2015) found that individuals with strong habitual self-stigma, but not weak habitual self-stigma, exhibited an attentional bias by naming self-stigma words faster in a Stroop task.

Prospective studies. A single correlational study investigated the longitudinal impact of habitual negative self-thinking (Verplanken et al., 2007; Study 8). This study revealed that baseline habitual negative self-thinking scores predicted variance in depression and anxiety symptoms at a 9-month follow-up over and above a multitude of factors, including age, gender, life stress, and baseline symptoms.

RQ3: Where mental processes have been framed as habits, how has the concept of mental habit been applied to mental health?

Types of constructs framed as mental habits. A variety of psychological constructs were examined as mental habits in the reviewed articles (see Table 3). Half (12/24) of empirical studies applied habit to *negative self-thinking*, though 8 of these were from a single article (Verplanken et al., 2007). Of the remaining empirical studies, 3 studies applied the concept of habit to *worry* (Verplanken, 2012; Verplanken & Fisher, 2014), 3 studies applied habit to *self-critical thinking* (James, Verplanken, & Rimes, 2015; Thew et al., 2017a), 3 studies applied habit to *self-stigma* (Chan & Mak, 2017; Chan & Lam, 2018), 2 studies applied habit to *negative body image thinking* (Verplanken & Tangelder, 2011; Verplanken & Velsvik, 2008), and 1 study applied habit to *emotion regulation* (Christou-Champi et al., 2015).

Mental habits as a mediator. Two studies examined whether habit—specifically, habitual negative self-thinking and habitual self-criticism—mediated relationships between other

psychological constructs. Fisher et al. (2017) found that habitual negative self-thinking (along with emotion dysregulation) mediated the relationship between dispositional mindfulness and uncontrolled/emotional eating. In another study, habitual self-criticism was found to mediate the relationship between perfectionism and psychological distress (James, Verplanken, & Rimes, 2015). Habitual negative self-thinking, along with problem solving, was shown to mediate the relationship between age group (older versus younger individuals) and depression symptoms, and age group and worry symptoms (Armstrong, Wuthrich, Knight, & Joiner, 2014).

Mental habits as a moderator. Two experimental studies investigated mental habit as a moderator of the relationship between two variables (Verplanken, 2012; Verplanken & Fisher, 2014, Study 2). Habitual worry moderated the effect of experimentally induced nostalgia on depression and anxiety symptoms (Verplanken, 2012), and the effect of a mindfulness intervention on the number of unpleasant images participants chose to view (Verplanken & Fisher, 2014, Study 2).

Mental habits as an outcome variable in non-experimental designs. Two correlational studies also examined mental habit as a dependent variable. Armstrong et al. (2014) found that a sample of older adults experienced significantly less habitual negative self-thinking compared to young adults. In another correlational study, Thew et al. (2017a) found that individuals with major depressive disorder or an eating disorder experienced more habitual negative self-thinking compared to control participants.

Mental habits as a predictor of mental health. Several studies investigated the incremental validity of mental habits in predicting variance in a psychological construct using hierarchical multiple regression. In particular, numerous studies demonstrated the incremental validity (when a psychological construct predicts variance in an outcome variable over and above

other constructs) of mental habits in predicting self-esteem (Chan & Mak, 2017; Verplanken, 2006; Verplanken et al., 2007, Study 2, Study 3, Study 4, Study 5, Study 6; Verplanken & Tangelder, 2011; Verplanken & Velsvik, 2008). For individuals with a diagnosed mental disorder, habitual self-stigma predicted variance in self-esteem, life satisfaction, and personal recovery from mental illness over and above the content of self-stigmatizing attitudes (Chan & Mak, 2017). A similar effect of self-stigma was found for parents of children with autism: habitual self-stigma predicted life satisfaction, depressive symptoms, caregiver gain (positive feelings towards caregiving), and caregiver burden (negative feelings towards caregiving), over and above stigma content (Chan & Lam, 2018).

Habitual negative self-thinking was shown to have incremental predictive power in multiple studies. Thinking negatively about oneself habitually, over and above doing so frequently, predicted self-esteem along with depression and anxiety symptoms (Verplanken, 2006). The incremental value of habitual negative self-thinking was further demonstrated in a series of studies by Verplanken et al. (2007): habitual negative self-thinking predicted self-esteem over and above the frequency of automatic thoughts (Studies 2 and 5), the number of self-generated thoughts and frequency of these thoughts (Studies 3 and 6), and mental rumination and mindfulness (Study 4).

Two studies investigated the incremental value of habitual negative body image thinking in predicting psychological outcomes. In a sample of adolescents, habitual negative body image thinking predicted variance in self-esteem and disturbed eating over and above body dissatisfaction (Verplanken & Velsvik, 2008). Habitual negative body image thinking also predicted variance in both implicit and explicit body satisfaction over and above number of negative body image thoughts and mean negativity of these thoughts (Verplanken & Tangelder, 2011). Moreover, the same study demonstrated that habitual negative body image thinking predicted additional variance

in self-esteem, disturbed eating, and snacking behaviour over and above negative body image thoughts, negative of body image thoughts, and implicit and explicit body dissatisfaction. Habitual worrying was another construct related to mental health: habitual worry was shown to predict variance in test anxiety over and above the number self-generated anxious thoughts provided by participants and the severity of worries (Verplanken 2014; Study 1). This study also found that dispositional mindfulness partially mediated the relationship between habitual worry and test anxiety. Thus, in this case, habitual worry did not serve as a mediator but rather its relationship to another variable (test anxiety) was partially mediated by a third variable (mindfulness).

Table 3. Study 1 descriptive features of empirical studies

Descriptive feature	Number of studies ¹ (%)
Sample²	
Non-clinical university students/adults	18 (75.0%)
Clinical population	4 (16.7%)
Parents of children with autism	1 (4.2%)
Nationally representative adult sample	1 (4.2%)
Construct measured as a habit²	
Negative self-thinking	12 (50.0%)
Worry	3 (12.5%)
Self-critical thinking	3 (12.5%)
Self-stigma	3 (12.5%)
Negative body image thinking	2 (8.3%)
Emotion regulation	1 (4.2%)
Research design	
Cross-sectional/Correlational	17 (70.8%)
Experimental	5 (20.8%)
Longitudinal	1 (4.2%)
Quasi-Experimental	1 (4.2%)
Measure of habit²	
HINT adaptation	18 (75.0%)
Self-generated thought HINT adaptation	6 (25.0%)

¹Studies within the same paper are treated separately

²Empirical studies only

Discussion

The present scoping review investigated how the concept of *mental habits* has been applied to mental health. This review sought to answer three research questions, namely how often thought processes related to mental health have been conceptualized as habits, how mental habits have been measured and operationalized, and how mental habits have been applied to examine mental health. Our systematic search strategy identified 20 peer-review journal articles, containing 24 empirical studies.

We found that numerous authors have identified and conceptualized mental processes as “habits”. Mental habits have been measured in the same way as behavioural habits, using variants of the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003), such as the Habit Index of Negative of Thinking (HINT; Verplanken et al., 2007). Mental habits were defined similarly to behavioural habits, with 80% of articles identifying automaticity as a core feature of mental habits and 55% of articles including repetition as a defining aspect of habit. Only 4 articles (20%) referenced that mental habits are cue-dependent, meaning that habits are an automatic response to a contextual cue in the environment. A unique facet of the definitions of mental habits, compared to behavioural habits, is the emphasis on thought *process* (how we think) compared to thought *content* (what we think). Half of the included articles, 10 in total, described how habitual thinking was distinguished based on thought process, not thought content.

Our third research question (RQ3) asked how the concept of mental habit has been applied to mental health. The results of the current scoping review suggest that various mental processes have been examined as mental habits, including habitual negative self-thinking (e.g., Verplanken et al., 2007), self-stigma (e.g., Chan & Mak, 2017), worry (e.g., Verplanken, 2012), negative body

image thinking (e.g., Verplanken & Tangelder, 2011), self-criticism (e.g., James, Verplanken, & Rimes), and emotion regulation (Christou-Champi et al., 2015). Not only were a diverse array of mental processes investigated as habits, there were different applications of mental habits in relation to mental health: mental habits served as outcome variables, independent variables in multiple regression analyses, mediators, and moderators. In many studies, mental habits predicted variance in constructs related to mental health (e.g., self-esteem) over and above thought frequency (e.g., negative thought frequency; Verplanken et al., 2007), suggesting that mental habits predict unique aspects of our mental health.

One of the most important findings from this review concerns the absence of studies incorporating the concept of mental habits. Research to date has focused exclusively on negative mental habits, such as negative self-thinking and worrying. Indeed, all 24 of the identified studies identified negative thought patterns. The absence of studies focusing on *positive* mental habits represents an important opportunity for both habit researchers and mental health professionals. The strict focus on negative mental habits that adversely affect our mental health raises the question whether positive mental habits might promote mental health. This remains an open question, however, considering the lack of research on positive mental habits identified by this review.

Another striking finding of this review is that most studies were excluded from consideration. Even though our search captured diverse applications of mental habits to the domain of mental health, over 99% of all studies captured by our search were excluded. This result, while unsurprising given that habit researchers have generally focused on behavioural habits, confirms that researchers and clinicians have not integrated this term with related theories and constructs. Our search yielded a multitude of articles examining transdiagnostic thinking processes, often

focused on the *process* of thinking rather than thinking *content*, and yet these studies did not incorporate the concept of habit. The lack of integration of mental habits into existing research on thinking patterns related to mental health has several implications for mental health research and clinical practice.

Lack of integration between “mental habits” and related constructs. Although this review detected numerous studies that explicitly referenced mental habits as a distinct theoretical construct from other mental processes, there were many studies of transdiagnostic mental health processes that were screened out despite being closely related to the concept of mental habits. The concept of repetitive negative thinking (RNT), for example, is a well-researched phenomenon that focuses on the process of repetition (Ehring & Watkins, 2008), rather than habit. It is challenging to untangle the differences between RNT and habitual thinking. The Perseverative Thinking Questionnaire (PTQ), which measures repetitive negative thinking, contains 15 items related to *how* participants think about negative experiences and problems (Ehring et al., 2011). The PTQ asks participants about the frequency of these types of negative thoughts and contains items relating to automaticity (the defining feature of habits) such as “Thoughts just pop into my mind” and “Thoughts come to my mind without me wanting them to”. The presence of automaticity in a scale purported to measure RNT raises the question whether RNT and habitual thinking are distinct concepts. The distinction between thought automaticity and frequency is not a trivial semantic issue, but a major theoretical difference, given that thought automaticity predicts mental health outcomes over and above thought frequency (e.g., Verplanken et al., 2007). Moreover, habitual negative thinking implies a mode of thought acquisition and maintenance (cue-dependent responses that become automatic through repetitive cues in stable environments), whereas repetitive negative thinking is a descriptive feature of thinking, but no makes no claims on

acquisition/maintenance. The relationship between the constructs of repetitive negative thinking and habitual negative thinking, however, has seldom been explored, though Watkins (2008) classified habitual negative-self thinking as falling under the broader classification of RNT.

Automatic thoughts versus mental habits. Mental habits also seem relevant to the concept of automatic thoughts, as operationalized in the Automatic Thought Questionnaire (ATQ; Hollon & Kendall, 1980). The ATQ has been applied broadly and widely cited as a measure in mental health research. Given the role of automaticity in mental habits, and the explicit reference to automaticity in the phrase “automatic thoughts”, one might expect there to be theoretical overlap between these constructs and explicitly reference one another in the literature. In practice, however, no such overlap exists. The ATQ measures the frequency of negative cognitive self-statements, not their automaticity. The emphasis on frequency in ATQ, rather than automaticity, might explain why no study using the ATQ as a primary outcome met our search criteria. The lack of theoretical integration between the study mental habits and the study of automatic thoughts has relevance to clinicians, given that changing automatic thoughts is an important part of Cognitive Behavioural Therapy (CBT; Beck, 1970).

In addition to the constructs that are similar to, but conceptually distinct from, mental habits, our search strategy discovered several articles that discussed “mental habits” without distinguishing habit as a distinct process. For example, several articles studied “habitual” cognitive reappraisal as a strategy for regulating emotions (Cutuli, 2014; Fladung, Baron, Gunst, & Kiefer, 2010; Joormann & Gotlib, 2010; Sai, Wang, Ward, Ku, & Sang, 2015; Vanderhasselt, Baeken, Van Schuerbeek, Luypaert, & De Raedt Rudi). In many of these studies, the “habitual” use of cognitive reappraisal was measured using the Emotion Regulation Questionnaire (ERQ), which is explicitly referred to as a scale that measures the use of cognitive reappraisal and suppression

(Gross & John, 2003). The ERQ examines the dispositional and situational strategies people employ to regulate their emotions. It is possible that, in this context, the authors used “habit” as a colloquial term, rather than as a theoretical construct. Other authors have also discussed the role of mental “habits” as important factors that underlie psychological symptoms, such as depression and anxiety, without defining habits as a distinct theoretical construct (Hertel, 2004; Hertel & Brozovich, 2010).

The lack of integration of mental habits as cue-dependent automatic cognitive responses with the related fields of repetitive negative thinking, automatic thoughts, and cognitive reappraisal speaks to the nascence of habitual thinking as a field of study and the potential for this field to inform existing research and clinical practice. The study of mental habits has been neglected in these related fields of study. Meanwhile, certain cognitive processes (such as cognitive reappraisal) have been frequently described as “habitual” without specifying a theoretical difference between “habit” and related constructs (such as repetitive thoughts). The insights gained by using the theoretical lens of mental habits may lead to new connections between the related, yet unintegrated, literatures of repetitive negative thinking, automatic thoughts, and cognitive reappraisal.

Given the conceptual overlap between “mental habits” and related constructs like automatic thinking, repetitive negative thinking, and rumination, one potential criticism is that a habit framework does not help us more deeply understand the thinking patterns that characterize mental health problems. We believe there are two unique contributions of a habit framework to existing models.

First, unlike other constructs, a mental habit framework explicitly emphasizes the role of cues and prompts that trigger thinking patterns. Clinicians often emphasize cues in psychotherapy, particularly in Cognitive Behavioural Therapy: CBT therapists frequently use “thought records”

in which patients delineate the situation that triggered an automatic thought, with the intention of breaking the link between the trigger and the thought. A habit framework is therefore not “new” to clinicians, although it more readily maps onto the treatment of negative automatic thoughts than frameworks that do not formalize the cue-response relationship.

Second, a habit framework emphasizes the role of automaticity as an important feature of thinking patterns related to mental health. Automaticity was listed as a defining feature of mental habits in 80% of the articles included in this review. The emphasis that a mental habits framework places on automaticity is novel given that most self-report measures—even the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980)—measure the frequency, not automaticity, of negative thinking. While conceptually similar, automaticity and frequency are distinct constructs; a thought may be frequent yet not automatic, or infrequent yet automatic. There is some evidence that thought automaticity predicts unique variance in mental health outcomes over and above thought frequency (Verplanken et al, 2007).

The arguments presented in this review are a preliminary attempt to explore the potential of adopting a mental habit framework. However, as evidenced by the number of articles excluded in this review, the empirical literature on mental habits is nowhere near as robust as other constructs such as repetitive negative thinking, rumination, and worry. By summarizing the diverse yet nascent literature on mental habits, we hope to begin a conversation about the potential utility of this theoretical framework and how it complements other related constructs. We do not see the mental habit conceptualization of cognitive processes as competing with or attempting to eclipse related constructs; rather, the concept of a “mental habit” may allow clinicians to re-envision their practices and provide researchers with a new vocabulary to explore the cue-dependent automatic relationship between negative thinking patterns and their triggers.

Limitations and Future Directions

One limitation of this review is that a single researcher (EC) screened all of the abstracts and full-text articles. Although an independent screener reviewed a random 10% of these abstracts and articles, it is possible that having a sole screener introduced bias into the article selection process. To limit the scope of our search, we decided to only include studies examining how *mental* habits affect mental health. Thus, we did not include studies investigating how *behavioural* habits affect mental health, which are undoubtedly important. We also did not include existing research on behavioural interventions that seek to change habits in mental disorders (e.g., habit reversal training; Azrin & Nunn, 1973). Many mental disorders are typified by repetitive and automatic thoughts and behaviours, such as obsessive-compulsive disorder, Tourette's syndrome, and trichotillomania (hair-pulling). It is possible that investigating the *habitual* nature of mental disorders, such as these, will inform their assessment and treatment. For example, a recent randomized trial investigated the impact of intervention designed to treat disorder routines (habits) in hospitalized patients with anorexia nervosa (Steinglass et al., 2018).

Another fundamental limitation of this review is that the samples of participants in the included studies are from non-clinical, healthy samples. We perceive this review not as a definitive summary of the mental habit literature, but rather as a starting point to facilitate future discussions about theoretically related thinking patterns that underlie mental health. Despite these limitations, the included articles provide preliminary evidence that adopting a “habit” lens to mental health research and clinical practice offers a novel way to conceptualize the thinking patterns that contribute to mental health. Future research might consider developing and validating psychological interventions that identify and target problematic behavioural and mental habits across mental disorders.

Conclusion

The results of this scoping review suggest that mental habits are a distinct theoretical construct from thinking patterns characterized by repetition alone. This review found numerous articles studying mental habits in a variety of mental health domains, such as negative self-thinking and self-criticism. Despite the breadth of mental phenomena that have been shown to have habitual characteristics, all the included studies examined *negative* mental habits (i.e., thinking patterns that would be detrimental to mental health). Consequently, no study included in this review examined *positive* mental habits (i.e., thinking patterns that might promote mental health). Likewise, the concept of “mental habit” has yet to be integrated with related concepts in psychology, such as automatic thoughts and repetitive negative thinking. There is extensive opportunity, therefore, for research into the relationship between habits, maladaptive thinking patterns, and mental health. Such continued investigation may allow for researchers and clinicians to synthesize related theoretical constructs in mental health and improve the quality of theories of mental health and psychological interventions.

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Chapter 3: How Automatic are Automatic Thoughts? Investigating How Two New Measures of Positive and Negative Automatic Thinking Predict Well-Being (Study 2)

Abstract

Background: The study of mental habits and automatic thinking has been poorly integrated. To integrate these areas of research, we developed two measures of automatic thinking: the Positive Thought Automaticity Index (PTAI) and Negative Thought Automaticity Index (NTAI). These new measures incorporated elements from existing questionnaires to measure thought content and the process of automaticity more precisely.

Method: Participants from the United Kingdom (Study 2a; $n = 133$) and Canada (Study 2b; $n = 308$) completed the NTAI and PTAI along with existing measures of depression, satisfaction with life, and habitual thinking. We conducted bivariate correlations, hierarchical regressions, and mediation analyses to assess the psychometric properties of the NTAI and PTAI.

Results: Across the two studies, the NTAI and PTAI demonstrated evidence of predictive and concurrent validity, internal consistency reliability, and test-retest reliability. For both measures, thought automaticity and frequency were strongly correlated. Positive and negative thought automaticity predicted variance in well-being outcomes over and above thought frequency. The relationship between positive and negative thought frequency and how much participants believe thoughts to be true was partially mediated by thought automaticity.

