Spontaneous Future Cognition:

Cognitive Mechanisms and Goal-Directed Functions

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Intellectual Property Statement

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

Spontaneous future cognition denotes the human capacity to "pre-experience" possible events in one's future without intention. Theoretical accounts have built upon episodic future thinking (EFT), mind-wandering, and involuntary memory research. However, the specific cognitive mechanisms involved (e.g., sensitivity to environmental triggers; representational nature) require further clarification. Furthermore, the idea that everyday spontaneous future thoughts (SFTs) play a role in goal-directed behaviour remains speculative. This thesis investigated cognitive mechanisms and goal-directed functions of SFT, unifying previous findings and furthering conceptual understanding. Studies 1 and 2 examined the influence of cue content on SFTs in a low-demand attentional vigilance task. More SFTs were reported by participants viewing life-goal cues (e.g., "High-flying career") than standard cues under laboratory conditions (Study 1), but not online (Study 2). Effects were not specific to cue-triggered thoughts, suggesting environmental triggers might operate differently for SFTs than for memories. Study 3 tested, in a novel experimental paradigm, the hypothesis that some future thoughts are spontaneously reactivated, pre-encoded representations. Voluntary EFTs (e.g., imagining oneself in a marketplace in one year) reoccurred spontaneously more often than non-future constructions, again irrespective of specific environmental cues. Study 4 gathered naturalistic data on *self-regulatory thought* (SRT) modes, finding differences according to subjective controllability and providing a paradigm for eliciting idiographic goal descriptions. Addressing the thesis' second aim, Studies 5 and 6 established predictive effects of anticipatory thought on student performance. Study 5 linked spontaneous, goal-directed thought with subsequent test scores; Study 6 examined whether longer-term anticipatory thought would impact performance dependent upon SRT mode. Students who *mentally contrasted* an ideal outcome with obstacles to success achieved better academic grades with increasing exam-related thought frequency; non-mental-contrasters showed the opposite tendency. Findings are synthesised in a conceptual model encompassing cognitive and functional aspects and aiming to stimulate ongoing SFT research.

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Abbreviations

SFT	spontaneous future thought
EFT	episodic future thought
IAM	involuntary autobiographical memory
MW	mind-wandering
MoF	memories of the future
FRT	fantasy realisation theory
SRT	self-regulatory thought
TUT	task-unrelated thought
SIT/SDT	stimulus-independent / -dependent thought
CCQ	Current Concerns Questionnaire
MW-S/MW-D	Spontaneous / Deliberate MW Scales
CRT	choice reaction time task
MFCT	modified future Crovitz test
M	mean
SD	standard deviation
SE	standard error
CI	confidence interval
ms	milliseconds

Chapter 1. Situating the Programme of Research

1.1. General introduction to the field

1.1.1. What is spontaneous future thinking?

The present work takes as its central subject matter a phenomenon which has recently been identified with the label spontaneous future thought (Cole & Kvavilashvili, 2019). This term denotes a type of "flash-forward" whereby one feels transported forwards in time, experiencing a possible future event as if it were happening in the present, without a conscious attempt to bring it to mind (Berntsen, 2019). For instance, one might suddenly visualise oneself in the supermarket next week, or in next year's holiday destination, while performing household chores. Alternatively, an imagined version of events at an imminent meeting or appointment might come before one's consciousness without warning. In fact, spontaneous future thought (hereafter SFT) can encompass a potentially limitless array of anticipated events which might plausibly befall the thinker (Baumeister et al., 2018; Kvavilashvili & Rummel, 2020). This flexibility to imagine diverse future possibilities has long been considered a hallmark of human cognitive capability (Tulving, 1985; Wheeler et al., 1997; Suddendorf & Corballis, 2007; Szpunar, 2010).

Besides its versatility, research interest in SFT has been spurred by its prevalence in everyday life – around 20-30 instances per day for young adults (D'Argembeau et al., 2011; Finnbogadóttir & Berntsen, 2013; Kvavilashvili & Rummel, 2020). This observation suggests that SFT is an equally prevalent component of human experience as the occurrence of involuntary autobiographical memories, an existing area of study from which SFT research initially emerged (Berntsen, 2019; Berntsen & Jacobsen, 2008). Furthermore, there are compelling arguments that SFT plays a functional role in guiding goal-directed behaviour (Cole & Kvavilashvili, 2021; Seligman et al., 2016; Smallwood & Andrews-Hanna, 2013). All these aspects present SFT as a promising topic of inquiry meriting further research efforts, both theoretical (e.g., *What is its cognitive basis? How does SFT relate to other concepts such as prospective memory?*) and applied (e.g., *What are its benefits in certain behavioural contexts?*). The following sections briefly elaborate on several relevant

dimensions – spontaneity, content and functional value – that contextualise the empirical focus of the present work. In this way, gaps in the literature can be identified and corresponding research questions posed.

1.1.2. Spontaneity and cue-dependence

An essential, defining property of SFT is that it is an *involuntary* form of mental experience – brought to mind without deliberate attempt (Berntsen, 1996, 2019; Berntsen & Jacobsen, 2008). Hence, it can be distinguished from deliberate attempts to construct future events in one's mind, such as when someone asks "What do you see yourself doing in five years' time?" or when one intentionally visualises details of an upcoming social occasion. Nonetheless, the present work assumes that such spontaneous thoughts may occur either with or without external impetus (i.e., cues in the environment). In this respect, the focus differs from research on daydreaming and mind-wandering, both of which are often characterised as *stimulus-independent* forms of thought (Antrobus, 1968; Christoff et al., 2016; but see Maillet et al., 2017).

Consequently, any involuntary thought of a possible, personal future event can be considered an instance of SFT, whether or not it is connected with information in the subject's present environment. The topic of cue-dependence will be recurrent throughout the thesis, with Studies 1 and 2 specifically probing the effects of environmental cues and the design of Study 3 also reliant on the concept of externally cued SFT.

1.1.3. Constraints on the content of SFTs

While the range of future events one could imagine is essentially unlimited, there are certain constraints upon what types of cognitive representations constitute examples of SFT. Recent theoretical accounts propose that future cognition depends on a network of abstracted, semantic information about the self (Conway et al., 2019; D'Argembeau, 2016, 2020). This *autobiographical knowledge base*, depicted schematically in Figure 1.1, combines past and future representations at different levels of abstraction along a mental timeline (D'Argembeau, 2020). In the model, the construction of an episodic event (bottom level) is constrained by its associative links to higher-level

information such as lifetime periods and past / future self-images (Conway, 2005; Markus & Nurius, 1986). Consistent with this, higher-level autobiographical knowledge has been shown to play a role in the deliberate (re)construction of both past and future episodes through cue elaboration and strategic search processes (Conway & Pleydell-Pearce, 2000; D'Argembeau & Mathy, 2011; Rathbone et al., 2011).

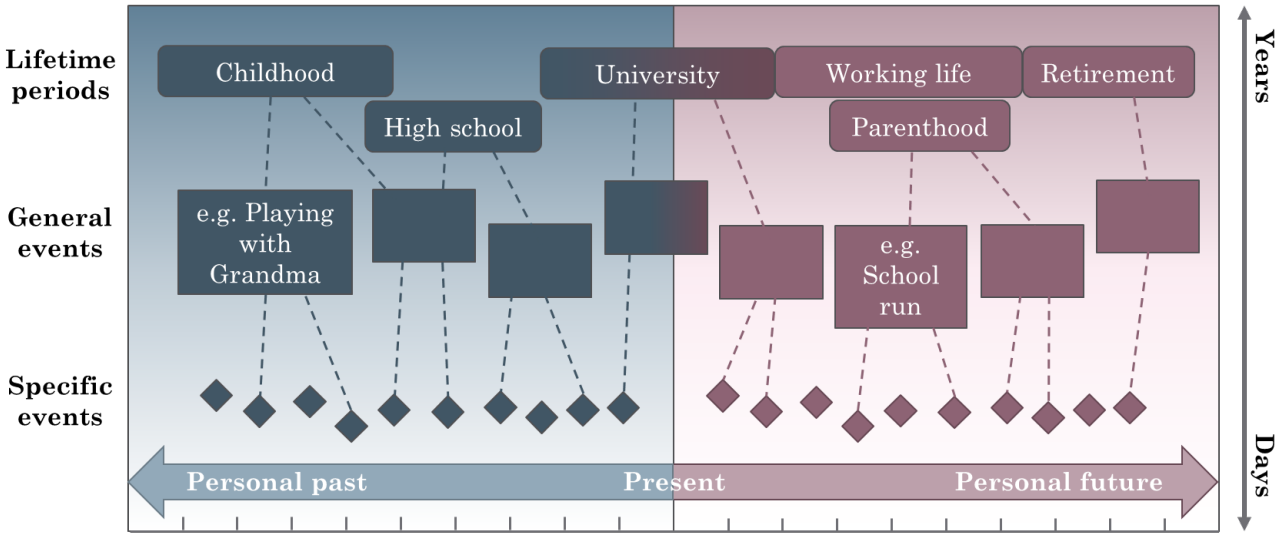


Figure 1.1. Schematic model of autobiographical knowledge organised along the mental timeline (horizontal) and by level of abstraction (vertical). Based on Conway et al. (2019) and D'Argembeau (2020).

In the case of *spontaneous* future thoughts, one can assume that autobiographical knowledge is not strategically searched to produce a specific event (cf. "direct" access; Uzer et al., 2012; Jeunehomme & D'Argembeau, 2016). Nonetheless, SFTs are essentially personal in nature and can be considered autobiographical representations in the same manner as involuntary memories (see Berntsen & Jacobsen, 2008). Hence, unlike other forms of imaginal experience (such as daydreaming; Singer, 1975), SFT depicts events that are at least somewhat likely to occur in one's personal future (cf. Demblon & D'Argembeau, 2014). Implausible imagined events (e.g., growing wings and flying away) do not meet the specification; nor do impersonal thoughts, such as speculating about global or political future events not involving the self (L. J. Levine et al., 2020). Atemporal thoughts – of events not connected with a specific point in time – may also be excluded, despite their representational similarity to autobiographical thoughts (Mullally & Maguire, 2014).

These considerations narrow the focus of the thesis, enabling the pursuit of more specific and targeted research questions. Nonetheless, it is acknowledged that this represents a reduction of the infinitely varied and dynamic landscape of conscious thought (Klinger et al., 2018; Smallwood et al., 2021). It is hoped that, in further demarcating the antecedents and functions of one specific class of thoughts, the present work will bring indirect benefits for the broader study of spontaneous thought, mind-wandering and related phenomena (Cole & Kvavilashvili, 2021; Kvavilashvili & Rummel, 2020).

1.1.4. Structure and orientation of this chapter

The work presented in this thesis is embedded from the outset in the psychology of goals – traditionally a distinct research topic with close links to social psychology (Austin & Vancouver, 1996; Gollwitzer & Oettingen, 2012; Milyavskaya & Werner, 2018). The overarching aim is to draw empirical links between the experience of SFT and the cognitive and behavioural dynamics of goal pursuit in which it may play a functional role. As such, the present chapter must give an adequate introduction to both these aspects. To this end, it first reviews relevant literature from the contributary fields of episodic future thinking, involuntary memory, and mind-wandering, before introducing psychological conceptions of goal pursuit. Unanswered questions and areas requiring further integration are indicated throughout, laying the ground for the particular aims and research questions pursued in each subsequent chapter. To pre-empt the final section in broad strokes, the fundamental intention of the thesis is to synthesise disparate lines of research, along with a diverse range of novel empirical data, to arrive at a more complete account of what spontaneous future thinking *is* and *does* within human cognition.

1.2. The legacy of episodic future thinking

SFT research has been heavily informed by a longer-standing literature on episodic future thinking (EFT), defined in a landmark theoretical paper by Atance and O'Neill (2001) as "a projection of the self into the future to pre-experience an event" (p. 533). This definition evokes earlier models of episodic memory (Tulving, 1985; Wheeler et al., 1997) that propose a fundamental link between the capacity to reconstruct past episodes and to imagine the future. According to Tulving (1985, 2002), both experiences are accompanied by a distinct form of awareness: *autonoesis*, or "self-knowing" consciousness. Thus, when recalling episodic memories or experiencing episodic future thoughts, one becomes aware of oneself at a particular point in *subjective time* (Tulving, 2002); such awareness is absent when one recalls purely semantic (i.e., factual) information. On this basis, episodic memory and future thinking are argued to constitute two facets of a unitary faculty of *mental time travel* (MTT; Dudai & Carruthers, 2005; Schacter & Addis, 2007; Suddendorf & Corballis, 2007; Wheeler et al., 1997).