Conclusions: These studies provided evidence of the utility of measuring automaticity as a distinct construct from frequency in predicting well-being outcomes. The mediation results of Study 2b also suggest one possible pathway through which automaticity impacts well-being.

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Negative thinking is a common depressive symptom: people experiencing depression often think “I’m stupid”, “I’m worthless”, or “No one likes me”. One of the most widespread and effective methods for treating depression is Cognitive Behavioural Therapy (CBT; Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012), which involves identifying and changing these thoughts and the behaviours related to them. However, although CBT interventions can effectively treat various mental health concerns, a substantial proportion of people do not benefit from CBT (Glenn et al., 2013; Hofmann et al., 2012). Consequently, CBT interventions might benefit from exploring new ways of conceptualizing negative thinking. In the following two studies, we investigated the role of automaticity as a defining characteristic of thinking by developing two new measures of how positive and negative automatic thoughts. We then used these measures to test how thought automaticity relates to well-being.

Automaticity: a distinct thought process

CBT research and clinical practice describe various thinking patterns that underlie mental disorders. For example, several authors (Ehring & Watkins, 2008; Harvey, Watkins, Mansell, & Shafran, 2004) have proposed repetitive negative thinking (RNT) as a transdiagnostic construct that perpetuates several mental health problems. RNT refers to negative thoughts that are repetitive, passive, and relatively uncontrollable (Ehring & Watkins, 2008). For example, depressive rumination (depressive thinking about the past) and worry (anxious thinking about the future) are different types of RNT, among several others (Ehring & Watkins, 2008). The concept of RNT distinguishes thought *content* (what we think) from thought *process* (how we think): while rumination and worry differ in content, these maladaptive thinking patterns share the process of being repetitive and involuntary. Repetitive thinking, however, is not the only thinking process relevant to CBT, which often targets automatic thinking.

Identifying and changing automatic thoughts is foundational to modern CBT, with many early theoretical discussions emphasizing the role of automatic thoughts in depression. For example, A.T. Beck (1963) described how automatic thoughts arise “without any apparent antecedent reflection or reasoning” (p. 41) and have an “involuntary quality” (p. 41). After decades of research investigating cognitions, emotions, and behaviours, Beck’s early theorizing has culminated in modern CBT approaches that emphasize identifying and changing automatic thoughts as a core mechanism of change for everyday psychological problems, including depression (e.g., J. Beck, 2021). As described by Greenberger and Padesky (2015), automatic thoughts “simply pop into our heads automatically throughout the day. We don’t plan or intend to think a certain way...One of the purposes of CBT is to bring automatic thoughts into awareness” (p. 52). Teachman, Joormann, Steinman, & Gotlib (2012) also argued that automaticity is a core feature of anxiety and depressive disorders.

The concept of *automatic thinking* often used in CBT treatment manuals is theoretically similar to another construct—*mental habits* (Verplanken et al., 2007). Habit can be defined as a process by which a stimulus generates an impulse to respond (Gardner, 2015). In essence, habits can be understood as cue-dependent automatic responses. Recent authors have argued for the potential benefits of broadly applying a habit framework to evidence-based psychological treatments (Colvin et al., 2021; Harvey, Callaway, Zieve, Gumport, & Armstrong, 2020), including anxiety treatments (Brewer & Roy, 2021) and depressive rumination (Watkins & Nolen-Hoeksema, 2014b). Both thoughts and behaviours can be examples of responses to a stimulus because habitual thoughts and behaviours result from an internal process in which a cue generates an automatic response. Automaticity is a critical defining feature of habits (Gardner, 2012).

Study 1 investigated the existing research on mental habits in the context of mental health. This review identified 20 articles and 24 discrete empirical studies on the relationship between mental habits and mental health. Included articles conceptualized different types of thoughts as habitual, including negative self-thinking, worry, self-critical thinking and negative body image thinking. However, we did not find any articles investigating the effects of positive mental habits. Included articles emphasized automaticity as a defining feature of mental habits. Despite automaticity being a defining feature of mental habits, no identified articles connected the concept of mental habits to automatic thinking. Therefore, the present study sought to capitalize on the opportunity to bridge the gap between the study of automatic thoughts and mental habits.

Building upon existing measures of automatic thinking

Automatic thinking and mental habits are often studied using self-report questionnaires such as The Automatic Thoughts Questionnaire (ATQ; Hollon & Kendall, 1980) and the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). These measures have conceptual strengths that can be integrated to study automaticity as a distinct mental process.

The most popular measure of automatic thinking, the ATQ (Hollon & Kendall, 1980), measures the frequency of 30 negative self-statements common in depression (e.g., “I’m worthless”). The negative self-statements from the ATQ came from participants’ organic responses about the thoughts that “popped in their head” during situations they found to be depressing. The authors then distilled these responses to 30 items. Although the ATQ accurately measures common depressive thoughts, they measure the *frequency* of these thoughts (i.e., how often participants experience them), not their automaticity. As a result, the ATQ does not assess automaticity as a thinking process.

In contrast, the most common measure of habit, the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003), measures automaticity directly. The SRHI contains 12 items that measure a behaviour's frequency, automaticity, and relation to self-identity. Mental habits are most often measured by adapting the SRHI to a construct of interest, such as negative self-thinking or worry (Colvin et al., 2021). The automaticity subscale of the SRHI, the Self-Report Behavioural Automaticity Index (SRBAI), has also been studied to measure automaticity directly (Gardner, Abraham, Lally, & de Bruijn, 2012). Adaptations of the SRHI for thinking patterns, such as the Habit Index of Negative Thinking (HINT; Verplanken et al., 2007), measure thinking process (*how* one thinks) in detail but measure thinking content (*what* one thinks) with limited precision. For example, the widely cited HINT (Verplanken et al., 2007) contains one content item, "Thinking negatively about myself", followed by the 12 process items of the SRHI (e.g., "Something I do automatically"). As a result, there is less emphasis on the specific content of negative thoughts. In contrast, the most widely cited measure of automatic thinking, the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980), has the opposite problem: the ATQ contains a comprehensive list of 30 negative self-statements related to depression and only 1 process item that measures the frequency of these self-statements. In summary, the SRHI emphasizes thought process but not thought content, while the ATQ emphasizes thought content, but not process. Thus, there is an opportunity to combine the elements of these two questionnaires to measure automatic thinking with more precision.

Current studies: developing and testing a new measure of thought automaticity

The current studies sought to build upon existing automatic thinking and mental habit measures by integrating these areas of study. We had two main objectives. First, we sought to develop two new measures of thought automaticity that incorporate thought process and content—

the Positive Thought Automaticity Index (PTAI) and Negative Thought Automaticity Index (PTAI/NTAI). We developed these measures to blend process items adapted from the Self-Report Behavioural Automaticity Index, a 4-item subscale of the SRHI that only measures automaticity (Gardner, Abraham, et al., 2012), with content items from existing measures of automatic thinking. The NTAI contains content items from the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980), while the PTAI contains content items from the Positive Automatic Thoughts Questionnaire (Ingram & Wisnicki, 1988). Second, we sought to use this new measure to tease apart the unique roles of thought automaticity and frequency in predicting mental health outcomes.

Study 2a developed the PTAI and NTAI and investigated the basic psychometric properties of these new measures. Study 2b further examined the psychometric properties of these scales in a separate sample and tested the predictive utility of measuring automaticity as a thinking process compared to frequency. By combining measures of automatic thinking and mental habits, these studies bridge the gap between two highly related, although until now unintegrated, fields of study.

Study 2a – Pilot Development of the Positive and Negative Thought Indices

Study 2a developed an initial version of the NTAI and PTAI and provided preliminary data about the construct validity, predictive validity, and internal consistency reliability in a sample of adults in the United Kingdom. Participants completed these new measures, an existing measure of habitual negative thinking, and questionnaires assessing depressive symptoms and satisfaction with life. We hypothesized that the NTAI would demonstrate convergent validity by correlating strongly with the HINT (Hypothesis 1), that the NTAI and PTAI would demonstrate predictive validity (Hypothesis 2) by correlating strongly with depressive symptoms (positive correlation with the NTAI, negative correlation with the PTAI) and satisfaction with life (negative correlation

with the NTAI, positive correlation with the PTAI), and that thought automaticity would strongly correlate with frequency for both the NTAI and PTAI (Hypothesis 3).

Method

Participants and procedure

Participants were recruited and paid a nominal fee through Prolific Academic, a UK-based online research recruitment platform (Palan & Schitter, 2018; Peer, Brandimarte, Samat, & Acquisti, 2017). Participants completed an online questionnaire about mental habits and their overall well-being. The only exclusion criterion was being under 18 years of age. A total of 153 participants completed the study, with 20 individuals excluded for failing an attention-check item. We recruited 153 participants based on feasibility constraints related to this project. Of the 133 participants included in our analyses, 57 were men (43%), 72 women (54%), 3 people who identified as transgender or other (2%), and 1 person did not disclose gender (<1%). Age ranged from 18 to 77 years ($M = 29.8$, $SD = 10.9$).

Development of the TAI

We developed the NTAI and PTAI using the self-statements outlined in the ATQ (Hollon & Kendall, 1980) and P-ATQ (Ingram & Wisnicki, 1988), respectively. The NTAI incorporated 4 negative self-statements of depression from the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980): *Something has to change*, *My future is bleak*, *I'm worthless*, and *I can't finish anything*. Likewise, the PTAI incorporated 4 positive self-statements from the Positive Automatic Thoughts Questionnaire (Ingram & Wisnicki, 1988): *Life is exciting*, *I take good care of myself*, *I am fun to be with*, and *I will be successful*. We chose these content items based on our clinical experience and how these frequently these thoughts have come up in clinical practice.

For each content item in the NTAI and PTAI, we developed an automaticity subscale adapted from the SRBAI (Gardner, Abraham, Lally, & de Bruijn, 2012). The SRBAI consists of 4 items related to a particular behaviour: “Behaviour X is something I do... 1) automatically, 2) without having to consciously remember, 3) without thinking, and 4) I start doing before I realize I’m doing it”. We adapted this automaticity subscale for the NTAI and PTAI. Our subscale consisted of three items describing whether the thought “pops into my mind... 1) automatically; 2) instantly, and; 3) without my control”. In addition to the automaticity subscale, participants also reported the frequency of each positive and negative self-statement “. Due to human error, one of the self-statements intended for the NTAI erroneously assessed frequency rather than automaticity (the word “regularly” was used instead of “automatically”), and we therefore removed this statement from our analyses.

Additional Measures

In addition to the NTAI and PTAI, participants completed measures related to depression, satisfaction with life, and an existing questionnaire measuring habitual negative thinking. We assessed depressive symptoms using the *Centre for Epidemiological Studies Depression Scale* (CES-D; Andresen, Malmgren, Carter, & Patrick, 1994). The *Satisfaction with Life Scale* (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) measured how satisfied participants were with their lives, and an adapted version of the Habit Index of Negative Thinking (HINT; Verplanken et al., 2007) assessed the relationship between our new measure and an existing measure of habitual thinking. The HINT used in this study was shortened to contain only the automaticity items found in the Self-Report Behavioural Automaticity Index (Gardner, Abraham, et al., 2012).

Data Analysis

We conducted a series of bivariate correlations between the NTAI ($M = 3.35$, $SD = 1.42$, $\alpha = 0.86$), Negative Thought Frequency ($M = 1.98$, $SD = 0.91$, $\alpha = 0.75$), PTAI ($M = 3.79$, $SD = 1.19$, $\alpha = 0.91$), Positive Thought Frequency ($M = 2.15$, $SD = 0.78$, $\alpha = 0.74$), HINT ($M = 4.42$, $SD = 1.34$, $\alpha = 0.84$), CES-D ($M = 20.76$, $SD = 5.61$, $\alpha = 0.80$), and SWLS ($M = 19.71$, $SD = 6.68$, $\alpha = 0.86$).

Results

Table 4 shows how the automaticity of positive and negative thoughts correlated with thought frequency, depression, satisfaction with life, and an existing measure of habitual thinking. The NTAI demonstrated high internal consistency ($\alpha = .91$), as did the PTAI ($\alpha = .91$). The NTAI correlated positively with the HINT ($r = .54$, $p < .001$) while the PTAI was negatively correlated with the HINT ($r = -.53$, $p < .001$). Consistent with Hypothesis 1, these results suggest convergent validity of the NTAI and PTAI.

The NTAI was correlated positively with depression scores ($r = .71$, $p < .001$) and negatively with satisfaction with life ($r = -.48$, $p < .001$), while the PTAI was negatively correlated with depression scores ($r = -.48$, $p < .001$) and positively correlated with satisfaction with life ($r = .42$, $p < .001$). Consistent with Hypothesis 2, these results suggest the predictive validity of the NTAI and PTAI.

The NTAI was strongly positively correlated with negative thought frequency ($r = .79$, $p < .001$), while the PTAI was positively correlated with positive thought frequency ($r = .77$, $p < .001$). Given the large effect sizes of the correlations, these results are consistent with Hypothesis 3. The NTAI and PTAI were negatively correlated ($r = -0.39$, $p < .001$) with one another.

Table 4: Study 2a bivariate correlations.

	NTAI	Negative thought frequency	HINT	PTAI	Positive thought frequency	CESD -10
Negative thought frequency	0.79*					
HINT	0.54*	0.45*				
PTAI	-0.39*	-0.47*	-0.53*			
Positive thought frequency	-0.41*	-0.37*	-0.49*	0.77*		
CESD-10	0.71*	0.76*	0.53*	-0.48*	-0.43*	
SWLS	-0.48*	-0.47*	-0.35*	0.42*	0.37*	-0.58*

* $p < .001$

Negative Thought Automaticity Index (NTAI); Positive Thought Automaticity Index (PTAI); Habit Index of Negative Thinking (HINT); Center for Epidemiological Studies of Depression 10-item Scale (CESD-10), Satisfaction with Life Scale (SWLS)

Discussion

Study 2a provided preliminary data about the psychometric properties of two measures of automatic thinking: the NTAI and PTAI. The results were consistent with Hypotheses 1, 2, and 3. As expected, the NTAI was positively correlated (large effect size) with an existing measure of habitual negative thinking and depressive symptoms, and negatively correlated with satisfaction with life (medium-to-large effect size). Conversely, the PTAI was positively correlated with satisfaction with life (medium effect size) and negatively correlated with depressive symptoms and

habitual negative thinking (medium-to-large effect size). Both the NTAI and PTAI exhibited high internal consistency reliability. While the NTAI and PTAI were negatively correlated, the medium effect size suggests that the presence of positive automatic thinking does not necessarily imply the absence of negative automatic thinking, and vice versa. Likewise, this suggests that negative automatic thinking is not the inverse of positive automatic thinking and that aspects of these thinking patterns may be distinct. This possibility is consistent with research on positive and negative affect, which have been found to be largely uncorrelated (Watson, Clark, & Tellegen, 1988).

This study also demonstrated the strong positive correlation between thought frequency and thought automaticity for both the negative ($r = .79$) and positive self-statements ($r = .77$). These results indicate that the constructs of frequency and automaticity are highly related. These results are consistent with current theories of habit formation, which hypothesize that automaticity emerges through repeating actions (and presumably thoughts) in stable environments (e.g., Wood, Quinn, & Kashy, 2002). Since repetition is often proposed as a precursor to automaticity, it is unsurprising that thought automaticity and frequency were highly correlated. The current study provides a preliminary estimate of the magnitude of this relationship for positive and negative self-statements. Although the current study examined the relationship between thought automaticity, thought frequency, and various well-being outcomes, it did not examine whether automaticity predicted any unique aspects of mental health compared to frequency. We explored this question in Study 2b.

Study 2b – How automatic are automatic thoughts? Measuring the role of automaticity in predicting mental well-being

Building on the NTAI and PTAI developed in Study 2a, Study 2b tested the incremental utility of thought automaticity in predicting well-being outcomes. Study 2b examined whether thought automaticity predicted outcomes over and above thought frequency and the test-retest reliability of the NTAI and PTAI at a 3-month follow-up. It also provided an opportunity to replicate the correlational results of Study 2a in a different sample. Following Study 2a, we noticed an opportunity to improve the NTAI and PTAI to become more representative of the breadth of positive and negative thoughts identified in existing research. In Study 2b, we revised the content items of NTAI and PTAI to include positive and negative thoughts based on the factor structures identified in the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980) and Positive Automatic Thoughts Questionnaire (Ingram & Wisnicki, 1988; see Appendix B). Given the specific emphasis placed on automatic (rather than frequent) thoughts in CBT protocols and that habit is theoretically distinct from frequency (e.g., Marteau, Hollands, & Fletcher, 2012), we hypothesized that thought automaticity would predict unique aspects of well-being. Although some existing research has examined the benefits of measuring the habitual nature of thinking (e.g., Verplanken et al., 2007), there is opportunity to investigate the role of automatic versus frequent thinking more precisely. For example, across several studies, Verplanken et al. (2007) found that habitual negative thinking predicted variance in well-being outcomes over and above frequent thinking. However, these analyses did not compare the automaticity and frequency of the same thoughts, but rather compared different full scales (e.g., the HINT and the ATQ) purported to measure habit and frequency, respectively. As a result, their results might have been confounded by other unintended differences between scales as opposed to the true differences between the

constructs of “habit” and “frequent thinking”. Using the updated NTAI and PTAI, we were able to build on the findings of Verplanken et al. (2007) by directly measuring (and comparing) the automaticity and frequency of the same thoughts. Based on the findings of Verplanken et al. (2007), we predicted that thought automaticity would predict variance in depression and satisfaction with life over and above thought frequency (Hypothesis 1). We also predicted that thought automaticity would predict variance in depression and satisfaction with life over and above an existing measure of mental habit (Hypothesis 2).

If automaticity does predict variance in well-being outcomes over and above frequency, it is reasonable to ask: *why*? Currently, there are limited mechanistic explanations as to why habitual thinking would predict unique aspects of well-being. We therefore tested the novel hypothesis that automaticity would mediate the relationship between thought frequency and belief that a positive or negative thought is true (Hypothesis 3). This mechanistic hypothesis was based on clinical experience administering CBT for common psychological problems, like depression. When people feel depressed, they often believe that their negative thoughts (e.g., “No one likes me”) are facts rather than thoughts that may be true. In CBT, clinicians help people form new habits of challenging these negative thoughts. In essence, this involves forming a new mental habit (e.g., “There are plenty of people who like me”) to replace the negative one. In this framework, a new automatic thought will theoretically replace the old negative thought (“No one likes me”), making the old thought less believable. However, this framework has yet to be tested. Finding evidence that automaticity is involved in the pathway from thought frequency to thought believability would add much needed data about the mechanisms through which mental habits contribute to well-being.

Methods

Participants and procedure

We recruited 422 Canadian undergraduate students seeking to complete a survey for course credit. Participants completed an online questionnaire examining the automaticity of positive and negative thinking and their well-being (See Appendix B). We recruited this sample based on feasibility constraints related to this project. A total of 375 participants fully completed the questionnaire, with 67 participants excluded for failing at least one of 4 attention-check items. Thus, our final sample comprised 308 participants. Participant ages ranged from 17-32 years ($M = 19.2$, $SD = 1.7$), with 221 (72.8%) as female, 87 (28.2%) as male, and no participants describing themselves as part of another gender category. In addition to a baseline questionnaire, all participants were invited to complete the same questionnaire three months after the baseline study. For the three-month follow-up, 58 participants (18.8% of the initial sample) submitted responses, with 44 participants (14.2% of the initial sample) providing complete data, which is the sample we used in our follow-up analyses.

Measures

Study 2b used similar measures to Study 2a. Participants completed updated versions of the PTAI and NTAI, the twenty-item version of the CES-D (Radloff, 1977), SWLS (Diener et al., 1985), and HINT (Verplanken et al., 2007). The NTAI and PTAI included more negative and positive self-statements (5 in total) to ensure that included thoughts were representative of thoughts studied in existing research. These positive and negative self-statements were followed by the same automaticity and frequency follow-up questions. We used different items from the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980) and Positive Automatic Thoughts Questionnaire (Ingram & Wisnicki, 1988) to align with the factor structure of these questionnaires.

For the NTAI ($\alpha = .96$), we chose 5 negative self-statements with at least one statement from each of the 4 factors identified by Hollon & Kendall (1980): personal maladjustment and desire for change, negative self-concept and negative expectations, low self-esteem, and giving up/helplessness. Likewise, we chose 5 positive self-statements for the PTAI ($\alpha = .94$) using at least one statement from each of the 4 factors identified by (Ingram & Wisnicki, 1988): positive daily functioning, positive self-evaluation, others' evaluation of self, and positive future expectations.

Data analysis

As in Study 2a, we conducted bivariate correlations between various measures and calculated their Cronbach's alphas: NTAI ($M = 3.91$, $SD = 1.47$, $\alpha = 0.96$), Negative Thought Frequency ($M = 2.29$, $SD = 0.91$, $\alpha = 0.86$), Negative Thought Believability ($M = 3.89$, $SD = 1.43$, $\alpha = 0.82$), PTAI ($M = 4.38$, $SD = 1.27$, $\alpha = 0.94$), Positive Thought Frequency ($M = 2.74$, $SD = 0.89$, $\alpha = 0.81$), Positive Thought Believability ($M = 5.29$, $SD = 1.16$, $\alpha = 0.80$) HINT ($M = 4.42$, $SD = 1.46$, $\alpha = 0.95$), CES-D ($M = 41.89$, $SD = 11.85$, $\alpha = 0.91$), and SWLS ($M = 23.02$, $SD = 6.54$, $\alpha = 0.87$).

To assess the reliability of the NTAI and PTAI, we calculated Cronbach's alpha (for internal consistency) and bivariate correlations between TAI scores at baseline and three-month follow-up (for test re-test reliability).

To assess the incremental value of thought automaticity over and above thought frequency in predicting outcomes in depression and satisfaction with life, we conducted a series of hierarchical linear regressions. We modelled depression and life satisfaction as separate dependent variables (DV), using a hierarchical regression modelling procedure. First, we inputted frequency of positive/negative thoughts as the independent variable (IV). Second, we ran a model with thought frequency and automaticity as IVs, with the same DVs. Third, we compared the first model

(with thought frequency as the sole IV) and the second model (with both thought frequency and automaticity as IVs) and calculated the change in the F-statistic and R^2 . We used the same procedure to assess whether the NTAI predicted variance in the DVs over and above an existing measure of mental habits (HINT).

For mediation analyses, we used the Model 4 PROCESS macro created by (Hayes, 2012). For this macro, we bootstrapped using 5000 samples with thought frequency as the IV, thought automaticity as the mediator, and thought belief as the DV. We examined the relationship between the IV and the mediator, (path a), the mediator and the DV (path b), the IV and the DV without the mediator (path c), and the IV and the DV with the mediator (path c'). Finally, we examined the 95% bootstrapped confidence intervals to determine whether the indirect effects were statistically significant (i.e., the confidence intervals did not contain 0). We defined full mediation as the IV no longer statistically significantly predicting the DV after the mediator was included. We defined partial mediation as the IV remaining a statistically significant predictor of the DV, assuming the 95% confidence intervals of the indirect effects did not contain 0.

Results

Bivariate correlations and reliability

The bivariate correlations in Study 2b largely replicated the results of Study 2a. Negative thought automaticity was strongly positively correlated with negative thought frequency ($r = .71$, $p < .001$), an existing measure of habitual negative thinking (HINT; $r = .80$, $p < .001$), and depression scores ($r = .73$, $p < .001$). The NTAI was also strongly negatively correlated with positive thought automaticity ($r = -.50$, $p < .001$) and satisfaction with life ($r = -.50$, $p < .001$). Positive thought automaticity was strongly positively correlated with positive thought frequency ($r = .81$, $p < .001$) and satisfaction with life ($r = .52$, $p < .001$). The PTAI was also strongly

negatively correlated with depressive symptoms ($r = -.53, p < .001$) and the HINT ($r = -.59, p < .001$).

For the subsample that completed the NTAI and PTAI three months after baseline ($n = 44$), we calculated test re-test reliability. Both the NTAI ($r = .82, p < .001$) and PTAI ($r = .83, p < .001$) demonstrated strong test re-test reliability.

Hierarchical regressions

Table 5 shows the hierarchical regression results for 4 separate models and Table 6 shows the regression results from Model 2, which included both automaticity and frequency as separate predictors. The results were consistent with Hypothesis 1. Negative thought automaticity predicted variance over and above negative thought frequency for depressive symptoms $\Delta F(1, 305) = 24.81, p < .001, \Delta R^2 = .035$, and satisfaction with life $\Delta F(1, 305) = 4.88, p = .03, \Delta R^2 = 0.010$. Likewise, positive thought automaticity predicted variance over and above positive thought frequency for depressive symptoms $\Delta F(1, 305) = 36.47, p < .001, \Delta R^2 = .086$, and satisfaction with life $\Delta F(1, 305) = 19.463, p < .001, \Delta R^2 = 0.045$.

The results were also consistent with Hypothesis 2: the NTAI predicted variance over and above the HINT for depressive symptoms $\Delta F(1, 305) = 40.09, p < .001, \Delta R^2 = .054$ and satisfaction with life $\Delta F(1, 305) = 10.25, p < .001, \Delta R^2 = .024$.

Table 5. Study 2b hierarchical regression results

DV	IV	Model 1: Frequency only		Model 2: Frequency + automaticity		<i>Model comparisons</i>	
		F	R ²	F	R ²	ΔF	ΔR^2
Depression	Negative thoughts	358.50	0.54**	205.60	0.57**	24.806	0.04**
	Positive thoughts	76.06	0.20**	60.67	0.28**	36.468	0.09**
Satisfaction with Life	Negative thoughts	117.00	0.28**	61.40	0.29**	4.484	0.01*
	Positive thoughts	97.78	0.24**	61.57	0.29**	19.463	0.05**

* $p < .05$ ** $p < .001$

Table 6. Study 2b regression results from Model 2 (frequency + automaticity)

DV	IV		<i>b</i>	<i>SE</i>	<i>t</i>
Depression	Negative thoughts	Frequency	5.49	0.95	5.76**
		Automaticity	2.93	0.59	4.98**
	Positive thoughts	Frequency	-0.59	1.09	-0.54
		Automaticity	-4.63	0.77	-6.04**
Satisfaction with Life	Negative thoughts	Frequency	-2.54	0.68	-3.73**
		Automaticity	-0.89	0.42	-2.11*
	Positive thoughts	Frequency	1.46	0.60	2.42*
		Automaticity	1.86	0.42	4.41**

* $p < .05$ ** $p < .001$

Mediation analyses

Automaticity partially mediated the relationship between thought frequency and belief that a thought is true for both positive and negative self-statements (see Figures 1 and 2).

For negative automatic thoughts, thought frequency significantly predicted automaticity (path a), $b = 1.40$, $t(306) = 29.5$, $p < .0001$. Together, negative thought frequency and automaticity significantly predicted belief, $F(2, 306) = 467.2$, $p < .0001$, $R^2 = 0.76$, with automaticity significantly predicting belief (path b), $b = 0.50$, $t(305) = 9.32$, $p < .0001$, and frequency significantly predicting belief (path c'), $b = 0.60$, $t(305) = 6.86$, $p < .0001$. Frequency independently predicted variance in belief (path c), $b = 1.30$, $t(305) = 25.7$, $p < .0001$. Although path c' remained statistically significant, the 95% CI [0.48, 0.93] with 5000 bootstrapped samples did not contain 0. Thus, negative thought automaticity partially mediated the relationship between frequency and belief.

The results were similar for positive automatic thoughts. Positive thought frequency significantly predicted automaticity (path a), $b = 1.15$, $t(306) = 24.0$, $p < .0001$. Positive thought frequency and automaticity significantly predicted belief when combined, $F(2, 305) = 202.86$, $p < .0001$, $R^2 = 0.57$, with automaticity significantly predicting belief (path b), $b = 0.44$, $t(305) = 7.51$, $p < .0001$ and frequency significantly predicting belief (path c'), $b = 0.41$, $t(305) = 4.9$, $p < .0001$. Frequency independently predicted variance in belief (path c), $b = 0.91$, $t(305) = 17.2$, $p < .0001$. Although path c' remained statistically significant, the 95% CI [0.32, 0.71] with 5000 bootstrapped samples did not contain 0. Thus, positive thought automaticity partially mediated the relationship between frequency and belief.

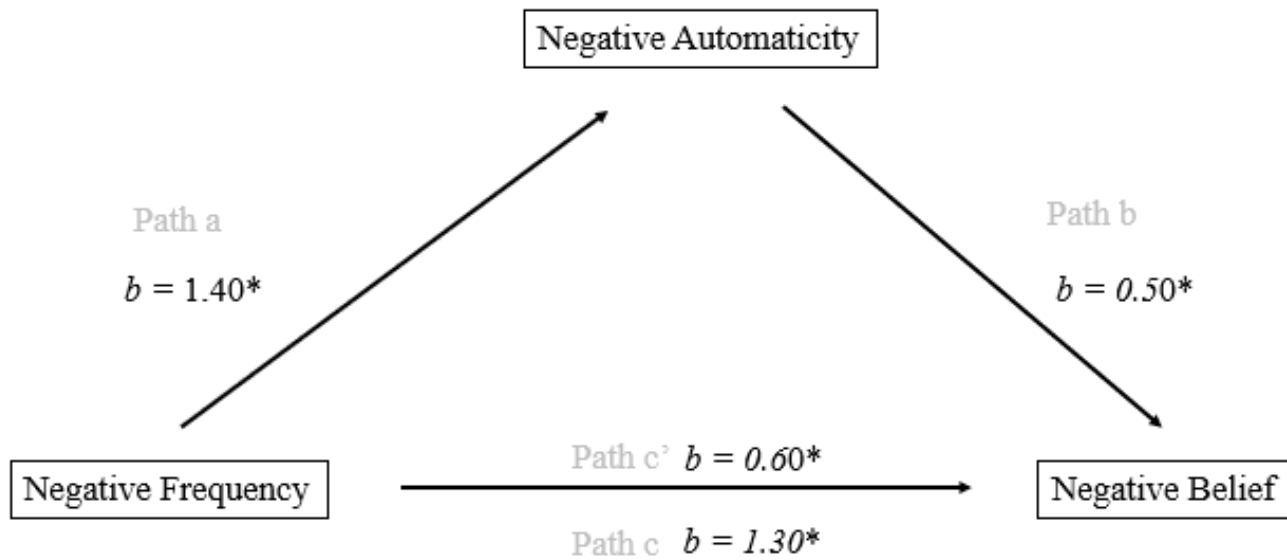


Figure 1. Study 2b mediation results for negative thoughts. $*p < .0001$

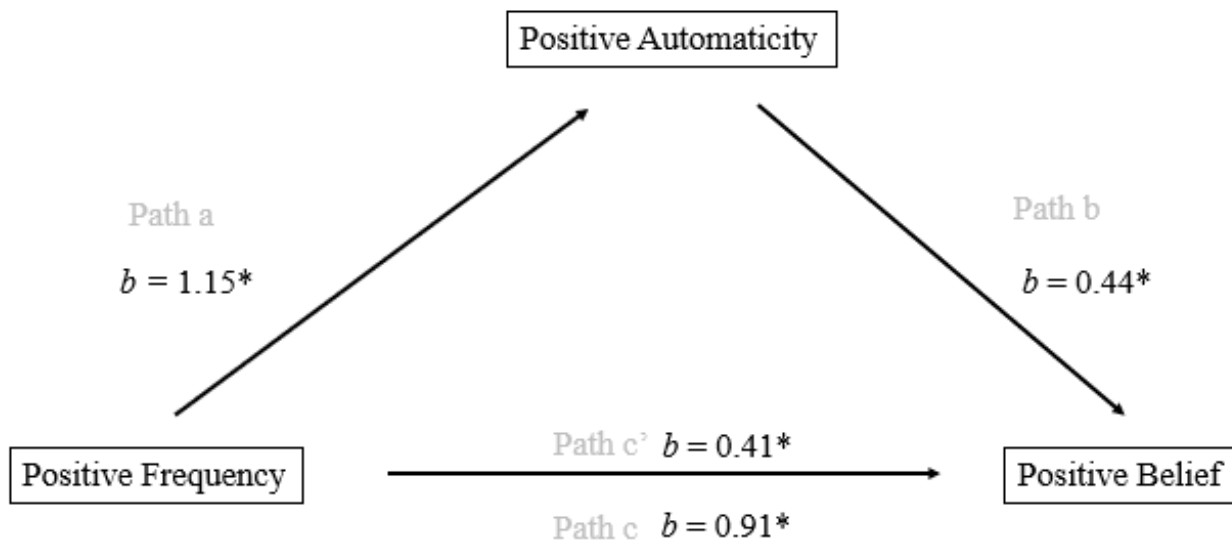


Figure 2. Study 2b mediation results for positive thoughts. $*p < .0001$.

Discussion

Study 2b provided further evidence of the psychometric properties of the NTAI and PTAI. Like Study 2a, the NTAI and PTAI correlated strongly in the expected direction with well-being outcomes (depressive symptoms and satisfaction with life) and negatively correlated with one another. This study also demonstrated that these new measures display test re-test reliability: baseline NTAI and PTAI scores were strongly correlated with scores at a 3-month follow-up.

Most notably, Study 2b demonstrated the incremental validity of the NTAI and PTAI compared to other measures. Specifically, the automaticity of positive and negative thoughts predicted variance in well-being outcomes over and above thought frequency. The NTAI also predicted variance in depressive symptoms and satisfaction in life over and above an existing measure of habitual negative thinking—the HINT (Verplanken et al., 2007).

Study 2 Discussion

The current studies developed two new measures of automatic thinking, the NTAI and PTAI, that enabled us to explore how thought frequency and automaticity predict well-being. These measures integrate the strengths of existing measures of automatic thoughts and mental habits. As a result, the NTAI and PTAI bridge a gap between previously disconnected research on mental habits and automatic thinking (Colvin et al., 2021).

Both studies demonstrated that the NTAI and PTAI subscales are reliable, with high internal consistency and test re-test reliability. In Study 2a, we developed preliminary versions of these measures, finding that thought automaticity was strongly correlated with thought frequency, existing measures of habit, and well-being outcomes (depressive symptoms and satisfaction with life). In Study 2b, we replicated these findings and further developed the NTAI and PTAI by including content items that reflected the factor structures of the ATQ (Hollon & Kendall, 1980)

and P-ATQ (Ingram & Wisnicki, 1988). We also found in Study 2b that thought automaticity predicted variance in well-being outcomes over and above frequency and a popular measure of mental habit. We draw three main conclusions from these studies.

Conclusion 1: The automaticity of both positive and negative thoughts predicts well-being outcomes. The incremental predictive utility of automaticity for positive and negative thoughts provides needed data about positive mental habits. In both studies, the NTAI and PTAI were moderately negatively correlated, implying that the absence of negative automatic thoughts does not necessarily imply the presence of positive thoughts. Since positive and negative automatic thoughts predict unique aspects of well-being, they could both be independent intervention targets. Future interventions for changing mental habits might implement new positive mental habits as a complement, or alternative, to breaking negative mental habits to foster well-being.

Conclusion 2: Thought automaticity predicts well-being outcomes over and above thought frequency. Our results suggest that automaticity predicts unique facets of well-being even though frequency and automaticity were highly correlated. In Study 2b, we found that the self-reported automaticity of positive and negative self-statements predicted variance in depression and satisfaction with life over and above the self-reported frequency of these statements. This finding is consistent with the results of Verplanken et al. (2007), who found that the HINT predicted well-being outcomes over and above other cognitive measures that did not measure habit as a distinct process. Our findings also build on Verplanken and colleagues by directly comparing frequency and automaticity for identical negative/positive self-statements. Our results suggest that automaticity is a specific thought process that predicts well-being over and above frequency for several identical negative and positive self-statements.

Conclusion 3: Self-reported thought automaticity and frequency are highly correlated.

Studies 1 and 2 found that thought automaticity and frequency were strongly correlated for positive and negative thoughts. The strength of this relationship suggests that self-reported frequency and automaticity are similar constructs. This finding is consistent with existing theoretical and empirical behavioural habit research demonstrating the close relationship between frequency and automaticity. Habits are often conceptualized as learned associations that emerge by performing a behaviour repeatedly in a stable context (e.g., Wood et al., 2002). Moreover, experimental data has demonstrated that repeating behaviours in stable contexts is associated with increased automaticity of that behaviour (Lally et al., 2010). It is therefore unsurprising for the self-reported frequency and automaticity of thoughts to be highly correlated.

Conclusion 4: Automaticity may be important because it links the frequency of a thought and whether it is perceived as true. Study 2b found that positive and negative thought automaticity partially mediated the relationship between frequency and belief that a thought is true. This finding builds on existing mental habit and automatic thinking research by demonstrating one mechanism a habit model is unique from other frameworks.

Clinical implications

The finding that automaticity predicts unique aspects of well-being has implications for clinicians seeking to change negative thoughts and promote positive ones. Clinicians could consider automaticity as a thinking process when conceptualizing the mental health concerns of clients (Teachman et al., 2012), in addition to other useful processes such as repetitive negative thinking (Ehring & Watkins, 2008).