Typically, EFT is studied using a variant of the cue-word paradigm widely used in autobiographical memory research (Crovitz & Schiffman, 1974; B. Levine et al., 2002). Participants are presented with a meaningful cue (e.g., the word "family") and must deliberately construct a related future event according to various parameters (D'Argembeau & Van Der Linden, 2004; studies reviewed in Schacter et al., 2012). One cannot assume a lack of intention in constructing such thoughts; hence the procedure can be termed a "voluntary" method for studying future thinking (Cole & Kvavilashvili, 2021). Following the underpinning theory, it has been a priority for researchers to evaluate the extent of autonoetic consciousness involved, for instance through ratings of sensory-perceptual vividness (de Vito et al., 2012; Devitt et al., 2017) and / or feelings of "pre-experiencing" one's future (Arnold et al., 2011; Atance & O'Neill, 2001; Lehner & D'Argembeau, 2016). Such *phenomenological* properties of imagined future events have been studied in comparable fashion by SFT researchers (Cole et al., 2016; Jordão et al., 2019; Plimpton et al., 2015). Chapters 2 and 3 of the present work, though primarily concerned with the antecedent mechanisms of SFT, also make use of

subjective ratings to verify the qualitative character of captured thoughts and thereby enhance the descriptive richness of the thesis.

In addition to shaping conceptualisation of the subjective dimension of future thoughts, the EFT literature has provided important insights into the underlying cognitive mechanisms. Jeunehomme & D'Argembeau (2016) used a standard (i.e., voluntary) cue-word paradigm to elicit episodic memories and future thoughts, and analysed them according to the way in which each thought came to mind. Based on subjective (self-report) and objective (protocol and RT) data, they were able to identify two distinct modes of thought, *generative* and *direct*, differentiated by the extent of elaborative processing of the cue (see also Uzer et al., 2012). In the generative mode, the cue triggers an iterative search of autobiographical knowledge, with the results evaluated and further elaborated until a specific, episodic thought is produced (cf. Conway & Pleydell-Pearce, 2000). This tends to be a prolonged, cognitively effortful process. By contrast, in the direct mode, an episodic thought arrives automatically and effortlessly in response to the processing of a cue, without an extended process of elaboration. Jeunehomme & D'Argembeau (2016) found the direct mode to predominate for both past and future thoughts, prompting them to consider whether future thoughts, like past memories, might sometimes consist of pre-constructed representations – *memories of the future*.

Jeunehomme & D'Argembeau (2016) explicitly state that their "direct" future thinking is not equivalent to the term "involuntary" used elsewhere (e.g., Cole et al., 2016). However, their results support the conclusion that cued production of episodic future thoughts can involve greater or lesser strategic control – perhaps approximating, in the latter instance, the truly involuntary or spontaneous future thinking that occurs in response to triggers in everyday life (Warden et al., 2019; D'Argembeau et al., 2011). Subsequent work by the same authors has identified factors that contribute to the memorability of future events, once constructed (Jeunehomme & D'Argembeau, 2017, 2021). Subjective properties such as vividness and feelings of autonoetic experience at construction can be used to predict later recall (Jeunehomme & D'Argembeau, 2017), while integration with knowledge about oneself and one's goals (i.e., autobiographical knowledge; Conway et al., 2019; D'Argembeau,

2020) also predicts more accurate recall, irrespective of subjective differences (Jeunehomme & D'Argembeau, 2021). These authors' use of conventional cue-word methods at the recall stage precludes drawing direct conclusions about involuntary retrieval, but it is tempting to speculate that the same encoding factors might be relevant in the spontaneous context. The important implication is that certain types of future event, constructed at an earlier point, may remain highly accessible for subsequent retrieval. Chapter 3 addresses this issue directly, as further contextualised by the following account of how involuntary memory has informed and contributed to the emerging field of SFT.

1.3. Involuntary thoughts of the personal past and future

SFT research has been heavily shaped by work on involuntary autobiographical memories (IAMs), where specific past experiences come to mind without conscious intent to retrieve them (Berntsen, 1996, 2021). The phenomenon is characterised by a feeling of being transported backwards in time, or "re-experiencing" past events, consistent with Tulving's concept of autonoesis (Wheeler et al., 1997). The cognitive characteristics of IAMs were first studied using naturalistic methods (Berntsen, 1996, 1998; Berntsen & Hall, 2004; Mace, 2004), demonstrating that they tend to occur during routine activities such as driving or housework. For instance, one might be cleaning the kitchen and suddenly recollect an experience from a holiday that took place some years ago. Laboratory studies have exploited this, investigating the cognitive dynamics of IAMs under controlled conditions that mimic the ecological context in which they naturally occur. Typically, this entails the use of a simple visual attention task requiring minimal concentration – such as a *vigilance task* in which participants respond to very occasional targets that are highly discriminable from the other stimuli (Schlagman & Kvavilashvili, 2008).

Another key feature of IAMs is that they are highly cue-dependent – frequently triggered by stimuli in the environment that share features with the content of the memory (Berntsen et al., 2013). For example, some familiar object (e.g., a memento bought on holiday) might trigger recollection of particular past events connected with it (Berntsen & Hall, 2004; Finnbogadóttir & Berntsen, 2013). This mechanism has been exploited in laboratory studies to maximise the available data and probe the processes of IAM retrieval more closely (Mace & Unlu, 2020; Vannucci et al., 2017). In this context, cue stimuli are presented to participants as irrelevant or "incidental" background material during a primary cognitive task (Schlagman & Kvavilashvili, 2008). One such study showed that verbal cues (such as the phrase "relaxing on a beach") elicited more IAMs than pictorial cues of equivalent meaning (Mazzoni et al., 2014), justifying their widespread use in lab studies (Cole et al., 2016; Plimpton et al., 2015; Schlagman & Kvavilashvili, 2008; Vannucci et al., 2015, 2017). Mazzoni et al. (2014) concluded that personal memories are more sensitive to verbal material due to its abstract nature – for instance, "relaxing on a beach" could trigger memories of a diverse range of experiences

in different individuals (cf. Mace, 2004). Other work has explored cue frequency effects, finding that moderately spaced verbal cues elicited the most IAMs compared to either no cues or continuous cues – endorsing the concept of *cue overload*, where interference prevents cues being processed adequately to trigger retrieval (Vannucci et al., 2015). Vannucci and her colleagues offered this as an explanation for why we are not constantly overwhelmed by involuntary memories during daily life.