By framing certain automatic thoughts as mental habits, evidence-based psychological treatments like CBT may be tailored to disrupt mental habits. While many clinicians may

informally describe thoughts as habits, there have been few formal linkages between the concept of automatic thinking with habit in popular CBT protocols. There have, however, been recent efforts to apply insights from habit theory to evidence-based psychotherapies to maximize their effectiveness (Harvey et al., 2020). There are many different ways to disrupt unwanted habits (Gardner et al., 2021): one may try to override existing habit association with a new, directly competing one (i.e., habit substitution), try to avoid or changes the cues leading to unwanted habitual thinking (i.e., habit discontinuity), or stopping oneself thinking the unwanted thought (or perhaps following up with compensatory/conflicting thought; habit inhibition).

These strategies may enhance common practices used by therapists, such as Thought Records in CBT, in which clients describe the situations that elicit problematic thoughts and list alternative thoughts that lower the intensity of negative emotions. A habit framework would predict that negative thoughts (e.g., “I’m a failure”) would become less automatic, and alternative thoughts (e.g., “I’m doing the best that I can”) more automatic, after repeated practice swapping negative automatic thoughts for alternatives in similar contexts.

Limitations and future directions

One potential limitation of these studies is the extent to which people can accurately self-report the automaticity of thoughts. Similar questions have been raised regarding habitual behaviour (e.g., Sniehotta & Presseau, 2012; Hagger, Rebar, Mullan, Lipp, & Chatzisarantis, 2015), which can be applied to automatic thinking. Orbell & Verplanken (2015) argued that while we do not have direct insight into the habit process itself, we can infer habit from the typical experiences and consequences (i.e., ‘symptoms’) of habitual behaviour. For example, a person can be smoking, but not cannot remember lighting their cigarette. They therefore infer that they must have lit their cigarette automatically. It is unclear whether humans experience thoughts and

consequences of those thoughts in the way as we do for behaviour. Future research could assess the validity of retrospective self-reported automaticity compared to automatic thoughts generated through experience sampling or through experimental manipulations (e.g., Hjartarson, Snorrason, Bringmann, Ögmundsson, & Ólafsson, 2021).

Another limitation of these studies is their modest sample sizes. Future research should seek to assess larger samples and collect more detailed demographic information (e.g., cultural diversity) to ensure that the results are more representative of the diversity within society. Future research could also assess the features of specific populations of interest, including clinical populations. By assessing more representative and targeted samples, future research will also specify the size of effects for different populations (e.g., the proportion of variance in well-being outcomes that automaticity predicts over and above frequency). It is possible that these effect sizes may vary for some populations (e.g., clinical populations) more so than healthy controls. In the current study, the effect size of the hierarchical regressions ranged from a ΔR^2 of .01 to .09. Thus, the incremental benefit of automaticity of negative thoughts predicting variance in satisfaction of life over negative thought frequency was small (1% increase in variance predicted) compared to the automaticity of positive thoughts predicting variance in depression outcomes over positive thought frequency (9% increase in variance predicted). Consequently, the automaticity of types of thinking may be more informative in predicting well-being outcomes than frequent thinking. Future research should tease apart under which automaticity is most useful as a construct compared to frequency.

In addition to the preliminary mediation results described here, future research should further explore the mechanisms through which automaticity predicts unique aspects of well-being. One possibility is that automaticity of self-statements describes more entrenched, long-term

patterns of thinking, formed through extended reinforcement of cue-response thinking patterns, whereas thought frequency may be influenced by numerous short-term external factors including stressors and life circumstances. While further research is needed on the role of automaticity in mental health, the current studies demonstrated that self-reported thought automaticity predicted unique aspects of well-being outcomes compared to thought frequency. These studies have also formally integrated the study of automatic thinking and mental habits in the context of mental health and provided a new measure for investigating these constructs in future research.

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Chapter 4: A Mixed-Methods Investigation of the Cues that Precede Automatic Thoughts

(Study 3)

Abstract

Background: The cues that trigger automatic thoughts are a key feature of mental habits. However, there have been few attempts to understand the situations that precede automatic thinking.

Methods: Using a mixed-methods design, 125 participants from the United Kingdom completed a questionnaire about the recent and past cues that have preceded their automatic thoughts. Participant examples of cue were coded using an existing framework developed by positive psychology research: PERMA (Positive Emotion, Engagement, Relationships, Meaning, and Achievement)

Results: We coded 92.0% of situations preceding negative thoughts and 96.8% of situations preceding positive thoughts using the PERMA framework. Participants endorsed experiencing internal (e.g., emotions) and external (e.g., situations) cues as preceding thoughts in similar proportions. Participants reported that multiple cues precede the same thought, with a median of 5 cues reported for both positive and negative thoughts.

Conclusions: This study provided real-world, concrete examples of the cues that trigger automatic thinking. The PERMA framework was a useful way to categorize most cues. We discuss the implications of the finding that many different cues can trigger the same thought for researchers and clinicians.

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So far, the studies in this dissertation have attempted to fill in gaps in the mental habit literature. Study 1 (Chapter 2) comprehensively reviewed how mental habits have been defined and measured in the existing literature related to mental health. We found that the literature has exclusively focused on negative mental habits, which are primarily defined in terms of automaticity and measured using adaptations of a single self-report measure, the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). In Study 2 (Chapter 3), we developed two new measures of thought automaticity (based on the limitations of existing measures) and tested new hypotheses about the relationship between automaticity, frequency, thought belief, and well-being for both positive and negative thinking. In this study, we found that thought automaticity predicted variance in well-being outcomes over and above thought frequency. We also found initial evidence of a mechanistic pathway through which automaticity impacts well-being: the relationship between frequency and belief was partially mediated by automaticity for both positive and negative thoughts. The present study (Study 3) builds on these two studies by examining the cues that precede automatic thoughts.

The operating definition for “habit” in this dissertation has been “a cue-dependent automatic response.” I arrived at this definition because it is both parsimonious and fits with the broad consensus I have perceived within the literature that habits are automatic and triggered by specific cues (e.g., Gardner, 2015; Wood & Neal, 2007; Wood & Rünger, 2016). Although definitions tend to emphasize that habits are cue-dependent, there has been limited emphasis on the role of cues in mental habit research.

In Study 1, we found that 80% of articles explicitly mentioned automaticity when defining habit, while only 20% explicitly mentioned cues. This empirical finding conflicts with the broader theoretical agreement that habits are triggered by specific contexts. This finding also juxtaposes

the empirical research on health behaviour change, which has emphasized the importance of cues: identifying the cues that precede behaviour is a primary intervention for habitual health behaviours (see Gardner & Rebar, 2019 for a review) and mental health behaviours (e.g., eating behaviours in anorexia nervosa; Steinglass et al., 2018). Moreover, the popular implementation intention exercise (Gollwitzer, 1999), which has been widely adapted in health interventions, also explicitly emphasizes identifying cues. In fact, Harvey, Callaway, Zieve, Gumport, & Armstrong (2022) recently highlighted that better understanding cues is a priority for future research. The authors specifically noted three “burning” questions for future research:

- 1) “For patients seeking an [evidence-based psychotherapy] to help them disrupt an unwanted habit, which types of cues are easier and which are harder to disrupt?”
(p. 576)
- 2) “For those seeking to build new desired habits, which types of cues promote efficient habit formation (e.g., internal, external, event-based, time-based)?”
(p.576)
- 3) “Within [evidence-based psychotherapies], how do we position cues optimally within a set of behaviours that are bundled together in the pursuit of building a sequence of new habits?” (p.576)

While it is outside the scope of this dissertation to answer all three questions, the present study sought to build towards these answers by asking an even more fundamental question related to mental habits: what are the cues that precede positive and negative automatic thoughts?

Cues and automatic thinking

As with the field of mental habits in general, the role of cues in automatic thinking is widely understood implicitly in clinical practice, but poorly addressed in the research literature. For

example, CBT clinicians routinely use the “Thought Record” technique to identify the cues that trigger negative automatic thoughts. Clients are asked to write out how a particular situation (e.g., receiving constructive criticism at work) led to negative automatic thoughts (e.g., “I’m a failure”) and negative emotions like sadness (Greenberger & Padesky, 2016). A key component of the Thought Record involves evaluating the accuracy or helpfulness of negative thoughts to challenge the beliefs that perpetuate low mood.

Clinicians often present the CBT model to clients, which illustrates the connection between situations, thoughts, behaviours, and emotions. Clinicians then troubleshoot with clients how they can respond more adaptively to situations that elicit negative thoughts. This approach can effectively lessen people’s negative responsiveness to daily stressors: CBT can reduce the impact of everyday adverse events on sad mood, even when the number of daily stressful situations does not change (Parrish et al., 2009). Using techniques like the Thought Record, CBT for depression works by breaking the link between stressful situations and unhelpful negative thoughts (Greenberger & Padesky, 2016). This relationship between automatic thoughts and their antecedents is an essential maintaining factor for depressive symptoms under the CBT model. However, there has been limited research on the direct antecedents of automatic thoughts.

Instead, there has been extensive research on the antecedents of depressive symptoms, which has elucidated several factors that often precede depressive episodes. For instance, the stress-diathesis hypothesis is a prominent model that proposes that life stressors exacerbated by an underlying predisposition cause depressive episodes (e.g., Colodro-Conde et al., 2018). For example, interpersonal stress (e.g., arguments, break-ups) often precede depressive symptoms (Stader & Hokanson, 1998). There is also some evidence that the relationship between adverse life

events and depression is mediated by negative thoughts, specifically for young people (Barnes Nacoste & Wise, 1991).

While it is well-documented that stress often precedes depressive symptoms, the exact relationship between stressful situations and depressive symptoms is an ongoing area of research. In an ecological momentary assessment study of undergraduate students, participants with higher depression scores had a stronger relationship between negative affect and negative thinking and a weaker relationship between positive affect and positive thinking (Wenze, Gunthert, & Forand, 2007). In this study, positive and negative cognitive reactivity (i.e., how much affect influenced thinking) had independent effects on depression symptoms. Despite this research on the antecedents of depressive symptoms, generally, there has been limited research on the cues that directly precede automatic thoughts, specifically. I conducted a brief cited reference search of Hollon & Kendall (1980), the study that developed the ATQ, and did not find any studies that investigated the situations that preceded automatic thoughts.

Despite this lack of empirical work on what immediately precedes automatic thinking, there are several suggestions within the clinical and theoretical literatures. These types of cues broadly fit into two types of categories: internal (e.g., bodily sensations) and external cues (e.g., environmental stimuli; Harvey et al., 2022). In a habit-based intervention for anorexia nervosa, Steinglass et al., (2018) helped clients identify external cues related to eating behaviours, like a dining room table or mirror, and internal cues, which included affective cues (e.g., anxiety, disgust, sadness) and cognitive cues (e.g., thoughts like ‘If I eat that cookie, I will lose control’). The authors cited protocols for trichotillomania as the inspiration for identifying internal cues, which involve identifying the “urge” to pull hair (i.e., an internal cue) and forming a new habit that is incompatible with hair pulling in response (Mansueto, Golomb, Thomas, & Stemberger, 1999).

To further highlight the theoretical distinction between internal and external cues, and why a habit framework incorporating cues might be more informative than merely the frequency of thoughts in response to cues, consider the following two clinical examples: social anxiety and panic disorder.

When in social interactions (external cue), a socially anxious person may automatically and immediately experience distressing thoughts about how others perceive them (mental habit). However, if the person actively avoids social interactions, they may not experience these negative thoughts with the same intensity, although they may continue to perseverate on past social encounters. Thus, in this case, assessments of the absolute frequency of the negative thoughts may be misleading, since these thoughts are often contingent on encountering the cue (i.e., social interaction). Information about the automaticity of these thoughts, given the cue of a social situation, might be informative about the nature of this person's anxiety. From this perspective, while automaticity and frequency may be correlated, they are distinct concepts.

Now consider the example of panic disorder, in which individuals experience recurrent unexpected panic attacks. One prominent cognitive model of panic disorder is that panic disorder is perpetuated by the catastrophic misinterpretation of bodily sensations (Clark et al., 1997). For example, when an individual with panic disorder experiences an elevated heart rate (internal cue) they automatically experience catastrophic thoughts (e.g., "I'm having a panic attack") which further raises anxiety, leading to a panic attack. Here, the strength of the relationship between an internal cue (a bodily sensation like elevated heart rate) and the associated automatic response (catastrophic thinking) may describe unique aspects of symptomology compared to the sheer frequency of unwanted panic attacks.

These examples demonstrate the potential role of a mental habit framework that incorporates cues for conceptualizing and treating mental health problems. However, there are few formal models that have attempted to incorporate the role of cues in mental habits, with the exception of Watkins and Nolen-Hoeksema (2014), who argued that depressive thinking patterns (i.e., rumination) ought to be conceptualized as habits. Considering the connection between sad mood and negative thinking (e.g., Wenze, Gunthert, & Forand, 2007), Watkins & Nolen-Hoeksema (2014) negative thinking is a habit cued by negative affect (i.e., an internal cue). Unfortunately, this model only specifies the role of internal cues (e.g., sad mood triggering the rumination habit) and not external cues. In addition, most attempts to measure mental habits have ignored the role of cues and instead focused on habitual nature of thinking. This critique also applies to the measures we created in Study 2, which focused on measuring the automaticity of specific positive and negative thoughts, rather than the cues that trigger these thoughts.

The present study sought to expand on the existing clinical (Mansueto et al., 1999; Steinglass et al., 2018) and theoretical (Watkins & Nolen-Hoeksema, 2014) investigations about the role of cues in psychopathology; in particular the role of cues in automatic thinking. In the present mixed-methods study, we explored the cues that precede positive and negative automatic thoughts. We opted to incorporate both qualitative and quantitative methods to capture the breadth of our research questions. Our primary research question was intentionally broad and exploratory: what are the cues that precede positive and negative automatic thoughts? Given the breadth of this main research question, we identified four sub-questions. First (RQ1), are there any notable themes in the qualitative data that might be useful for researchers and clinicians? Second (RQ2), given that little is known about the variety of cues that trigger thoughts, we asked how many cues do participants report having ever triggered the same automatic thought? Third (RQ3), to expand on

theoretical framework on internal cues proposed by Watkins & Nolen-Hoeksema (2014) and the anecdotal clinical evidence that external cues precede thinking, we asked: do participants endorse both internal and external cues as having preceded automatic thinking? Lastly (RQ4), given that self-report measures (e.g, Verplanken et al., 2007) often do not incorporate cues (including the measure developed in Study 2), we asked what is the relationship between *cued-automaticity* (automaticity in a given context) versus *automaticity without a concrete cue* (automaticity in general)?

Methods

Participants

We recruited and paid a nominal fee to 164 adults through Prolific Academic, an online research recruitment platform based in the United Kingdom (Palan & Schitter, 2018; Peer, Brandimarte, Samat, & Acquisti, 2017). To reduce the chances of having a clinical sample, we excluded 12 participants who endorsed having had a past clinical diagnosis of a mental disorder. We also excluded 16 participants who provided answers that were either 1) not in English, 2) incoherent, or 3) excessively vague. We were conservative when excluding participants based on their responses: if a response was remotely coherent or relevant, we retained it. We excluded an additional 23 participants who did not complete the full questionnaire. The final sample comprised 125 participants with ages ranging from 18-66 ($M = 29.6$, $SD = 11.3$); 51.2% of participants identified as male, and 48.8% as female.

Materials and Procedure

Participants completed a questionnaire about recent and past situations that have triggered positive and negative automatic thoughts (see Appendix C). This questionnaire used an exploratory mixed-methods design (see Tashakkori & Creswell, 2007) to explore the self-reported qualitative

descriptions of the situations that triggered automatic thoughts and the descriptive statistics of the types of cues endorsed by participants.

Recent situations

Participants began by choosing a thought from the 30 self-statements in the Automatic Thoughts Questionnaire (Hollon & Kendall, 1980): “*Which ONE of the following thoughts have you had most frequently over the past two weeks*”. Participants then described the situation that immediately preceded this thought:

“Think about the LAST TIME that you had this thought. Describe the situation you were in, in as much detail as possible. If you can't remember the last time, please describe a time that you remember that triggered this thought.”

Then, participants rated how automatically they experienced these thoughts in similar situations using the 3-item Thought Automaticity Index (TAI) as Study 2. This procedure was then repeated for a positive self-statement that participants chose from the Positive Automatic Thoughts Questionnaire (Ingram & Wisnicki, 1988).

Past situations

For the same positive and negative automatic thoughts selected, participants reported which cues had *ever* triggered this thought. Participants endorsed past cues using a checklist of 22 provided cues, including various scenarios, bodily sensations, and emotions (12 external cues, 10 internal cues; see Appendix C). We generated this checklist through discussions amongst the research team about common triggers of automatic thoughts. In this case, they rated the automaticity of the chosen thoughts in general (i.e., not tied to a similar situation to the one they described) using the TAI. Finally, participants described how frequently they experienced the chosen thoughts in a typical week.

Data Analyses

Given the mixed methods design of this study, we used both qualitative and quantitative analytic strategies.

Qualitative analyses

To understand themes underlying the situations that preceded positive and negative thoughts, we used the thematic analysis approach outlined by Braun & Clarke (2006). We followed the six general steps described in this thematic analysis approach: familiarizing oneself with the qualitative data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and reporting results. As Braun and Clarke recommended, we implemented these six steps flexibly. First, I reviewed all situations described by participants, jotted initial themes and ideas, and consulted with the co-investigator (DS). Through this iterative process, we identified a thematic framework based on an existing theory of well-being: PERMA (Seligman, 2018). This theory posits that well-being is composed of five elements: Positive Emotion, Engagement, Relationships, Meaning, and Accomplishment. We noticed that the PERMA framework captured a substantial proportion of the situation examples as we examined the data. Rather than create our own framework, we decided to use this framework given its existing recognition within the positive psychology movement and its broad applicability to the science of human flourishing. According to this framework, I then coded and tallied all situations. Although quantifying the instances of codes is not necessary in qualitative research (Maxwell, 2010), we decided to tally the number of cases within our framework to be more precise when presenting how often participants reported certain situations. Although many situations overlapped with several categories, we coded the situations based on which category best characterized the situation (i.e., ensuring that situations fit into only one category). Considering this overlap, we decided to separately code whether the

situation 1) referenced school or work, 2) related to an interpersonal encounter, or 3) referenced neither school, work, nor an interpersonal encounter.

To limit the bias associated with having a single coder (me) analyze the data, a research assistant (Katrina Waytowich) joined the research team to independently code the situations using the PERMA framework. After being trained on the PERMA model, the research assistant read each situation without knowing the principal investigators codes and independently coded whether each situation fit within a PERMA category (or “Other”). After this round of independent coding, the research assistant and I met to discuss any discrepancies in our coding. In this process, we developed a codebook (see Appendix D) in which we refined the specific criteria for each category based on our discussions. Finally, we resolved coding discrepancies through team discussions until we reached consensus by examining the situation in the context of the reported thought.

Quantitative analyses

We tallied which positive and negative automatic thoughts participants selected and the number of distinct cues participants reported from the 22-item checklist for recent and past situations. We calculated correlations between the cued TAI scores (i.e., self-reported automaticity of the selected thoughts related to the reported situation), TAI scores without a concrete cue (i.e., self-reported automaticity of the selected thoughts in general), and the frequency of thoughts in a typical week.

Results

Thematic analysis

Table 7 describes the PERMA coding results. The PERMA framework characterized 92.0% of situations preceding negative thoughts, with 59.2% of situations involving school/work, 22.4% involving an interpersonal encounter, and 24.0% referencing neither school, work, nor an

interpersonal encounter. For positive automatic thoughts, the PERMA framework characterized 96.8% of situations, with 43.2% of situations involving school/work, 44.0% involving an interpersonal encounter, and 20.0% referencing neither school, work, nor an interpersonal encounter. The following sections highlight some additional themes within the PERMA framework and illustrate what PERMA-related cues look like in the real world using ecologically valid, concrete examples of automatic thinking in context.

Table 7. Study 3 coding results for situations triggering positive and negative thoughts using PERMA.

PERMA category	Number of cases (% of total)	
	Negative automatic thoughts	Positive automatic thoughts
Positive / Negative emotion	16 (12.8%)	18 (14.4%)
Engagement	27 (21.6%)	19 (15.2%)
Relationships	21 (16.8%)	48 (38.4%)
Meaning	4 (3.2%)	6 (4.8%)
Accomplishment	47 (37.6%)	30 (24.0%)
PERMA (Combined)	115 (92.0%)	121 (96.8%)
Other	13 (10.4%)	13 (10.4%)
Any reference to school or work	74 (59.2%)	54 (43.2%)
Any reference to interpersonal encounter	28 (22.4%)	55 (44.0%)
No reference to work, school, or interpersonal	30 (24.0%)	25 (20.0%)

(P) Positive (and Negative) Emotions

This category involves hedonic pleasure—the pleasant emotions (or lack thereof) that motivate us in the short term. Based on this definition, we coded 16 negative situations (12.8%) and 18 positive situations (14.4%) as being best characterized by “Positive Emotion”. These situations captured the stresses and joys of daily life that impact pleasure.

Situations triggering negative automatic thoughts. Participants described situations in which stressful events led to the absence of positive emotion or the presence of negative emotion. The stress in these examples ranged from daily hassles to significant life stressors. For example, minor disappointments, like poor weather, sapped positive emotion (the thought *“I wish I were somewhere else”* being triggered by *“endless bad weather in the past week”*). Participants also described daily hassles such as being *“overwhelmed at work with too much to do, plus trying to keep on top of the household chores”* and *“cars breaking...money troubles”*, triggering the thought *“I feel like I’m up against the world”*. Participants also described significant life stressors, notably health challenges. For instance, one participant thought, *“nothing feels good anymore”* in response to a response to coping with a diagnosis: *“I recently found out I have [chronic illness] I’m in the process of accepting that fact.”* Other situations involved the inability to experience positive emotion (anhedonia). For example, another participant described having the same thought *“nothing feels good anymore”* while travelling to *“my native country, all the things that I used to enjoy 2 years ago now seem like I’m looking into a wall. Fun museums and good restaurants don’t seem to trigger any emotions like they used to.”*

Situations triggering positive automatic thoughts. Conversely, participants described situations that led to pleasant emotions. In contrast to ruminating on bad weather, positive automatic thoughts (e.g., *“life is exciting”*) arose from appreciating good weather: *“I was riding my bike to work and the weather was beautiful and I thought about how harsh the winter was for me in the last place I lived and just had a moment where I felt that life was exciting.”* Other small joys included positive self-esteem (e.g., *“I looked in the mirror and really liked how I saw myself”*) and victory for a favourite sports team (e.g., the thought *“I am in a great mood”* happening *“after my football team won an important game”*).

(E) Engagement

This category refers to being enraptured by an activity that requires effort and skill (University of Pennsylvania, 2022). Engagement is like the concept of flow conceptualized by Mihaly Csikszentmihalyi, which occurs during an activity that is “*so gratifying that people are willing to do it for its own sake, rather than for what they will get out of it*” (University of Pennsylvania, 2022). Disengagement, therefore, relates to the feelings like boredom and apathy when performing tedious activities. There was significant coding overlap between Engagement, Positive Emotion, and Accomplishment. We coded situations under Engagement when the participants emphasized the process of their activities, rather than its outcome (Accomplishment) and if the positive/negative emotion was caused by disengagement (Positive Emotion). We coded 27 negative situations (21.6%) and 19 positive situations (15.2%) as being best categorized under “Engagement”. Participants emphasized their experiences of (or struggles with) being immersed in a challenging task in these situations.

Situations triggering negative automatic thoughts. Participants described several situations related to disengagement. In many instances, participants noted dissatisfaction with their jobs. For example, one participant reported that the thought “*I wish I were somewhere else*” was triggered by “[*sitting*] at my desk at my boring job.” Likewise, another participant described how the thought “*something has to change*” arose while “*at work, doing administrative work for the last 5 years*”. In addition to their careers, participants also described a lack of engagement in their personal life. For instance, one participant described how the thought “*nothing feels good anymore*” was triggered by cycling through activities that did not lead to a feeling of flow:

“I woke up late...Turned on my PC, checked my social [media], watched a few videos on [YouTube], and then it struck me. I used to play lots of video games - now I just scroll

through my library and cannot find anything to play; [I] used to play guitar and it's collecting dust for few weeks. All my friends are busy doing something else, even none of my Spotify playlists feels good. And I've been sitting like that for few good months - doing absolutely nothing"

We coded this example as Engagement rather than Positive Emotion because the lack of positive feeling appeared to be driven by disengagement. This example also highlights the connection between engagement and positive emotion: it is pleasant to be in a flow state, while it is depressing to initiate a series of unstimulating activities. Another example highlighted how the cycle of procrastination can lead to negative automatic thoughts (*"I'm so disappointed in myself"*) by limiting one's ability to feel the engagement that comes from challenging yet rewarding work:

"I woke up a bit late the past few days[;] it pissed me off as I have a lot of stuff to take care of and get done. I know exactly what I should do. I also like it, but it is just too difficult. I just always do different stuff. Answering to this same study is a diversion. I feel sick. I am just not able to keep going doing what I choose to do. I always look for different stuff to occupy my time and each time I do I realize I should do something else."

Situations triggering positive automatic thoughts. Positive automatic thoughts, in contrast, were triggered when participants experienced flow-like experiences while engaged in tasks that required effort. These included artistic hobbies, like one participant who had the thought *"I finish what I start"* when painting: *"I was painting a landscape (I love painting) and I couldn't wait to finish it to see it finished"*. Participants also described engagement in the workplace. For example, one participant reflected on their interpersonal qualities (*"I have a good way with others"*) when interacting with customers:

“Today when I sent photos to my customers showing their dogs / cats content and having fun (my job is a cat sitter and dog walker). I can tell by the feedback that I’ve made them happy that their pets are in safe hands and I think I understand how to reassure them about this because I understand their fears and concerns.”

Participants also reported feeling engaged when completing schoolwork. One participant, for example, described having the thought *“I have many useful qualities”* while *“happily studying Spanish”*.

(R) Relationships

This category emphasizes how being connected to other people is essential for well-being. We coded 21 negative situations (16.8%) and 48 positive situations (38.4%) as being best categorized under “Relationships”. In coding discussions, there was a high degree of initial consensus about which situations ought to be categorized under “Relationships”. Nonetheless, several situations involved an interpersonal encounter with another person but fit better in another PERMA category. For example, if participants emphasized the interaction with another person in their situation, we coded it under “Relationships”. We separately coded 28 negative situations (22.4%) and 55 positive situations (44.0%) that included any reference to an interpersonal encounter.

Situations triggering negative automatic thoughts. Participants described how relationships led to negative thoughts in two primary ways: interpersonal conflict and loss/loneliness.

Interpersonal conflict. Several participants noted that arguments with other people triggered negative automatic thoughts. These included conflict with roommates (e.g., the thought *“Something needs to change”* occurring after *“I fell out with my roommates and I realised that I*

need to find somewhere better to live”). In addition, many participants described arguments with their families and significant others. These included feelings of guilt and regret. For example, one participant described having the thought “what’s the matter with me?” after “waking up hungover, knowing that I had [made] some bad decisions the night before and hurt people’s feelings”. For another participant, the fallout of conflict also led to feelings of low self-worth and the thought, “I’m no good”:

“I had a go at my boyfriend when he was making dinner for the family because it had got late. He was trying his best and I made him feel rubbish. I was watching the time and rather than get up or ask him to start dinner I carried on watching a film with the family. I had got angry with my 10 year old for complaining about his maths class and I felt like I was no good at being a mum and partner.”

Loss and loneliness. In addition to interpersonal conflict, participants described how relationship loss or the lack of connection led to negative automatic thoughts. Some stories of loss and loneliness were short. For example, negative thoughts arose for one participant while “*at home and felt quite depressed because I was alone*” and for another because “*I lost my dog. We had to put her down*”. Other stories of loss and loneliness were more elaborate. For example, one participant experienced the thought, “*my life’s not going the way I want it to,*” after bumping into an estranged friend:

“I saw an old friend at the cinema a couple of days ago. We used to be best friends, planned our lives around each other. I recently tried to reach out to her on Facebook, we met up and I asked when we should meet again later in a message and didn’t get a response. I was just reminded of this when seeing her, I looked down at my phone to pretend I didn’t see her and tried to make her not recognise me by hiding my face. It’s weird to compare how

close we were then to now. I'm not having a great time at the moment whereas I think she is, so that makes the realisation harder, too. I didn't think I'd end up this lonely."

The loss of connection and the resultant loneliness was also evident for another participant, who described how the thought "*no one understands me*" was triggered by their strained family situation:

"I live with my mother and two brothers. My mother has always favoured my brothers and I am essentially outcast. My mother and brothers speaking openly together, and my brothers' thoughts and feelings are always considered. I am never asked how I feel, and if something goes wrong, it is assumed to be my fault. I haven't felt that I have been understood in my family unit since the death of my father when I was 15."

Situations triggering positive automatic thoughts. Relationships also triggered positive thoughts, particularly examples of social support and connection to others.

Support. Participants emphasized the importance of having people they can turn to in times of need. For example, one participant was ill and thought, "*there are many people who care about me,*" when "*I was sick and my mom and significant other were very sweet and kind to make me feel better*". Participants also described social support as a practical way of managing the stresses of daily life, such as car troubles: "*my boyfriend not only helped me purchase and install a new battery for my car when I couldn't afford it, he also let me borrow his car until we could get mine running again in order for me to get to my classes.*" Participants also expressed social support as a necessary part of coping with emotional stress, leading to thoughts like "*I am a lucky person*" and "*I have friends who support me*". One participant reported that "*I called my friend as I was stressed and she listened to me [and] told me that it could all be sorted*" while another participant

noted positive thoughts following a “*heartfelt conversation with my roommate and [I] reflected on how many people in my life are willing to listen to my problems*”.

Connection. In addition to relying on relationships for support during difficult times, participants also emphasized how relationships facilitated a sense of belonging, connection, and closeness with other people. Participants described positive social interactions as triggering positive automatic thoughts. For example, one participant had the thought “*I am fun to be with*” while “*out for lunch with some friends and, as they often do, they reminded me how much they liked having me around*”. Another described reflecting on their personal qualities (i.e., a good sense of humour) after a series of positive interactions at a party:

“I was organizing a party for few friends and everyone wanted to talk with me, we were joking all the time, doing stupid and funny things. It felt good, people often tell me that my jokes are the best, but that day it was something different, better than usual.”

(M) Meaning

This category refers to being involved and connected to a larger purpose larger than oneself. Meaning is arguably the most difficult element of PERMA to categorize, partially because many of the most meaningful things in life relate to positive emotion, relationships, engagement, and accomplishment. Therefore, it was challenging to determine, with confidence, whether a given situation fit best in the “Meaning” category, especially given participants had limited room to explain situations. A significant proportion of coding discussions amongst the research team were focused on delineating stories about meaning from other categories. These discussions reached a conclusion once we could agree whether a particular situation was clearly referencing a deeper meaning or personal reflection. Ultimately, we coded 4 negative situations (3.2%) and 6 positive situations (4.8%) in the Meaning category, making it the least represented category in this study.

Situations triggering negative automatic thoughts. Both examples of meaning involved the thought “*my life’s not going the way I want it to*” because of a looming life decision:

- “*I was thinking big picture about my university course and upcoming year abroad, I feel the course I am on is a mistake its not my true passion but I feel as though I can’t stop, I have to complete it so as to not disappoint people in my life and so as to have not wasted all this money and time getting to this point, I don’t know if afterwards I will be able to redirect my life into the path I want.*”
- “*Just generally speaking I often wonder in what direction my life is going to lead and whether I’m going along the right path or not.*”

Situations triggering positive automatic thoughts. Among the positive situations that related to meaning involved deeper reflections on the role of relationships and accomplishment within one’s life. For example, one participant had the thought “*there are many people who care about me*” after “*having dinner with my boyfriend’s family, and we had some wonderful conversations where I felt included and cared for, as we discussed our future together*” While this situation clearly also fits under Relationships, we identified a level of self-reflection, purpose, and forward-looking optimism that we believed evidenced personal meaning. As an example of how meaning related to accomplishment, one participant thought “*I will be successful*” after reflecting while “*working on my masters degree. I really believe that I’m doing the right things with my life right now, I have good friends and family that supports me, I’m enrolled in different projects, I respect people and I’m respected and so I feel that I need to keep giving 100% in everything I do and my success will appear naturally.*” Once again, this situation could be categorized under Accomplishment, although we interpreted this level of detail and reflection to indicate there is personal meaning amongst these pursuits.

(A) Accomplishment

This category refers to well-being that comes from achievement and success. We categorized 47 situations related to negative thoughts (37.6%) and 30 situations related to positive thoughts (24.0%) as fitting under “Accomplishment”. Given the overlap between accomplishment and other domains, we separately coded whether situations involved school or work: 74 (59.2%) of negative situations and 54 (43.2%) of positive situations referenced school or work. The situations related to negative thoughts were often the inverse of situations for positive thoughts (e.g., failing a test versus passing a test).

Situations triggering negative automatic thoughts. These situations included various instances of failure and rejection in either the workplace or school and several participants noted negative thoughts related to finances.

Failure/rejection. A common theme that triggered negative automatic thoughts was failing an exam (e.g., “*I have failed the Med School Exam for the 3rd time*”) or being rejected from a job or university application (e.g., “*not being successful at a job interview yet again*”). Predictably, these situations led several participants to thoughts like “*I am a failure*”, “*I’m no good*,” or “*Why can’t I succeed?*” For example, one participant described their experience of being rejected by a university program:

“I found out that I didn't get accepted into this year's nursing program despite having a good GPA and high entrance exam scores. I'm an older, non-traditional student that has been trying to finish school for over a decade and for once I thought I was on a good path to do that. The fact that even though I qualified but wasn't accepted made me feel even more like a failure than I already did.”

Feelings of failure also emerged for participants during the day-to-day struggles with accomplishment in their studies or jobs. For instance, one participant (who, it must be emphasized, was **not** the author of this dissertation) noted how the thought *“I’m no good”* occurred while *“walking home after collecting data for my dissertation, under time pressure and after many consecutive hours of work.”* Likewise, other participants reported challenges from their bosses such as *“being scolded by boss”* or *“everyone else except myself being praised for good job”* as triggering negative thoughts.

Finances. Within the category of Accomplishment, many participants referenced financial difficulty as a trigger of negative automatic thoughts. These ranged from brief descriptions (e.g., *“lack of money”* or *“yesterday regarding my financial situation”*) to more specific financial worries, like planning for retirement (e.g., *“I am hoping to take phased retirement soon, but have discovered I will not receive as much pension as I had anticipated”*). One participant described how the thought *“I feel like I’m up against the world”* was triggered by the conflicting priorities and limitations of being a single parent:

“I have had a few bills come in and I’m working as many hours allowed and on benefits as a single parent. I feel bogged down with how I’m going to raise enough money to pay the bills and feel like every time I get my head above water something else crops up.”

Situations triggering positive automatic thoughts. In contrast to failure and rejection, participants described situations of success and acceptance, particularly in work and school settings. These stories were often the mirror image of the failure/rejection stories. Participants described passing exams (e.g., the thought *“today I’ve accomplished a lot”* being triggered by *“pass[ing] a difficult exam”*), getting accepted to university (e.g., the thought *“I will be successful”* being triggered by *“[getting] into Oxford Medical School”*), and praise at work:

“My manager had told me about a promotion he had put my name forward for. He told me that other managers also spoke highly of me and that I could expect to be offered the position.”

Descriptive statistics

Thought frequencies

Table 8 outlines the positive and negative thoughts selected by participants. While participants selected a range of thoughts from the ATQ and P-ATQ, the distribution was somewhat skewed, particularly for negative thoughts. For negative thoughts, 24 participants (19.2%) selected *“My life’s not going the way I want it to”* and 22 participants (17.6%) selected *“Something has to change”*.

Table 8. Study 3 frequencies of positive and negative thoughts as selected by participants

Negative automatic thought	# of cases (% of total)	Positive automatic thought	# of cases (% of total)
My life's not going the way I want it to	24 (19.2%)	I won't give up	16 (12.8%)
Something has to change	22 (17.6%)	There are many people who care about me	12 (9.6%)
I feel like I'm up against the world	9 (7.2%)	I have a good sense of humour	12 (9.6%)
Why can't I ever succeed?	6 (4.8%)	I will be successful	9 (7.2%)
There must be something wrong with me	6 (4.8%)	I am a lucky person	9 (7.2%)
No one understands me	5 (4.0%)	My life keeps getting better	6 (4.8%)
I wish I were somewhere else	5 (4.0%)	I have a good way with others	6 (4.8%)
I can't finish anything	5 (4.0%)	I am comfortable with life	6 (4.8%)
Nothing feels good anymore	4 (3.2%)	I have friends who support me	4 (3.2%)
My life is a mess	4 (3.2%)	I deserve the best in life	4 (3.2%)
I can't get started	4 (3.2%)	I am respected by my peers	4 (3.2%)
What's the matter with me?	3 (2.4%)	I am proud of my accomplishments	4 (3.2%)
I wish I were a better person	3 (2.4%)	I am in a great mood	4 (3.2%)
I can't get things together	3 (2.4%)	I am fun to be with	4 (3.2%)
I'm so disappointed in myself	3 (2.4%)	My future looks bright	3 (2.4%)
I'm a failure	3 (2.4%)	I take good care of myself	3 (2.4%)
What's wrong with me?	2 (1.6%)	I have many good qualities	3 (2.4%)
I can't stand this anymore	2 (1.6%)	I finish what I start	3 (2.4%)
I've let people down	2 (1.6%)	I am happy with the way I look	3 (2.4%)
I'm so weak	2 (1.6%)	There's nothing to worry about	2 (1.6%)
I'm no good	2 (1.6%)	Life is exciting	2 (1.6%)
My future is bleak	1 (0.8%)	I am so relaxed	2 (1.6%)
I wish I could just disappear	1 (0.8%)	Bad days are rare	1 (0.8%)
I don't think I can go on	1 (0.8%)	Today I've accomplished a lot	1 (0.8%)
I'm worthless	1 (0.8%)	I have many useful qualities	1 (0.8%)
I'm a loser	1 (0.8%)	My social life is terrific	1 (0.8%)
I'll never make it	1 (0.8%)		

Cues

Table 9 outlines the cues endorsed by participants as having triggered their positive and negative thoughts, respectively. The results suggest that participants identified both internal cues (e.g., feeling stressed; feeling happy) and external cues (e.g., failing to achieve a goal; getting positive feedback) as preceding their automatic thoughts. For negative thoughts, 44.1% of responses related to internal cues while 55.9% related to external cues. For positive thoughts, 34.8% of responses to internal cues while 65.1% related to external cues. Participants endorsed a range of cues triggering their automatic thoughts: our sample of 125 participants gave 596 responses for negative cues and 629 responses for positive cues. Table 10 outlines the number of cues selected by participants. Participants endorsed between 1 and 13 cues having ever triggered their chosen automatic thought ($M = 5$). A minority of participants reported that only one cue has ever triggered their selected automatic thought (19.2% for negative thoughts, 24.8% for positive thoughts).