A separate line of work has examined the frequency and characteristics of IAMs reported under different task instructions (Barzykowski & Niedźwieńska, 2016; Barzykowski & Staugaard, 2018). Previously, most studies had either probed participants' mental contents with no particular reporting criteria (Mazzoni et al., 2014; Vannucci et al., 2015) or specified that only memories should be reported (Schlagman & Kvavilashvili, 2008; Cole et al., 2016, *past involuntary* condition). Integrating the two lines of research, Barzykowski and Niedźwieńska (2016) systematically compared both methods. They found that the instruction to report only memories, prompting explicit monitoring of one's stream of consciousness (cf. Schooler et al., 2011), increased the frequency of IAM retrieval. This was interpreted to reflect a lowered awareness threshold – enabling less vivid and emotionally intense memories to enter consciousness alongside their phenomenologically richer counterparts (Barzykowski & Staugaard, 2018). Monitoring, then, is similar in its effects to the presence of intention (i.e., in a voluntary cue-word task; D'Argembeau & Van Der Linden, 2004), increasing frequency but diluting the quality of the resulting representations (Barzykowski & Staugaard, 2016; Cole et al., 2016). This is an important consideration when designing studies, as thoughts can be captured through probes imposed by the experimenter (Mazzoni, 2019; Plimpton et al., 2015) or through *self-caught* reporting, where the participant actively monitors their stream of consciousness for the appearance of relevant contents (Cole & Berntsen, 2016; Schlagman & Kvavilashvili, 2008). The implication is that the choice of method might affect not just the frequency, but also the quality of representations that can be accessed.

A large proportion of conscious thought concerns past and possible future events, alone or in combination (Baumeister et al., 2020; Beaty et al., 2018; Smallwood, 2013), and there is extensive overlap in the neurocognitive systems supporting episodic memory and future thinking (Addis et al.,

2009; Schacter et al., 2012). It has therefore been a natural extension of IAM research to investigate involuntary past and future thoughts in tandem, examining their similarities and differences when each occurs in consciousness. In a pioneering study, Berntsen and Jacobsen (2008) compared involuntary past and future thoughts using a naturalistic diary approach. Their results showed similarities in terms of frequency, cue-dependence, and phenomenological characteristics. Recalling earlier work on the brain's capacity to represent past and future events (Suddendorf & Corballis, 2007; Wheeler et al., 1997), Berntsen and Jacobsen (2008) employed the term *spontaneous mental time travel* to reflect the close correspondence between involuntary thoughts in either temporal direction. On a theoretical level, they articulated how both types of thought might arise through the automatic activation of autobiographical information associated with a relevant cue (e.g., knowledge of past or upcoming holidays for "relaxing on a beach"; see Figure 1.1). This would account for the emergence of similar cognitive and representational profiles in spite of a fundamental ontological difference (i.e., involuntary memories reflect veridical past events, while future thoughts reflect mere possibilities; Perrin, 2016).

More recent work has refined this view by highlighting certain disparities between IAMs and SFTs. For instance, IAMs are typically more vivid and emotionally impactful, while involuntary future projections are found to be more important and goal-relevant (Cole et al., 2016; Cole & Berntsen, 2016). Regarding thought occurrence, IAMs are more sensitive to the presence of verbal cues, although both are cue-triggered in the majority of instances when measured in the lab (Plimpton et al., 2015; Vannucci et al., 2017). Finally, Mazzoni (2019) concluded that the production of SFTs required more cognitive resources since they showed a more pronounced reduction than IAMs when cognitively demanding additional stimuli were introduced during a vigilance task. Yet despite these examples, several questions remain unanswered surrounding the cognitive mechanisms underlying both types of involuntary thought (Berntsen, 2019; Cole & Kvavilashvili, 2021).

Specifically, the extent of constructive or generative processing necessary to retrieve an IAM or experience an SFT is a matter of ongoing debate (Uzer et al., 2012; Cole et al., 2016; Mazzoni, 2019; Rubin, 2019; Berntsen & Nielsen, 2021). In involuntary memory, some authors point to

empirical differences in retrieval speed and subjective effort, relative to voluntary recall, as indicative of a lack of constructive processing (Uzer et al., 2012; Barzykowski & Staugaard, 2016). Others refute this, preferring the view that memory is fundamentally reconstructive (e.g., Schacter et al., 1998; Rubin & Umanath, 2015) and that the activation of autobiographical information necessary for such construction simply occurs more quickly and effortlessly (i.e., "automatically") for memories retrieved in the involuntary mode (Berntsen & Nielsen, 2021). Concerning SFT, the picture is similar: The increased disruption of SFTs by additional cognitive load has been taken by some as evidence of constructive processes (e.g., integration of episodic / semantic elements; Mazzoni, 2019). Other investigators, however, have emphasised striking differences in reporting speed (measured as cue-thought latency), effort and intention relative to voluntary future thoughts (Cole et al., 2016; Cole et al., *in preparation*), implying the existence of separable, qualitatively different modes of future thinking (Cole & Kvavilashvili, 2021).

With memories, aside from entirely false or confabulated events (e.g., Loftus, 2005), it is a matter of different mechanisms or routes to retrieving details of a past event bound together through real experience. There may be disagreement as to the exact form of the cognitive processes involved, or their neurobiological instantiation, but the essential representational nature of IAMs is relatively settled (Berntsen, 2021; Mace, 2019). For SFTs, on the other hand, it is an open question. Despite convincing theoretical arguments for the existence of memories of the future (highly accessible, pre-constructed future events sensitive to bottom-up cueing; Cole & Kvavilashvili, 2021; Jeunehomme & D'Argembeau, 2016), the hypothesis is yet to receive a direct experimental test. This will be the empirical focus of Chapter 3, aiming to advance understanding of SFTs' representational nature, as distinct from involuntary memories, and thereby clarify the relationship between the two on a more fundamental level than is achievable through thought-capture data alone (see Perrin, 2016, and Michaelian, 2016, for contrasting views on the ontological relationship between memory and future thought).