Table 9. Study 3 cues endorsed by participants as having ever triggered automatic thought

Cues preceding negative thoughts				Cues preceding positive thoughts			
Internal cues	n (% of total)	External cues	n (% of total)	Internal cues	n (% of total)	External cues	n (% of total)
<i>I felt stressed</i>	55 (8.0%)	<i>I failed to achieve a goal</i>	56 (8.2%)	<i>I felt happy</i>	57 (8.7%)	<i>Someone gave me positive feedback</i>	58 (8.9%)
<i>I felt sad</i>	45 (6.6%)	<i>I made a mistake</i>	42 (6.1%)	<i>I was smiling</i>	52 (8.0%)	<i>I performed well</i>	53 (8.1%)
<i>I felt hopeless</i>	33 (4.8%)	<i>I did something that isn't up to my standards</i>	38 (5.5%)	<i>I felt energetic</i>	39 (6.0%)	<i>I succeeded at achieving a goal</i>	50 (7.6%)
<i>I felt tense</i>	30 (4.4%)	<i>Someone gave me negative feedback</i>	36 (5.3%)	<i>I got a rush of energy</i>	23 (3.5%)	<i>I got complimented by someone close to me</i>	48 (7.3%)
<i>I felt tired</i>	28 (4.1%)	<i>I entered a particular setting (e.g., workplace or classroom)</i>	32 (4.7%)	<i>I felt surprised</i>	17 (2.6%)	<i>I did something that I considered up to my standards</i>	40 (6.1%)
<i>I was rejected</i>	24 (3.5%)	<i>I was in a situation where my performance was being evaluated</i>	28 (4.1%)	<i>My heart was beating fast</i>	12 (1.8%)	<i>I suspected someone liked me or enjoyed my company</i>	35 (5.4%)
<i>I felt on edge</i>	20 (2.9%)	<i>I was criticized by someone close to me</i>	24 (3.5%)	<i>I got butterflies in my stomach</i>	11 (1.7%)	<i>Someone paid attention to me</i>	34 (5.2%)
<i>My heart was beating fast</i>	13 (1.9%)	<i>I was not invited to/included in something</i>	22 (3.2%)	<i>I experienced a specific sensation in my body</i>	5 (0.8%)	<i>I got invited or was included</i>	28 (4.3%)
<i>I started sweating</i>	9 (1.3%)	<i>I suspected someone was upset with me</i>	22 (3.2%)	<i>I started sweating</i>	3 (0.5%)	<i>I entered a particular setting (e.g., workplace or classroom)</i>	25 (3.8%)
<i>I experienced a specific sensation in my body</i>	6 (0.9%)	<i>I was being ignored</i>	20 (2.9%)			<i>I was in a situation where my performance was being evaluated</i>	20 (3.1%)
		<i>I saw a particular person (e.g., a former friend or someone I find attractive)</i>	13 (1.9%)			<i>Someone accepted my invitation</i>	19 (2.9%)
Total negative internal	263 (44.1%)	Total negative external	333 (55.9%)	Total positive internal	219 (34.8%)	Total positive external	410 (65.1%)
Total negative cues	n = 596			Total positive cues	n = 629		

Table 10. Number of cues participants endorsed preceding automatic thoughts.

Cues	Negative automatic thought	Positive automatic thought
Number of cues	Ever (n, %)	Ever (n, %)
1	24 (19.2%)	31 (24.8%)
2	17 (13.6%)	13 (10.4%)
3	7 (5.6%)	13 (10.4%)
4	13 (10.4%)	5 (4.0%)
5	11 (8.8%)	7 (5.6%)
6	9 (7.2%)	11 (8.8%)
7	7 (5.6%)	10 (8.0%)
8	7 (5.6%)	7 (5.6%)
9	7 (5.6%)	7 (5.6%)
10	4 (3.2%)	3 (2.4%)
11	4 (3.2%)	7 (5.6%)
12	2 (1.6%)	2 (1.6%)
13	13 (10.4%)	9 (7.2%)
Median # of cues	5	5

Correlations

Table 11 describes the correlation between cued automaticity, automaticity without a concrete cue, and thought frequency. Cued and automaticity without a concrete cue were strongly correlated for both positive thoughts $r = 0.81, p < .001$ and negative thoughts $r = .85, p < .001$. These results provide a preliminary estimate that self-reported cued and automaticity without a concrete cue are highly correlated for both positive and negative automatic thoughts. Negative thought frequency was moderately correlated with negative cued automaticity $r = 0.28, p < .01$ and negative automaticity without a concrete cue, $r = 0.35, p < .001$; positive thought frequency was not statistically significantly correlated with positive cued automaticity $r = 0.17, p = 0.06$. Positive thought frequency was significantly correlated with while positive automaticity without a concrete cue, $r = 0.21, p = .02$. These moderate correlations suggest that self-reported automaticity is conceptually distinct from, though related to, the frequency of thoughts.

Table 11. Study 3 correlation table.

	Negative thought (cued automaticity)	Negative thought (uncued automaticity)	Negative thought frequency	Positive thought (cued automaticity)	Positive thought (uncued automaticity)	Positive thought frequency
Negative thought (cued automaticity)	1.00					
Negative thought (uncued automaticity)	0.85**	1.00				
Negative thought frequency	0.28**	0.35**	1.00			
Positive thought (cued automaticity)	0.21*	0.27**	-0.05	1.00		
Positive thought (uncued automaticity)	0.19*	0.30**	-0.02	0.81**	1.00	
Positive thought frequency	-0.04	0.01	0.05	0.17	0.21*	1.00

* $p < .05$ ** $p < .01$

Discussion

The current mixed-methods study explored the cues that precede automatic thoughts. The data generated by this study will serve as a foundation for future work on the role of cues when conceptualizing automatic thinking within a mental habit framework. This study addressed four research questions:

- RQ1: Are there any notable themes in the qualitative data that might be useful for researchers and clinicians?

- RQ2: how many cues do participants report having ever triggered the same automatic thought?
- RQ3: Do participants endorse both internal and external cues as having preceded automatic thinking?
- RQ4: what is the relationship between *cued-automaticity* (automaticity in a given context) versus *automaticity without a concrete cue* (automaticity in general)?

RQ1: Are there any notable themes in the qualitative data that might be useful for researchers and clinicians?

Using thematic analysis, we coded participants' open-ended responses about what triggered their positive and negative automatic thoughts using a framework popular in positive psychology research—PERMA (Positive Emotion, Engagement, Relationships, Meaning, Accomplishment; Seligman, 2018). We coded 92.0% of negative situations and 96.8% of positive situations using the PERMA framework, demonstrating that most preceding events could be classified under this framework. Participants provided relevant examples of PERMA situations preceding automatic thoughts, which added rich, concrete descriptions illustrating what PERMA looks like in daily life. The finding that the vast majority of situations fit under this framework may be helpful to researchers by suggesting which types of cues might be most salient to target in habit interventions related to mental health. The finding that the PERMA framework was equally helpful for classifying the antecedents that precede positive and negative automatic thoughts is also an opportunity to bridge positive and clinical psychology.

RQ2: how many cues do participants report having ever triggered the same automatic thought?

We found that participants endorsed a range of cues that have previously triggered the same automatic thought. Notably, participants endorsed a median of 5 different cues triggering the same thought in the past. This finding has several implications for both clinicians and researchers seeking to change mental habits. Clinically, mental health professionals could ask clients whether a range of situations trigger the same automatic thought when completing Thought Records. For habit researchers, this finding suggests that mental habits are rarely isolated to a single cue-response relationship. Therefore, habit researchers ought to consider the *range* of cues related to habitual thinking. Habits are often conceptualized as being a cue-dependent automatic response (e.g., Gardner, 2015; Wood & Neal, 2007; Wood & Rünger, 2016); however, the finding that multiple cues precede the same automatic thoughts suggests that there may be several cue-responses relationships for the same automatic thought. This finding is also relevant for researchers studying an array of health behaviours. For example, implementation intention exercises (Gollwitzer, 1999) are a common strategy for health behaviour habit formation involve proactively creating an if-then statement for a desired cue-response relationship (e.g., eating a piece of fruit with breakfast). Habit interventions could build on this technique by identifying the range of cues that trigger health behaviours, rather than a single cue.

RQ3: Do participants endorse both internal and external cues as having preceded automatic thinking?

In addition to reporting multiple cues for the same thought, participants also endorsed a diverse mix of internal cues (e.g., emotions and bodily sensations) and external cues (e.g., specific situations). This finding further suggests that mental habit frameworks ought to be more complex than a single-cue, single automatic thought, since participants reported that multiple diverse cues precede automatic thoughts. This finding is consistent with the CBT model, which purports that

internal and external cues are related: the relationship between situations, thoughts, behaviours, and emotions is complex and overlapping (Greenberger & Padesky, 2016). This finding also builds on Watkins & Nolen-Hoeksema's (2014) habitual rumination framework, which proposed rumination as triggered by sad mood. In light of the findings that participants reported both external situations and internal sensations as preceding automatic thoughts, this framework could expand to include automatic as a habitual response to both external cues (e.g., professional or interpersonal rejection) alongside internal cues (e.g., sad affect).

RQ4: what is the relationship between *cued-automaticity* (automaticity in a given context) versus *automaticity without a concrete cue* (automaticity in general)?

The correlational results suggest that there is a strong relationship between the self-reported automaticity of a specific cue-response relationship and automaticity of the thought in general. For example, this finding suggests that the automaticity of the thought “*My life’s not going the way I want it to*” in a specific context (e.g., getting fired from a job) would be similar in across contexts in which it is triggered. This finding is admittedly difficult to interpret, primarily due to a lack of conceptual clarity about the difference between cued and automaticity without a concrete cue in the existing habit literature. Creating this research survey forced us to reckon with the question: what does it mean for a thought to be automatic *in general*? Given the exploratory nature of this study, we do not have a concrete answer. However, it should be noted that the mental habit literature has exclusively measure automaticity without a specific cue-response relationship (e.g., Verplanken et al., 2007), which is a more nebulous concept than the automaticity of specific cue-response relationship, which we argue is more intuitive to grasp. It would be beneficial for habit researchers to investigate whether automaticity is most useful as a construct in a specific cue-response relationship in future studies.

Limitations and future directions

This exploratory study has several limitations to consider when interpreting its results. There were many coding challenges due to the inherent ambiguity of the situations participants presented. Notably, many reported situations overlapped between the domains in PERMA. We did our best to mitigate the subjectivity and bias presented by the overlapping categories by using an independent coder and using team discussions to reach consensus. While this process cannot be completely devoid of subjectivity and bias, the team discussions enriched our understanding of how the PERMA model could be applied in the context automatic thinking. The finding that the PERMA framework as a collective captured over 90% of the examples speaks to the utility of this framework, even if there was some ambiguity about whether each domain was proportionately represented in our analysis. Furthermore, one intention of this study was to capture concrete examples of cues from participants, which was unhindered by our coding tabulations.

Another coding challenge was identifying stories about meaning. We only identified a handful of stories that were best categorized by the Meaning domain. This result should not be interpreted as suggesting that meaning is not related to automatic thoughts. Instead, it is more likely that meaning is harder to identify from a short text description, since it requires participants to elaborate on the impact of the situation. For example, many participants described their careers, their families, and their close friends: these topics were undoubtedly meaningful to participants, even if they were best categorized by the other PERMA domains. Future research could further investigate participant reflections on the antecedents of their automatic thoughts to determine whether these situations have a deeper meaning.

Another limitation relates to our study design, which was intentionally exploratory. Instead of an experimental design, we opted for a mixed-methods approach. As a result, we relied on

participants' descriptions about what "triggered" their automatic thoughts, rather than a controlled experiment to determine the causal impact of specific triggers. Mood induction is one possible paradigm for this type of experimental study (e.g., Scherrer, Dobson, & Quigley, 2014). Given that participants chose many cues having ever triggered their thoughts, we were unable to tease apart whether participants attributed the thought to being triggered by an internal or external cue. As another strategy to mitigate the bias of retrospective self-report, future research could also use ecological momentary assessment to more accurately and precisely identify antecedents to automatic thoughts in real-time (e.g., Wenze et al., 2007). Such research could help disentangle the role of internal versus external events as triggering habitual thinking. Finally, future research could also consider investigating the role of cues in triggering mental habits in clinical populations, which was beyond the scope of this exploratory study. These future research directions would build on this preliminary study, which attempted to address a gap in the habit literature to better understand the cues that precede automatic thoughts.

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Chapter 5 - General Discussion

Think back to the thought exercise that started this dissertation: what did you do this morning? Everyone has a slightly different morning routine, often defined by cue-dependent automatic responses like “brushing my teeth after I get out of the shower”. These behaviours set the stage for your day. They may be beneficial (like brushing your teeth) or harmful (like smoking a cigarette). Many of these daily behaviours become lifelong habits, which incrementally shape the course of our lives and our well-being. In this dissertation, I explored the idea that thoughts can be habits, too. If thoughts can be framed as habits, we can explore similar thought exercises.

Consider the last time you were sad. What went through your head? Did you think “I’m a failure” or “there’s something wrong with me?” How about the thought “I should call my partner” or “Maybe I should exercise to improve my mood”? How automatically did these thoughts pop into your head? How might the default automatic reaction to negative thoughts put you at risk for experiencing depressive symptoms? In this dissertation, I have argued that these questions are worth asking and, through the three presented studies, I explored new ways to measure and conceptualize the automaticity of positive and negative thinking. I believe that the findings of these studies bring together existing research in evidence-based psychotherapy, habit formation, and mental health, to offer a fresh way to conceptualize existing ideas. Offering a new way of thinking about the thoughts that characterize mental health will benefit clinicians and researchers seeking to better understand why human beings suffer and how to help them effectively. Unfortunately, not everyone benefits from evidence-based psychotherapy (e.g., Glenn et al., 2013; Hofmann et al., 2012). One of the biggest limitations of EBPTs is that we do not fully understand the mechanisms of change that underlie them. In this dissertation, I examined one particularly thought

process that is theoretically linked to changes in CBT, automatic thoughts, and explored their connection to a related concept, mental habits.

This dissertation had four objectives:

1. Systematically investigate the existing research on mental habits and describe the current research landscape (Study 1; Chapter 2)
2. Develop a new measure of mental habits that integrates insights from research on habits, automatic thoughts, and positive thinking (Study 2; Chapter 3)
3. Expand on existing mental habit research by exploring the cues that precede positive and negative mental habits (Study 3; Chapter 4)
4. Propose a conceptual distinction between habits and related constructs based on this program of research and discuss their relevance for clinicians and researchers (General Discussion)

In this section, I summarize the findings of Studies 1, 2, and 3 and discuss whether they have accomplished their corresponding dissertation objectives. Then, I expand on how the findings in this dissertation might illuminate our overall understanding of the relationship between mental habits and automatic thoughts as useful conceptual categories related to mental health.

Objective 1: Systematically investigate the existing research on mental habits and describe the current research landscape

In Study 1, we used a scoping review methodology to survey the broad literature related to habitual thinking processes related to mental health. Of the 2817 articles we screened, 19 met our inclusion criteria and we discovered 1 additional article through a manual search of reference lists. These 20 articles contained 24 separate studies and 4 commentaries on the role of habitual processes in thinking related to mental health (see Table 1 for the features of each study). We

found that existing mental habit research consistently referenced automaticity as a defining feature of habit (80% of articles). Researchers also identified repetition (55% of articles) and the distinction between habit as a thinking process (50% of articles), while only 20% included cues as a defining feature of mental habits. We found that the majority of research has used cross-sectional, correlational research designs (70.8%) with university student samples (75%) measuring a range of psychological constructs: negative self-thinking, worry, self-critical thinking, self-stigma, negative body image thinking, and emotion regulation.

Importantly, Study 1 found several meaningful gaps in the habit literature. Most notably, we found no studies that 1) investigated the role of positive mental habits in well-being and 2) integrated the concept of automatic thinking, which is a foundational concept in CBT, with the concept of mental habits. We addressed these gaps in the literature in Study 2. This scoping review was a preliminary attempt to summarize the study of mental habits, which was a poorly defined area of research. Now that these studies have been organized within this scoping review, future researchers could build on this scoping review by conducting a systematic review and meta-analysis of new studies in this area to identify themes within this field of study with more rigour.

Objective 2: Develop a new measure of mental habits that integrates insights from research on habits, automatic thoughts, and positive thinking

Study 2 developed two new measures of mental habits—the Positive Thought Automaticity Index (PTAI) and the Negative Thought Automaticity Index (NTAI). These measures addressed the shortcomings of existing mental habit and automatic thought questionnaires. The Automatic Thoughts Questionnaire (Hollon & Kendall, 1980) contains 30 self-statements common in depression (strong thought content) but only measures the frequency of these thoughts (limited thought process). The structure of the Positive Automatic Thought Questionnaire (P-ATQ; Ingram

& Wisnicki, 1988) is similar. In other words, these automatic thought questionnaires do not measure automaticity, but rather the frequency of common depressive thoughts. In contrast, the Habit Index of Negative Thinking (HINT; Verplanken et al. 2007) measures the single thought “thinking negative about myself” (limited thought process) followed by 12 questions about the automaticity, frequency, and relation to self-identity (strong thought process). The NTAI and PTAI sought to integrate the strengths of these questionnaires to measure the content and process of automatic thinking with more precision. Integrating the strengths of these questionnaires also allowed us to test specific hypotheses

The results of Study 2, which were conducted with participants in the United Kingdom and Canada, demonstrated that the NTAI and PTAI possessed favourable psychometric properties in terms of predictive and concurrent validity, internal consistency reliability, and test re-test reliability. Given the structure of the NTAI and PTAI, we were able to directly compare the automaticity and frequency (different thought processes) of the same thoughts (same thought content). We found that the automaticity of positive and negative thinking predicted variance in depression and satisfaction with life over and above thought frequency, using hierarchical regression. This finding suggests that automaticity is a distinct thought process that predicts unique aspects of well-being outcomes. We also explored one possible mechanism through which automaticity relates to well-being differently than frequency: we found that the relationship between thought frequency and believing a thought is true was partially mediated by the automaticity of positive/negative thinking.