1.4. Mind-wandering: A methodological lens for observing SFTs

The nascent field of SFT has also taken influence from the study of mind-wandering (MW), where attention strays from one's present surroundings into internally generated content (Smallwood & Schooler, 2015, 2006). Mind-wandering comprises thoughts of past and future autobiographical events, hypothetical and atemporal thoughts and a range of other mental contents and is sometimes labelled "daydreaming" (Klinger, 1971; Singer, 1975; Poerio et al., 2016) or "task-unrelated thought" (L. Giambra, 1995; Seli, Beaty, et al., 2018; Stawarczyk et al., 2011). Despite some controversy over how exactly to delineate MW in relation to other forms of mental experience (see Seli, Kane, Smallwood, et al., 2018; Christoff et al., 2018; Seli, Kane, Metzinger, et al., 2018), there is consensus that its central feature is an awareness of content beyond the "here-and-now" (e.g., Schooler et al., 2011). Moreover, there is consistent evidence that autobiographical thoughts predominate during MW, irrespective of assessment method (Konu et al., 2021; Linz et al., 2019; Smallwood & Schooler, 2015). Understandably, therefore, considerable overlap exists between MW and the involuntary thought literature summarised above (see also Barzykowski et al., 2019). This presents two key benefits for the SFT researcher: shared methodologies and empirical results with direct implications for the study of SFTs.

Recent years have seen great methodological innovation in the study of mind-wandering. Naturalistic studies have developed increasingly sophisticated methods for capturing ongoing thought in everyday contexts (Hurlburt & Akhter, 2006; Ottaviani & Couyoumdjian, 2013; Robison & Unsworth, 2018; Song & Wang, 2012), improving data quality and decreasing participant burden. Meanwhile, the long-standing laboratory paradigm of dual-task experience sampling (Giambra, 1995; Smallwood & Schooler, 2015) has been refined and extended, using different "primary" tasks to modulate concurrent cognitive load (e.g., response inhibition task = high load; Randall et al., 2014) and introducing manipulations to probe the antecedents of different MW content (mood inductions, Smallwood et al., 2009, 2011; goal inductions, e.g., Stawarczyk et al., 2011). Characteristics of individual MW episodes (e.g., temporal orientation, affective content, apparent function) can then be assessed in relation to personal and contextual factors (cf. Kane et al., 2017). Many studies employing

such methods have treated involuntary autobiographical thought (including SFT) and mind-wandering as overlapping or equivalent concepts (Plimpton et al., 2015; Vannucci et al., 2015, 2017). For instance, Plimpton et al. (2015) used an attentional vigilance task with occasional thought probes to gauge differences in autobiographical mind-wandering between dysphoric and non-dysphoric participants. They found a specific difference in the type of future thoughts experienced (see section 1.5.1). Such results add to our understanding of thought patterns in a mental health context (Killingsworth & Gilbert, 2010; Poerio et al., 2013; Smallwood, O'Connor, et al., 2007) and underline the benefits of integration between MW and spontaneous thought research.

Two further papers published under the banner of mind-wandering have rendered important insights for subsequent research on SFT (Baird et al., 2011; Stawarczyk et al., 2011). Firstly, Baird et al. (2011) assessed the prevalence of future-oriented task-unrelated thoughts during a standard laboratory task (choice reaction time / CRT task), taking into account individual participants' working memory capacity. Their results showed that around half of all MW episodes were future-oriented, outnumbering past-related thoughts (termed a *prospective bias*; Smallwood et al., 2009); and that higher working memory scores predicted a greater proportion of future thoughts in relation to past (e.g., IAMs). They also found, through content coding, that future thoughts typically referenced both oneself and one's goals; this was not the case for memories and was hence interpreted as evidence of autobiographical planning occurring in the mind-wandering state (see also Smallwood et al., 2013). Baird et al. (2011) concluded that future-oriented MW is an adaptive ability that enables one to take advantage of moments when one's cognitive resources exceed external demands, to plan and prepare for future events (cf. Smallwood & Andrews-Hanna, 2013).

Relatedly, Stawarczyk et al. (2011) examined the influence of goal orientation using an experimental design in which half of participants were instructed to list their current goals before completing a similar dual-task experience sampling procedure. Consistent with Baird et al.'s (2011) correlational results, the goal orientation group reported more future-oriented thoughts, reflecting an increased tendency to engage in anticipation and planning when in a mind-wandering state. Both papers framed their discussion around the functional value of *mind-wandering* as a monumental

construct, yet their key findings concern the antecedents and consequences of future-oriented thoughts, underlining their relevance to the present programme of research. Stawarczyk et al. (2011) even included a measure of intentionality in their MW probes, with low resulting values implying that the thoughts were spontaneous (cf. Barzykowski & Staugaard, 2016; Jordão et al., 2019). It therefore seems credible that an increased focus upon one's goals, and the availability of excess cognitive resources during undemanding tasks, are practically and theoretically relevant factors for learning more about SFT.

Despite clear empirical overlap, some would argue that involuntary thoughts such as SFTs should be conceptually distinguished from MW – since the former, by definition, lack conscious intent (Berntsen, 1996, 2019, 2021). In other words, while both phenomena involve self-generated thoughts that are irrelevant to present task performance (Christoff et al., 2016), SFT is not simply a sub-class of MW as the mind can wander either spontaneously or deliberately (Seli, Risko, et al., 2016; Seli, Kane, Smallwood, et al., 2018). Furthermore, much of the MW literature views the possibility of environmental triggers with scepticism, invoking the classic characterisation of MW as both task-unrelated and *stimulus-independent* (Antrobus, 1968; Smallwood & Schooler, 2015). Recently, some authors have argued for a distinction between stimulus-independent and -dependent forms of MW (Maillet et al., 2017), hence relaxing the boundaries of the overarching concept. In any case, SFT research is insulated from such controversies by starting from the empirical observation that many spontaneous thoughts arise in response to cues (Berntsen & Jacobsen, 2008; Schlagman & Kvavilashvili, 2008; Plimpton et al., 2015; Cole et al., 2016).