Future research could build on the results of Study 2 in several ways. Mental health researchers might consider applying the distinction between thought frequency and automaticity to the study of specific disorders (e.g., obsessive-compulsive disorder). For example, researchers

could examine whether the automaticity of intrusive thoughts in OCD might predict symptom severity or treatment outcomes compared to the frequency of these thoughts. Psychotherapy researchers could also consider including the automaticity of thoughts, and the NTAI and PTAI specifically, as outcome measures in clinical trials. In these trials, automaticity could be examined as a mechanism of change in psychotherapy. For example, does a change in the automaticity of thoughts precede other symptom changes (e.g., depressive symptoms)?

Objective 3: Expand on existing mental habit research by exploring the cues that precede positive and negative mental habits

Study 3 built on Studies 1 and 2 by investigating an aspect of the habit model that has been relatively unexamined in the literature—the cues that precede automatic thoughts. This study used a mixed-methods approach to elicit real-world examples of situations that trigger positive and negative thoughts. We found that almost all of these self-reported situations (92.0% of negative situations and 96.8% of positive situations) could be categorized using the PERMA framework (Seligman, 2018) Positive Emotion, Engagement, Relationships, Meaning, and Accomplishment. These situations provided rich examples of what types of cues trigger automatic thoughts in people's lives. We also found that participants endorsed a substantial number of internal and external cues: negative thoughts (44.1% internal, 55.9% external) and positive thoughts (34.8% internal, 65.1% external). Moreover, participants reported that they rarely experienced just a single cue for their chosen thoughts: they reported a median of 5 cues having triggered positive and negative automatic thoughts in the past.

Future research could build on Study 3 by using other research methods to examine the cues that precede automatic thoughts. Researchers could use ecological momentary assessment methods to ask participants to report the situations they are in during the day (e.g., attending a

lecture, being at work, spending time with family) and which automatic thoughts they endorse experiencing at that moment. This methodology would limit the bias of retrospective questionnaires and give real-world, real-time, information about what people think during the day and how it relates to their environment. Researchers could also consider using experimental methods to directly manipulate the cues that may precede positive or negative thoughts. For example, researchers could simulate academic failure by randomly assigning positive or negative feedback on a quiz (e.g., participants are randomized to receive a “bad” grade or a “good” grade) and assessing which automatic thoughts this situation may trigger. Researchers could also assess each participant’s attribution about what triggered the automatic thought. Researchers could also use experimental methods to better understand the relationship between internal and external cues. One possible study could ask participants to write about a time they felt sad (to evoke sad emotions) and examine whether such a paradigm triggers negative automatic thoughts. These experimental paradigms would allow researchers to better understand the causal chain of how cues trigger automatic thoughts.

Taking these studies together, the first three objectives of this dissertation have been accomplished. I will now focus on accomplishing Objective 4 by discussing the implications of this program of research for the study of mental habits, automatic thinking, and mental health.

What is the difference between automatic thoughts and mental habits?

As the scoping review in Study 1 highlighted, mental habits and automatic thoughts are conceptually similar, but rarely integrated in the literature. In Study 2, we argued that existing measures of thought automaticity are inadequate given they either do not measure automaticity directly (e.g., the Automatic Thoughts Questionnaire; Hollon & Kendall, 1980) or are imprecise in which thoughts they measure (e.g., the Habit Index of Negative Thinking; Verplanken et al.

2007). We therefore created the NTAI and PTAI to integrate these measures of automatic thinking and mental habit. However, a question emerges now that these measures have been integrated and no longer exist in separate areas of research: what is the difference between automatic thoughts and mental habits? Based on the results of the three studies presented in this dissertation, I offer the following distinction.

Automatic thoughts and mental habits are both theoretically defined by the same thought process—automaticity. I propose that mental habits are a specific subtype of automatic thinking: all mental habits are automatic thoughts, but not all automatic thoughts are mental habits. While automatic thoughts are defined by automaticity, mental habits are defined by several other features that relate to how they are acquired, maintained, and changed. For example, habits become automatic through repetition in stable contexts (e.g., Gardner, Rebar, & Lally, 2022; Lally, Van Jaarsveld, Potts, & Wardle, 2010; Wood & Rünger, 2016). Of the articles reviewed in Study 1, 80% identified automaticity as a defining feature of habit. Despite the prominent role of automaticity, many articles identified additional features of habit, including that they are formed through repetition (55% of articles) in stable contexts with specific cues (20% of articles).

These findings are consistent with features of behavioural habits identified in the existing research literature (e.g., Gardner, 2015; Wood & Rünger, 2016). Recently, Harvey and colleagues (2022) proposed several specific defining features of habits as they relate to mental health and evidenced-based psychotherapy. Their habit formation model explicitly proposes that habits form through repeating a behaviour consistently with a stable context/cue, leading to cue-dependent automatic responses. This dissertation sought to build on this model by exploring the idea that thoughts may become habitual in a similar fashion. Figure 3 is an adaptation of the Harvey et al. (2022) model for behavioural habits by substituting thoughts for behaviours.

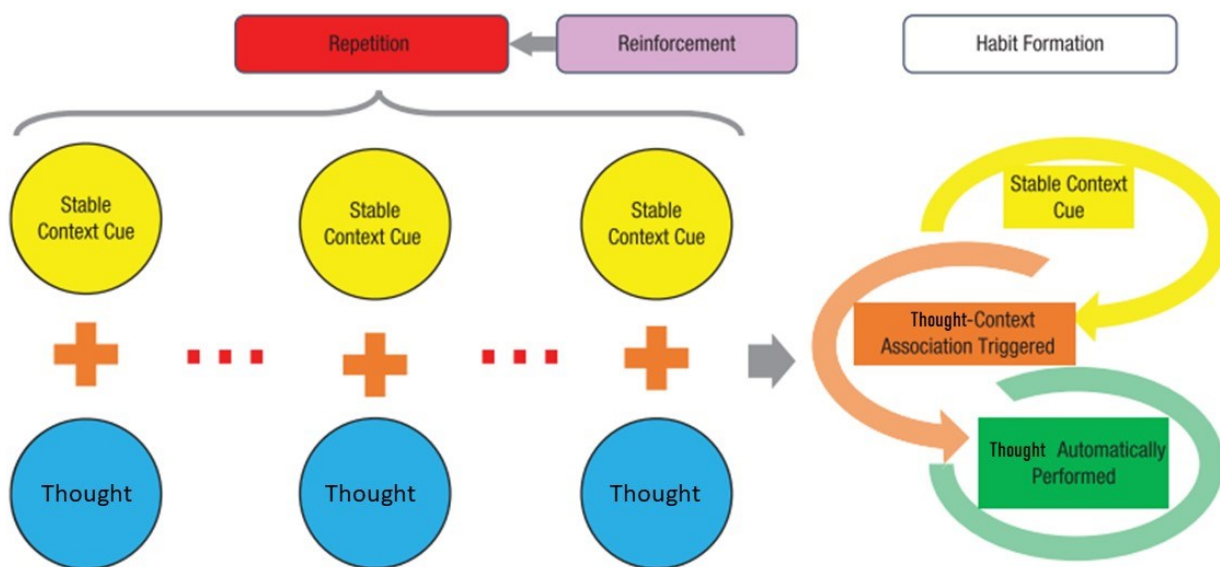


Figure 3. *A model of mental habit formation model adapted from Harvey et al. (2022)*

This model of mental habits is highly specific: it suggests a mechanism through which mental habits are acquired, maintained, and ultimately changed. I propose, therefore, that “mental habits” should be understood as a subsection of the overarching category of “automatic thinking” for thoughts that can be best understood using the model presented above. In contrast, automatic thoughts are most simply defined as thinking that possesses the features of automaticity (e.g., involuntary, effortless, and sudden). This flexible definition allows for the possibility that not all automatic thoughts are mental habits. For example, an individual with obsessive-compulsive disorder may experience an “intrusive thought” that automatically pops into their head, without a specific cue. Alternatively, a depressed individual may have the core belief “I am worthless” that automatically pops up at various times throughout the day, seemingly at random.

This model implies that *some* automatic thoughts can be understood as mental habits but does not imply that *all* thoughts are best characterized in this way. Therefore, there are no theoretical pretenses about whether an automatic thought is tied specifically to a cue, or how the automaticity changes over time, whereas a mental habit is, by definition, cue-dependent.

Conversely, the mental habit model implies a mechanism of change in psychotherapy involving a cue-response relationship that has been described in the behavioural habit literature. In this framework, automaticity is a necessary but not sufficient condition for a thought to be a mental habit.

As a result, I consider the NTAI and PTAI presented in these studies as measures of thought automaticity, not mental habit, since the content of these measures examines positive and negative self-statements, not where and when these statements arise. However, the NTAI and PTAI could be adapted to measure mental habits if they included a cue prior to each content item. For example, the content item “Thinking ‘I’m worthless’ is something that pops into my mind...” is a measure of automatic thinking, while the item “Thinking ‘I’m worthless’ (thought) after I make a mistake at work (cue) is something that pops into my mind...” would be a measure of mental habit.

There are several clinical and research implications of this mental habit model. For clinicians, this model formalizes the ideas that are often presented to clients in CBT. Burns’ (1980) referenced habits 52 times in his best-selling book “Feeling Good”; Beck (1963) emphasized the importance of automaticity as characteristic feature of depressive thinking in his foundational work formulating CBT; contemporary CBT treatment manuals emphasize the role of generating alternative, balanced thoughts in response to stable contexts that previously elicited negative thoughts, with the premise that these new thoughts will become automatic with practice (Beck, 2021; Greenberger & Padesky, 2016). This model is also consistent with inhibitory learning models, which propose that psychiatric symptom reduction occurs through corrective learning (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). Clinicians may use the adapted Harvey et al. (2022) model as a way of showing clients how forming new, balanced thoughts, may become more automatic through practicing techniques like the Thought Record (Beck, 2021).

For researchers, the proposition that mental habits are a subset of automatic thoughts may be a useful way to begin connecting the many disparate thinking patterns identified in Study 1. In addition to offering a connection between automatic thoughts and mental habits, future research could examine whether other constructs like repetitive negative thinking (Ehring & Watkins, 2008), preservative thinking (Ehring et al., 2011), rumination (Watkins & Nolen-Hoeksema, 2014), and worry (Verplanken & Fisher, 2014). The adapted Harvey et al. (2022) model presented above is designed to be a tentative way to test hypotheses about how some of these constructs might be consolidated. Future research is needed to understand the nuances of how different types of thinking fit, or do not, in this model and whether improvements can be made to better capture the process of mental habit formation.

Conclusion

It is a truism that what we think impacts what we do and how we feel. In this dissertation, I explored the idea that our thoughts can be just as habitual as our behaviours and that this reframe has the potential to improve our understanding of well-being. I have surveyed the existing mental habit research and identified gaps in the literature (Study 1) and addressed some of those gaps in Studies 2 and 3. My hope is that this program of research can generate novel research questions about the thinking processes that underlie mental health. More research on mental habits has the potential to further formalize the techniques clinicians use daily to treat problems like mood disorders, anxiety disorders, and substance use. Evidenced-based psychotherapies do not always work for everyone and the more that researchers and clinicians reframe psychological problems in new ways, the more we might help people who are struggling. By continuing to study the science of habit formation, researchers can uncover how forming new, positive thoughts, may help us break the chains of negative mental habit that characterize suffering.

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Appendix A: Study 1 Scoping review search terms and PRISMA checklist

PSYCINFO and MEDLINE Search		
#	MENTAL HABITS	Results
1	(habit* adj3 (mental or cognit*)).ti,ab	1019
2	(habit* adj3 (think* or thought*)).ti,ab	736
3	(automatic adj3 (think* or thought*)).ti,ab	1296
4	(habit* adj3 worr*).ti,ab	41
5	(habit* adj3 rumin*).ti,ab	46
6	habit index.ti,ab,tm	201
7	((repetitive* or perserverative* or frequent* or recurrent*) adj3 (think* or thought*)).ti,ab.	2277
8	Perseverative Thinking Questionnaire.ti,ab,tm.	88
9	Automatic Thoughts Questionnaire.ti,ab,tm.	607
10	1-9 (OR)	5769
11	English language only	244
12	English language only + human (s)	4529
13	English language only + human + peer-review	3689
14	Remove duplicates	2927
15	habituat*.ti,ab.	21206
16	habitat*.ti,ab	60694
17	14 NOT (15 or 16)	2838
18	Covidence remove duplicates	2817

Supplemental Table. PRISMA-ScR Checklist (Tricco et al., 2018)				
Section	Item	Description	Page number(s)	Comment
Title	1	Identify the report as a scoping review.	N/A	Done
Abstract				
Structured Summary	2	Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	p.1	Done.
Introduction				
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	p.7-8	Done
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	p.8	Done
Methods				
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	N/A	Not registered.

Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale	p.9	Done.
Information sources	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed	p.8	Done.
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated	N/A (Supplemental material)	Done, see supplemental material
Selection of sources of evidence	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review	p.9	Done
Data charting process	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	p.10	Done
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made	N/A (Search items in supplemental material)	Done, see supplemental material

Critical appraisal of individual sources of evidence	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate)	N/A	Not done.
Summary measures	13	Not applicable for scoping reviews.	N/A	N/A
Synthesis of results	14	Describe the methods of handling and summarizing the data that were charted	p.10-11	Done
Risk of bias across studies	15	Not applicable for scoping reviews.	N/A	N/A
Additional analyses	16	Not applicable for scoping reviews	N/A	N/A
Results				
Selection of sources of evidence	17	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	p.11 and Figure 1	Done.
Characteristics of sources of evidence	18	For each source of evidence, present characteristics for which data were charted and provide the citations	p.11-18	Done.
Critical appraisal within sources of evidence	19	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A	Not done.
Results of individual sources of evidence	20	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives	p.11-18 (see also Tables 1, 2, and 3)	Done.
Synthesis of results	21	Summarize and/or present the charting results as they relate to the review questions and objectives.	p.11-18	Done.

Risk of bias across studies	22	Not applicable for scoping reviews	N/A	N/A
Additional analyses	23	Not applicable for scoping reviews	N/A	N/A
Discussion				
Summary of evidence	24	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	p.19-24	Done.
Limitations	25	Discuss the limitations of the scoping review process	p.24-25	Done.
Conclusions	26	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	p.26	Done.
Funding	27	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	p.26	Done.

Appendix B: Study 2b Questionnaire

How do my thoughts affect how I'm feeling? An exploratory study of automatic thinking.

Description: In this study, you will answer a few questions about your thoughts and your overall well-being by completing an online questionnaire. The questionnaire should take you between 45-60 minutes. You will have the option to complete a shorter version of the questionnaire 3 months from now (for the chance to win an Amazon gift card!). You will be asked about some of the positive and negative thoughts that you typically have in addition to questions about your well-being. The goal of this study is to further investigate how our thoughts influence how we feel. The results of this study will inform how we help people improve their mental health.

Section 1 – Demographic questions

Q1. Please indicate your gender:

Male | Female | You don't have an option that applies to me. I identify as (please specify)

Q2. What is your age?

Q3. What is your ethnicity?

Q4. How what year of study are you in:

Q5. What is your program of study?

Q6. What language did you speak growing up?

English, French, Other (please describe)

Q7. What language do you study in?

English, French, Other (please describe)

Section 2 – Negative Automatic Thoughts

Listed below are a variety of thoughts that pop into people's heads. Please read each thought carefully and answer the following questions.

Q1. Thought: "I'm so disappointed with myself"

Q1a. Thinking "I'm so disappointed with myself" is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q1b. Thinking "I'm so disappointed with myself" is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q1c. Thinking "I'm so disappointed with myself" is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q1e. When I think "I'm so disappointed with myself", I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q1f. How frequently, if at all, does the thought "I'm so disappointed with myself" occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q2. Thought: "There is something wrong with me"

Q2a. Thinking "There is something wrong with me" is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q2b. Thinking "There is something wrong with me" is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q2c. Thinking “There is something wrong with me” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q2e. When I think “There is something wrong with me”, I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q2f. How frequently, if at all, does the thought “There is something wrong with me” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q3. Thought: “I hate myself”

Q3a. Thinking “I hate myself” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q3b. Thinking “I hate myself” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q3c. Thinking “I hate myself” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q3e. When I think “I hate myself I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q3f. How frequently, if at all, does the thought “I hate myself” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q4. Thought: “I’m a failure”

Q4a. Thinking “I’m a failure” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q4b. Thinking “I’m a failure” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q4c. Thinking “I’m a failure” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q4e. When I think “I’m a failure I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q4f. How frequently, if at all, does the thought “I’m a failure” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q5. Thought: “I’m worthless”

Q5a. Thinking “I’m worthless” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5b. Thinking “I’m worthless” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5c. Thinking “I’m worthless” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5e. When I think “I’m worthless” I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5f. How frequently, if at all, does the thought “I’m worthless” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q5. Thought: “It’s just not worth it”

Q5a. Thinking “It’s just not worth it” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5b. Thinking “It’s just not worth it” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5c. Thinking “It’s just not worth it” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5e. When I think “It’s just not worth it” I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5f. How frequently, if at all, does the thought “It’s just not worth it” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Section 3 – Positive Automatic Thoughts

Listed below are a variety of thoughts that pop into people’s heads. Please reach thought carefully and answer the following questions.

Q1. Thought: “There are many people who care about me”

Q1a. Thinking “There are many people who care about me” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q1b. Thinking “There are many people who care about me” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q1c. Thinking “There are many people who care about me” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q1e. When I think “There are many people who care about me”, I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q1f. How frequently, if at all, does the thought “There are many people who care about me” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q2. Thought: “I am a lucky person”

Q2a. Thinking “I am a lucky person” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q2b. Thinking “I am a lucky person” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q2c. Thinking “I am a lucky person” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q2e. When I think “I am a lucky person”, I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q2f. How frequently, if at all, does the thought “I am a lucky person” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q3. Thought: “I have many good qualities”

Q3a. Thinking “I have many good qualities” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q3b. Thinking “I have many good qualities” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q3c. Thinking “I have many good qualities” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q3e. When I think “I have many good qualities” I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q3f. How frequently, if at all, does the thought “I have many good qualities” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q4. Thought: “I take good care of myself”

Q4a. Thinking “I take good care of myself” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q4b. Thinking “I take good care of myself” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q4c. Thinking “I take good care of myself” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q4e. When I think “I take good care of myself” I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q4f. How frequently, if at all, does the thought “I take good care of myself” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q5. Thought: “I’m fun to be with”

Q5a. Thinking “I’m fun to be with” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5b. Thinking “I’m fun to be with” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5c. Thinking “I’m fun to be with” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5e. When I think “I’m fun to be with” I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5f. How frequently, if at all, does the thought “I’m fun to be with” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Q5. Thought: “My future looks bright”

Q5a. Thinking “My future looks bright” is something... that pops into my mind automatically

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5b. Thinking “My future looks bright” is something... that pops into my mind without my control

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5c. Thinking “My future looks bright” is something... that pops into my mind instantly

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5e. When I think “My future looks bright” I believe this thought to be true

Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

Q5f. How frequently, if at all, does the thought “My future looks bright” occur to you in a typical week?