Ultimately, the mere observation that MW frequently includes spontaneous, future-oriented content (including specific, personal episodes) explains its relevance to understanding SFT. The important distinction is that, while mind-wandering research seeks to delineate and explain the broader phenomenon (and its dynamic aspects; see Irving & Thompson, 2018), SFT research uses similar techniques to gain access to tokens of a more specific class of mental experience. Hence, rather than engage in definitional debates (Seli, Kane, Metzinger, et al., 2018; Christoff et al., 2018; Seli, Kane, Smallwood, et al., 2018), the priority here is to acknowledge the practical value of existing

research on the temporal characteristics of task-unrelated thought when devising studies to more precisely target SFT. The next section reviews theory and evidence relating to the potential functions of both MW and SFT, softening the above distinctions and integrating various lines of research that will help ground the thesis' second main area of enquiry – the function of SFT in goal-directed behaviour.

1.5. The functional value of spontaneous future thinking

1.5.1. Proposed functions of future-oriented MW and SFT

As mentioned, future-oriented mind-wandering often relates to uncompleted personal goals and future plans (Baird et al., 2011; Stawarczyk et al., 2011). This evidence has been used to support the argument that mind-wandering is an adaptive ability that serves to facilitate mental preparation and planning (Schooler et al., 2011; Smallwood & Andrews-Hanna, 2013). Moreover, it has been shown that the predominance of future-oriented thoughts during MW – the so-called "prospective bias" (Smallwood et al., 2009) – depends on the availability of cognitive resources. This is true both between individuals – where higher working memory capacity predicts an increased prospective bias (Baird et al., 2011) – and between task contexts (Konu et al., 2021; Randall et al., 2014, 2019). It is therefore conceivable that MW represents a self-regulatory mechanism that, when circumstances allow, utilises spare cognitive capacity to construct or maintain plans for future goal-directed behaviour (Klinger et al., 2018; Seligman et al., 2016; Smallwood & Schooler, 2015).

Recent SFT research using both naturalistic (Warden et al, 2019) and laboratory-based methods (Plimpton et al., 2015; Mazzoni, 2019) has arrived at similar conclusions. These studies have used post-hoc coding of thought descriptions to attempt to isolate different forms of future-oriented content. Plimpton et al. (2015) used a three-way classification derived from a thematic content analysis of their data, which distinguished between plans, hypothetical events and upcoming events. Similarly, Mazzoni (2019) trained her participants to categorise future thoughts as either "plans" or "scenarios", depending on the extent of agency involved. Both schemes capture a broad distinction – between anticipating future possibilities and planning one's own actions – that is mirrored in the

episodic future thinking literature (D'Argembeau et al., 2011; Szpunar et al., 2014). Such work can therefore begin to elucidate how the different prospective functions identified in the voluntary literature may emerge in a spontaneous context (cf. Duffy & Cole, 2020).

Plimpton et al. (2015) found that the relative frequencies of plans and hypothetical events experienced during a vigilance task were sensitive to levels of trait dysphoria (i.e., sub-clinical depressive symptoms). Dysphoric participants (n = 20) reported significantly more hypothetical thoughts, and significantly fewer plans, than non-dysphoric participants (n = 20). On the other hand, past-related thoughts (i.e., involuntary memories) occurred at similar levels in both groups. This suggests that, in conditions of minimal cognitive demand, mood affects not the temporal orientation of one's spontaneous thoughts but the typical content of thoughts about the future (cf. Smallwood et al., 2007). This is consistent with the recent characterisation of depressive thought in terms of *faulty prospection* (Roepke & Seligman, 2016), as distinct from dysfunctional processing of past or present events (as in classic rumination; Nolen-Hoeksema et al., 2008). Thus, an argument can be made along the lines of "inferring function from dysfunction" (Rose, 1998): If dysphoric mood, a generic indicator of dysfunctional thinking (Holmes et al., 2008; Gamble et al., 2021), produces a preponderance of hypothetical future thoughts relative to concrete plans, then perhaps the latter could be considered the hallmark of *functional* spontaneous future thinking.

Consistent with the preceding evidence, Mazzoni (2019) found that the emergence of spontaneous future plans required fewer cognitive resources than scenarios (implied by lower sensitivity to a cognitive load manipulation). Thus, despite their increased cognitive complexity, future plans appeared to occur more readily in consciousness. Mazzoni (2019) concluded that her results reflect a distinction between momentary, novel future constructions (i.e., scenarios) and "*memories* of previously formed future plans" (p. 695, emphasis added), two distinct types of future-oriented representation relying on separate cognitive mechanisms. These results are consonant with the emerging view that some SFTs are pre-encoded representations, similar to autobiographical memories, which can be retrieved with ease (i.e., memories of the future; Cole & Kvavilashvili, 2021).

In summary, classification schemes in the recent SFT literature (Plimpton et al., 2015; Mazzoni, 2019) distinguish planning from other potentially functional future-oriented processes such as scenario building (cf. Szpunar et al., 2014). This work complements and enriches mind-wandering approaches that reduce the functions of spontaneous future-oriented thought to the single construct of "autobiographical planning" (Baird et al., 2011; Smallwood & Schooler, 2015).

Despite growing evidence delineating possible functions of future-oriented MW and SFT, the relationship between given thoughts (e.g., imagining buying someone a gift) and a participant's overarching goals or intentions (making a favourable first impression; attempting to appease an offended party) often remains elusive. Typically, as in the studies discussed above, researchers only have access to thought descriptions reported at a particular time. Arguments for functionality are therefore restricted to the indirect kind: the proposal that given types of future thought might *in principle* benefit progress towards one's goals, although their actual fulfilment is not measured. To maximise its explanatory potential, the field therefore needs to consider ways in which sensitive measures of thought content can be combined with empirical observation of goal progress and fulfilment. Before reviewing the literature on goal pursuit that forms a backdrop to this endeavour, evidence from two related areas (mental simulation and automatic thought) will now be summarised, highlighting possible strategies for making thought functions directly observable.

Pham and Taylor (1999) set out to investigate the effects of different forms of mental simulation on student exam performance, and their underlying mechanisms, based on earlier theoretical predictions (S. E. Taylor & Schneider, 1989). They instructed students to perform one of three simulation exercises: *process simulation* (visualising oneself studying effectively); *outcome simulation* (visualising oneself receiving a high grade); or a combination of both. In addition, students in a control group were asked simply to monitor their studying behaviour up until the time of the exam (a period of around one week). The investigators asked all participants to report on their prior study behaviour, planning, emotional reactions (anxiety, worry, confidence) and a number of motivational measures immediately after performing their designated exercise, in order to assess possible mediators of simulation effects. They also contacted participants the day before the exam to

obtain measures of actual study behaviour and performance expectations shortly before performance was assessed. Pham and Taylor's (1999) results showed an average grade increase of around 7% for students assigned to practice process simulation, compared to the class average, versus a 2% decrease for those practising outcome simulation (planned comparison: $t = 2.52$, $p < .01$). Furthermore, mediational analyses showed that these effects could be explained by a combination of reduced feelings of anxiety, boosting performance directly, and increased reported planning, which boosted students' grade strivings on the previous day and thereby improved exam performance.

From the present perspective, Pham and Taylor's (1999) study presents a promising framework for measuring the effects of different thought modes on standardised performance data. It combines the rigour of an experimental manipulation with high ecological validity through the use of a real university assessment as an outcome measure. This type of work is somewhat lacking in the spontaneous thought / MW literature (but see Kane et al., 2021; Poerio et al., 2016). Nonetheless, the conceptual value of Pham and Taylor's (1999) study must be balanced against the limited relevance of their results to the question of *spontaneous* thoughts and their possible functions. Although participants in the various conditions were told to keep a record of their study behaviour, including occasions on which they rehearsed the initial simulation instructions, the investigators were not primarily interested in the emergence of goal-related content in ongoing thought. Hence, while the spontaneous rehearsal of particular simulations in the intervening period might play a part in determining subsequent performance levels (besides the documented mediators of anxiety and planning), this could not be verified within the design used by Pham and Taylor (1999).

Another study, on the functional value of automatic thought, provides a useful blueprint for eliciting thought content in relation to an anticipated goal. Morsella et al. (2010) informed participants that they would shortly be required to perform a task retrieving the names of all 50 US states, a letter-counting task also involving US state names, or neither task. All participants then completed an 8-minute mindfulness exercise encouraging them to focus on their breathing, during which they were asked to write down any "intrusive cognitions" (i.e., automatic, task-unrelated thoughts) that came to mind. Results showed that participants in the first group – assigned a performance goal involving

long-term memory retrieval – experienced significantly more geography-related thoughts during the intervening task than those in the other two groups. Morsella et al. (2010) explained their results in relation to the functional demands of each task: For letter-counting, intervening retrieval practice would not be beneficial (similar to the control condition, where no prospective demands were imposed). Therefore, thoughts about geography reported in the name retrieval condition – including but not limited to the rehearsal of state names – were taken to reflect automatic cognitive preparation for anticipated task demands (cf. Smallwood & Andrews-Hanna, 2013; Seligman et al., 2016). An alternate explanation based on simple priming could be ruled out, as control participants were made aware of the state name task (like those in the experimental group) but told they would not have to complete it.

Morsella et al.'s (2010) results, at face value, suggest that the contents of consciousness during a period of low-demand activity can be steered by the anticipation of an imminent performance goal. It is tempting to view this, through the present lens, as evidence of goal-directed function (cognitive preparation) in spontaneous thoughts of a particular future event (the naming task). However, there are grounds for proceeding with caution in this interpretation. Firstly, Morsella et al. (2010) simply had their participants note down any thoughts they perceived to be "intrusive" during the mindful breathing exercise. The notes were then used to derive scores for the number of geography-related and unrelated thoughts per participant, but no other information was provided on the occurrence or phenomenological experience associated with each thought (cf. Cole et al., 2016; Johnson et al., 1988). Thus, despite the authors' comparison of their data with the involuntary past and future thoughts of Berntsen and Jacobsen (2008), there is no guarantee that they truly reflect involuntary / spontaneous thoughts in the present sense (Berntsen, 2019; Cole & Kvavilashvili, 2021)[1]. Moreover, Morsella et al. (2010) described their predictions and findings in terms of the anticipated goal "triggering" preparatory thoughts; but no data were collected on the proximal triggers

[1] For instance, many of the geography-related thoughts in Morsella et al. (2010) might more closely resemble "mind pops", i.e., a form of spontaneous *semantic* representations (Kvavilashvili & Mandler, 2004).

(if any) that brought each thought to mind. The results must therefore be viewed as merely suggestive, rather than conclusive, regarding the effects of an upcoming goal on spontaneous future thinking.

Another caveat to the study by Morsella et al. (2010) is that they did not actually implement the advertised naming task, meaning that the putative function of the sampled thoughts could not be evaluated directly by looking at effects on overt behaviour (cf. Pham & Taylor, 1999; Poerio et al., 2016). Progress might be made in future research by combining these approaches – pairing an experimentally manipulated goal (such as a naming task) with some method of recording spontaneous thoughts during the preparation period, and assessing thought effects on behavioural outcomes. To ensure the validity of captured thought data, one would have to include measures of spontaneity (Barzykowski & Niedźwieńska, 2016; Jordão et al., 2019). In addition, since an assumed property of SFTs is that they are episodic, depicting specific events (Cole et al., 2016), it would be desirable to include some way of distinguishing episodic from non-episodic thoughts (B. Levine et al., 2002). After all, state names could presumably be rehearsed without the involvement of episodic memory processes (Tulving, 2002; but see Greenberg & Verfaellie, 2010). These considerations have informed the rationale and design of Studies 5 and 6 (Chapter 5), in the context of educational attainment. The next section completes the literature review by outlining theoretical approaches to goal pursuit which could be more closely integrated with cognitive research on SFT, also informing the empirical direction of the thesis.

1.5.2. Integrating SFT research with goal pursuit theories

Baumeister et al. (2016) make a strong case for conceptualising future thinking as "first and foremost a set of mental acts designed to guide future action for practical ends" (p. 3), terming this *pragmatic prospection*. This self-regulatory ability allows people to consider the array of possible outcomes in a given domain in relation to one's own future choices. Hence, the framework predicts and explains how prospective thought enables one to construct viable plans in order to achieve personal goals (Baumeister et al., 2016). In so doing, it draws upon existing models of the ways in which people conceive of their goals (Oettingen, 2012; Oettingen & Mayer, 2002) and develop plans to implement the necessary steps (Gollwitzer, 1999). Baumeister et al. (2016) propose that pragmatic

prospection can be split into two distinct stages, broadly reflecting these two areas of activity. In the first stage, desired future outcomes are selected from the wider matrix of possibilities (Baumeister et al., 2018), equating to *goal setting* (Klinger & Cox, 2011; Oettingen et al., 2001). The second stage serves to determine a route by which those outcomes may be achieved, equating to the process of planning: Once a goal has been identified as both desirable and feasible, a sequence of steps is formulated in order to reach that goal, taking account of relevant contingencies and external events (Gollwitzer & Oettingen, 2012). For instance, if an individual has conceived a desire to own a more energy-efficient car (i.e., the first stage), pragmatic prospection then affords the opportunity to mentally simulate and evaluate possible actions to bring this about (e.g., saving money for a deposit or committing time to researching different models). This second stage is crucial to the definition of pragmatic prospection. Wholly unfeasible goals such as the fantasy of owning a private space rocket can be imagined, but are unlikely to set in train pragmatic processes aimed at making them a reality.