Not at all | Sometimes | Moderately Often | Often | All the time

Section 4 – Mental Health Questionnaires

The Center for Epidemiologic Studies Depression Scale

Below is a list of ways that you might have felt or behaved. Please answer how often you have felt this way during the past week.

Q1. I was bothered by things that usually don’t bother me.

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q2. I did not feel like eating; my appetite was poor

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q3. I feel that I could not shake off the blues even with help from my family and friends

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q4. I felt that I was just as good as other people

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q5. I had trouble keeping my mind on what I was doing

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q6. I felt depressed

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q7. I felt that everything I did was an effort

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q8. I felt hopeful about the future

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q9. I thought my life had been a failure

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q10. I felt fearful

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q11. My sleep was restless

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q12. I was happy

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q13. I talked less than usual

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q14. I felt lonely

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q15. People were unfriendly

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q16. I enjoyed life

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q17. I had crying spells

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q18. I felt sad

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q19. I felt that people dislike me

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Q20. I could not get “going”

Rarely or none of the time (less than 1 day) | Sometimes or a little of the time (1-2 days) | Occasionally or a moderate amount of time (3-4 days) | Most or all of the time (5-7 days)

Satisfaction with Life Scale

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

Q1. In most ways my life is close to my ideal.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

Q2. The conditions of my life are excellent.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

Q3. I am satisfied with my life.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

Q4. So far I have gotten the important things I want in life.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

Q5. If I could live my life over, I would change almost nothing. *Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree*

Habit Index of Negative Thinking

Instruction: “Occasionally we think about ourselves. Such thoughts may be positive, but may also be negative. In this study we are interested in negative thoughts you may have about your- self. Please indicate how much you agree or disagree with the following statements.”

Thinking negatively about myself is something...

1. I do frequently.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

2. I do automatically.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

3. I do unintentionally.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

4. that feels sort of natural to me.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

5. I do without further thinking.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

6. that would require mental effort to leave.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

7. I do every day.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

8. I start doing before I realize I’m doing it.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

9. I would find hard not to do.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

10. I don't do on purpose.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

11. that's typically "me."

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

12. I have been doing for a long time.

Strongly disagree | Disagree | Slightly Disagree | Neither agree nor disagree | Slightly agree | Agree | Strongly Agree

Validity Checks

Lastly, it is vital to our study that we only include responses from people that devoted their full attention to this study. Otherwise, years of effort (the researchers' and the time of other participants) could be wasted. You will receive credit for this study no matter what. However, please tell us how much effort you put forth towards this study.

"I put forth ____ effort towards this study"

- Almost no (1)
- Very little (1)
- Some (1)
- Quite a bit of (0)
- A lot of (0)

Also, often there are several distractions present during studies (other people, TV, music, etc.). Please indicate how much attention you paid to this study. Again, you will receive credit no matter what. We appreciate your honesty!

"I gave this study ____ attention"

- Almost no (1)
- Very little of my (1)
- Some of my (1)
- Most of my (0)
- My full (0)

In your honest opinion, should we use your data in our analyses of this study?

- Yes (0)
- No (1)

Appendix C: Study 3 Questionnaire

Thank you for your interest in our study. Taking part involves completing a survey that takes around 10 mins. To go straight to the survey, click the button at the bottom of this page. To learn more about the study, please read the information below.

Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. If there is anything that is not clear or if you would like more information, please contact me at harry.l.morris@kcl.ac.uk.

What is the purpose of the study?

The purpose of the study is to identify common positive and negative self-thoughts and the potential triggers of these thoughts. The study also aims to evaluate the extent to which such thoughts occur habitually, using a novel measure of thought habits.

Why have I been invited to take part?

You are being invited to participate in this study because you are a Prolific user aged 18 years of age or older.

What will happen if I take part?

If you agree to take part you will complete a survey anonymously. The survey will ask you questions about positive and negative self-thoughts that you have had, and the potential triggers of these thoughts, along with questions measuring the habitual nature of these thoughts. The survey should take approximately 15 minutes to complete.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to and choosing not to take part will not disadvantage you in any way. If you choose to take part you will be asked to provide your consent. To do this you will be asked to indicate that you have read and understood the information provided on this screen, and that you consent to your anonymous data being used for the purposes explained. If you would like to ask any questions about the study before deciding whether to take part, please contact me at harry.l.morris@kcl.ac.uk.

You are free to withdraw at any point during completion of the survey, without having to give a reason. Withdrawing from the study will not affect you in any way. Once you submit the survey, it will no longer be possible for us to withdraw from the study because the data you have submitted will be fully anonymous to us.

What are the possible benefits of taking part?

As is the case with all studies posted on Prolific, you will be paid for the time you take to complete the survey.

What are the possible risks of taking part?

You will be asked personally sensitive questions regarding the negative thoughts you may have about yourself and the situations which trigger these thoughts. If you feel uncomfortable during– or after – completion of this study, please contact me at harry.l.morris@kcl.ac.uk and you will be assigned to appropriate support services.

Data handling and confidentiality

This research is anonymous. This means that nobody on the research team will be aware of your identity, and we will not be able to connect you to the answers you provide, even indirectly. Your data will be

processed confidentially, and held securely in an encrypted file on a secure networked drive at King's College London. The data shall be retained for 3 to 7 years, in line with the King's Data Retention Schedule.

The data controller for this project will be King's College London (KCL). Research is a task that the University carries out in the public interest. Your data will be processed in accordance with the standards set by the General Data Protection Regulation 2016 (GDPR).

How is the project being funded?

This study is being funded by the King's College London Psychology department.

What will happen to the results of the study?

The results of the study will be summarised in a report for the researcher's final year KCL BSc Psychology research project. We may also report findings from the study at national and international conferences, and submit a report for publication in a peer-reviewed scientific journal. We expect the study to be completed by early March 2020. If you would like to receive a summary of the study findings, please contact me at harry.1.morris@kcl.ac.uk.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me at harry.1.morris@kcl.ac.uk

What if something goes wrong?

If this study has harmed you in any way or if you wish to make a complaint about the conduct of the study you can contact the project supervisor for further advice and information:

Dr Benjamin Gardner

Room 2.11, Floor 2, Addison House

Institute of Psychiatry, Psychology and Neuroscience King's College London

Guy's Campus

London SE1 1UL

Email: benjamin.gardner@kcl.ac.uk

Tel: +44(0) 207 848 6926

Thank you for considering taking part in this research.

If you have any questions arising from the information on the previous screen, please ask by emailing harry.1.morris@kcl.ac.uk. You can request a copy of the consent form, if you wish, by contacting this same email.

I confirm that I have had the opportunity to consider the information on the previous page, and to ask questions, and that any questions I have asked have been answered to my satisfaction.

Yes

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time before submitting the questionnaire.

Yes

I consent to the processing of my personal information for the purposes explained to me on the previous page. I understand that such information will be handled in accordance with the terms of the General Data Protection Regulation.

Yes

I understand that the information I provide may be subject to review by responsible individuals from the College for monitoring and audit purposes.

Yes

I understand that confidentiality and anonymity will be maintained and it will not be possible to identify me in any research outputs.

Yes

Section 1 – Demographic questions

Participants will be given textboxes for each of these fields

Please indicate your gender:

Male | Female | Transgender | Other | Prefer not to say

What is your age? _____

Have you ever received a clinical diagnosis of a mental health disorder?

Yes | No

Section 2 - Negative Automatic Thoughts

Which ONE of the following thoughts have you had most frequently over the past two weeks? Make a note of your selected thought, because we will shortly ask you a series of questions about it.

1. I feel like I'm up against the world
2. I'm no good
3. Why can't I ever succeed?
4. No one understands me
5. I've let people down
6. I don't think I can go on
7. I wish I were a better person
8. I'm so weak
9. My life's not going the way I want it to
10. I'm so disappointed in myself
11. Nothing feels good anymore
12. I can't stand this anymore
13. I can't get started
14. What's wrong with me?
15. I wish I were somewhere else
16. I can't get things together
17. I hate myself
18. I'm worthless
19. Wish I could just disappear
20. What's the matter with me?
21. I'm a loser
22. My life is a mess
23. I'm a failure
24. I'll never make it

25. I feel so helpless
26. Something has to change
27. There must be something wrong with me
28. My future is bleak
29. It's just not worth it
30. I can't finish anything

You will now answer a series of questions for your selected thoughts.

1. Think about the LAST TIME that you had this thought. Describe the situation you were in, in as much detail as possible. If you can't remember the last time, please describe a time that you remember that triggered this thought. _____

2. Please complete the following statements. "When I encounter a similar situation to the one I selected, my previously chosen thought is..."
 - a. that pops into my mind automatically
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
 - b. that pops into my mind without my control
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
 - c. that pops into my mind instantly
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

3. Which of the following situations have EVER triggered this thought?
 1. When I make a mistake
 2. When someone gives me negative feedback
 3. When I fail to achieve a goal
 4. When I do something that isn't up to my standards
 5. When I enter a particular setting (e.g., workplace, classroom)
 6. When I'm in a situation where my performance is being evaluated
 7. When I'm not invited or included
 8. When I get rejected
 9. When I get criticized by someone close to me
 10. When I suspect someone is upset with me
 11. When I'm being ignored
 12. When I see a particular person (e.g., a former friend, someone I find attractive)
 13. When my heart is beating fast
 14. When I start sweating
 15. When I feel sad
 16. When I feel anxious
 17. When I feel stressed
 18. When I feel tense

19. When I feel on edge
 20. When I feel hopeless
 21. When I feel tired
 22. When experience a specific sensation in my body
4. The following questions concern your previously chosen thought. Generally, this thought is something:
- a. that pops into my mind automatically
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
 - b. that pops into my mind without my control
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
 - c. that pops into my mind instantly
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
5. How frequently, if at all, does the thought occur to you in a typical week?
Not at all | Sometimes | Moderately Often | Often | All the time

Section 3 - Positive Automatic Thoughts

Which ONE of the following thoughts have you had most frequently over the past two weeks? Make a note of your selected thought, because we will shortly ask you a series of questions about it.

1. I am respected by my peers
2. I have a good sense of humour
3. My future looks bright
4. I will be successful
5. I'm fun to be with
6. I am in a great mood
7. There are many people who care about me
8. I'm proud of my accomplishments
9. I will finish what I start
10. I have many good qualities
11. I am comfortable with life
12. I have a good way with others
13. I am a lucky person
14. I have friends who support me
15. Life is exciting
16. I enjoy a challenge
17. My social life is terrific
18. There's nothing to worry about
19. I'm so relaxed
20. My life is running smoothly
21. I'm happy with the way I look
22. I take good care of myself
23. I deserve the best in life
24. Bad days are rare

25. I have many useful qualities
26. There is no problem that is hopeless
27. I won't give up
28. I state my opinions with confidence
29. My life keeps getting better
30. Today I've accomplished a lot

You will now answer a series of questions for your selected thoughts.

1. Think about the LAST TIME that you had this thought. Describe the situation you were in, in as much detail as possible. If you can't remember the last time, please describe a time that you remember that triggered this thought. _____

2. Please complete the following statements. "When I encounter a similar situation to the one I selected, my previously chosen thought is..."
 - a. that pops into my mind automatically
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
 - b. that pops into my mind without my control
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
 - c. that pops into my mind instantly
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree

3. Which of the following situations have EVER triggered this thought?
 1. When I make a mistake
 2. When someone gives me negative feedback
 3. When I fail to achieve a goal
 4. When I do something that isn't up to my standards
 5. When I enter a particular setting (e.g., workplace, classroom)
 6. When I'm in a situation where my performance is being evaluated
 7. When I'm not invited or included
 8. When I get rejected
 9. When I get criticized by someone close to me
 10. When I suspect someone is upset with me
 11. When I'm being ignored
 12. When I see a particular person (e.g., a former friend, someone I find attractive)
 13. When my heart is beating fast
 14. When I start sweating
 15. When I feel sad
 16. When I feel anxious
 17. When I feel stressed
 18. When I feel tense

- 19. When I feel on edge
- 20. When I feel hopeless
- 21. When I feel tired
- 22. When experience a specific sensation in my body

4. The following questions concern your previously chosen thought. Generally, this thought is something:
 - a. that pops into my mind automatically
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
 - b. that pops into my mind without my control
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
 - c. that pops into my mind instantly
Strongly disagree | Disagree | Somewhat disagree | Neutral | Somewhat agree | Agree | Strongly agree
5. How frequently, if at all, does the thought occur to you in a typical week?
Not at all | Sometimes | Moderately Often | Often | All the time

Appendix D: Study 3 Qualitative Codebook

PERMA Category	UPenn definition https://ppc.sas.upenn.edu/learn-more/perma-theory-well-being-and-perma-workshops	Coding notes
<i>Positive Emotion</i>	This route to well-being is hedonic – increasing positive emotion. Within limits, we can increase our positive emotion about the past (e.g., by cultivating gratitude and forgiveness), our positive emotion about the present (e.g., by savoring physical pleasures and mindfulness) and our positive emotion about the future (e.g., by building hope and optimism). Unlike the other routes to well-being described below, this route is limited by how much an individual can experience positive emotions. In other words, positive affectivity is partly heritable and our emotions tend to fluctuate within a range. Many people are, by disposition, low in experiencing positive emotion. Traditional conceptions of happiness tend to focus on positive emotion, so it can be liberating to know that there are other routes to well-being, described below.	<i>Negative situations</i> • Presence of negative emotions • Daily hassles and unfortunate unexpected events • Negative thoughts • Health problems <i>Positive situations</i> • “Small joys” • Presence of positive emotion <i>Distinguishing from other categories</i> • Relationship: If a relationship leads to positive/negative emotion, code as Relationship • Engagement: If (dis)engagement leads to positive/negative emotion, code as Engagement • Meaning: If (lack of) meaning leads to positive/negative emotion, code as a Meaning • Accomplishment: If (lack of) accomplishment leads to positive/negative emotion, code as Accomplishment
<i>Engagement</i>	Engagement is an experience in which someone fully deploys their skills, strengths, and attention for a challenging task. According to Mihaly Csikszentmihalyi, this produces an experience called “flow” that is so gratifying that people are willing to do it for its own sake, rather than for what they will get out of it. The activity is its own reward. Flow is experienced when one’s skills are just sufficient for a challenging activity, in the pursuit of a clear goal, with immediate feedback on progress toward the goal. In such an activity, concentration is fully absorbed in the moment, self-awareness disappears, and the perception	<i>Negative situations</i> • Feeling disengaged, bored, fed up with the process of work, leisure, or activities • Being burnt out or spread too thin at work <i>Positive situations</i> • Being focused and happy with work, school, or leisure activities <i>Distinguishing from other categories</i> • Positive emotion: if positive/negative emotion

	of time is distorted in retrospect, e.g., time stops. Flow can be experienced in a wide variety of activities, e.g., a good conversation, a work task, playing a musical instrument, reading a book, writing, building furniture, fixing a bike, gardening, sports training or performance, to name just a few.	stems from (dis)engagement, code as Engagement • Relationship: If a relationship is emphasized and leads to (dis)engagement, code as Relationship • Meaning: If (dis)engagement is the consequence of a deep, personal realization, code as a Meaning; if (dis)engagement is related to the present moment, rather than a larger topic, code as Engagement • Accomplishment: In contexts of work, school, leisure, or personal achievement, if the emphasis is on the process of the experience (i.e., how a participant felt), code as Engagement; if the emphasis is on the outcome (i.e., success/failure), code as Accomplishment
Relationships	Relationships are fundamental to well-being. The experiences that contribute to well-being are often amplified through our relationships, for example, great joy, meaning, laughter, a feeling of belonging, and pride in accomplishment. Connections to others can give life purpose and meaning. Support from and connection with others is one of the best antidotes to “the downs” of life and a reliable way to feel up. Research shows that doing acts of kindness for others produces an increase in well-being. From an evolutionary perspective, we are social beings because the drive to connect with and serve others promotes our survival. Developing strong relationships is central to adaptation and is enabled by our capacity for love, compassion, kindness, empathy, teamwork, cooperation, self-sacrifice, etc.	<i>Positive situations</i> • Any situation that emphasizes an interpersonal encounter or relationship as the main topic • Examples: feeling connected to friends and family, positive interactions with colleagues at work <i>Negative situations</i> • Any situation that emphasizes an interpersonal encounter or relationship as the main topic • Examples: feeling connected to friends and family, positive interactions with colleagues at work <i>Distinguishing from other categories</i> • Positive emotion: if the relationship seems to be causing the positive emotion, code as Relationship • Engagement: If a relationship is emphasized and leads to (dis)engagement, code as Relationship • Meaning: If the relationship is referenced in the context of a deep, profound, personal

		realization (and the main emphasis is on the realization), code as a Meaning • Accomplishment: In contexts of work, school, leisure, or personal achievement, if the reference to relationships is secondary
<i>Meaning:</i>	A sense of meaning and purpose can be derived from belonging to and serving something bigger than the self. There are various societal institutions that enable a sense of meaning, such as religion, family, science, politics, work organizations, justice, the community, social causes (e.g., being green), among others.	<i>Positive situations</i> • Any positive reference to a deeper purpose and/or sense of meaning <i>Negative situations</i> • Any reference to lacking a deeper purpose and/or sense of meaning <i>Distinguishing from other categories</i> • Any other category might reference meaningful experiences. If the major point of the passage is the reflection on why an experience was deeply meaningful, code as Meaning
<i>Accomplishment</i>	People pursue achievement, competence, success, and mastery for its own sake, in a variety of domains, including the workplace, sports, games, hobbies, etc. People pursue accomplishment even when it does not necessarily lead to positive emotion, meaning, or relationships.	<i>Positive situations</i> • Any reference to accomplishing a goal in any setting including job accomplishments, school performance, and financial success <i>Negative situations</i> • Any reference to failing to achieve a goal in any setting <i>Distinguishing from other categories</i> • Positive emotion: the positive/negative is best explained as a consequence of personal accomplishment or

		failure, code as Accomplishment • Engagement: In contexts of work, school, leisure, or personal achievement, if the emphasis is on the process of the experience (i.e., how a participant felt), code as Engagement; if the emphasis is on the outcome (i.e., success/failure), code as Accomplishment • Relationships: if other people are referenced yet the primary focus of the situation is success/failure, code as Achievement • Meaning: If the accomplishment is referenced in the context of a deep, profound, personal realization (and the main emphasis is on the realization), code as a Meaning
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