The two-stage framework presented by Baumeister et al. (2016) reconciles previously conflicting results regarding levels of optimism exhibited in different contexts (see also Monroe et al., 2017). Consonant with evidence from self-regulation research (Oettingen, 2012; Pham & Taylor, 1999), it holds that effective goal pursuit features a combination of optimistic expectations tempered with a realistic appreciation of necessary steps and likely obstacles to success. Baumeister et al. (2020) conducted a large study examining the temporal and pragmatic content of everyday thoughts and found that around 30% of all thoughts referred to the future, alone or in combination with another "time zone" (e.g., future and present). Future thoughts were rated as more meaningful than past or present (cf. Heine et al., 2006), with those that featured planning (74%) and / or *temporal integration* with another time zone (48%) the most meaningful of all. Future thoughts that did not involve planning were often characterised by the responses "what you hope will happen" and "wondering what will happen", potentially indicative of goal selection and the consideration of future possibilities (Baumeister et al., 2020). Collectively, this evidence provides further support for the theory of pragmatic prospection (Baumeister et al., 2016), in that it identifies distinct forms of future-oriented thought (planning versus hypothetical thinking) which are both common and meaningful in the

everyday contents of consciousness (cf. Plimpton et al., 2015; Mazzoni, 2019). Furthermore, Baumeister et al.'s (2020) study highlights the potential applicability of pragmatic prospection in the context of spontaneous thought and its behavioural functions; future thoughts scored lower than present-focussed thoughts in estimates of conscious control (interpreted here as a reverse measure of spontaneous occurrence; cf. Cole & Kvavilashvili, 2021). Nonetheless, similar caveats apply here as for the studies reviewed in the preceding section: Baumeister et al. (2020) did not set out specifically to investigate *spontaneous* future thought, therefore their data likely reflect a heterogeneous mix of mental content, only some of which would meet our essential criteria (see section 1.1).

The work presented here anticipates considerable benefits in forging stronger links between theories of goal pursuit – such as pragmatic prospection – and the study of SFT. For instance, if distinct forms of prospection such as hypothetical thinking and planning can be identified among undifferentiated "everyday" thoughts (Baumeister et al, 2020), can these separate potential functions be isolated in a sample of more highly controlled SFTs? Studies reviewed above that have analysed involuntary thoughts according to experimenter- or participant-imposed categories (Plimpton et al., 2015; Mazzoni, 2019) would appear to answer in the affirmative. Rather than recapitulate those findings, this thesis will pursue a line of argument implied from both theoretical and empirical directions (Baird et al., 2011; Baumeister et al., 2016, 2020; Cole & Kvavilashvili, 2021; Oettingen & Schwörer, 2013; Stawarczyk et al., 2011): Spontaneous thinking about future events and actions can play an instrumental role in regulating behaviour towards desirable outcomes.

Another strand of theoretical work informing the present approach concerns the ways in which goals may be processed at a more abstract level, distinct from the simulation of future events (see Austin & Vancouver, 1996). The practice of *mental contrasting*, devised as an intervention to optimise goal pursuit in specific life domains (e.g., dieting; Oettingen & Wadden, 1991), constitutes one such approach (Oettingen, 2000, 2012). Mental contrasting entails first focussing on a desired outcome and then switching emphasis onto perceived obstacles to success (for instance, contemplating the satisfaction of a successful outcome at work before considering the challenges you may face). This promotes effective cognitive and emotional regulation (i.e., planning / managing

anxiety; cf. Pham & Taylor, 1999) and produces more selective goal pursuit than when one fixates solely on a desired outcome (Oettingen, 2012; for recent reviews of evidence see Cross & Sheffield, 2019; Hauser, 2018). Thus, one's general self-regulatory performance is improved (cf. Sevincer et al., 2017), since goals which lack sufficient incentive to warrant overcoming the associated obstacles tend to be disengaged from, thus freeing up motivational resources (Muraven & Baumeister, 2000; Wrosch et al., 2003). Study 4 (Chapter 4) focusses specifically on abstract goal processing, investigating the *self-regulatory thought modes* that occur naturally in a particular context. This conceptual and methodological departure informs and contextualises the aims and methods of the subsequent Chapter 5, which investigates goal-related spontaneous thought and performance in a naturalistic educational setting.

1.6. Thesis overview and summary of aims

Table 1.1 provides an overview of the content of each subsequent thesis chapter, including Chapter 6, a discussion and synthesis of the empirical findings and their conceptual value in explaining SFT. Its purpose is to illustrate the guiding research questions, principal methods and contributions of each chapter. As the chapters progress, less emphasis is placed on the subjective qualities of SFT as a form of conscious experience, instead foregrounding the question of functionality in pursuing its real behavioural consequences.

In summary, this thesis aims to A) expand and refine understanding of the cognitive basis of SFT; B) examine the cognitive, motivational and behavioural dynamics of goal pursuit in which SFT may play a functional role; and C) lend evidential weight to theoretical proposals connecting the two (Cole & Kvavilashvili, 2021; Seligman et al., 2016; Smallwood & Andrews-Hanna, 2013). Synthesising disparate lines of research along with a range of novel empirical data, the ultimate aim is to arrive at a more complete account of spontaneous future thinking both as a cognitive phenomenon and a functional ability.

Table 1.1. Overview of Thesis Chapters 2–6.

Chapter Title	Main Research Questions	Methods	Contributions
Chapter 2: What's in a cue? Influences of cue content on the occurrence and characteristics of SFTs	− How does changing verbal cue content impact the occurrence and characteristics of SFTs? − What can this tell us about the underlying mechanisms of SFT?	− Mixed-design laboratory experiment (Study 1) − Mixed-design online experiment (Study 2)	− Refined understanding of SFT triggers and their relation to goals − Novel online task paradigm
Chapter 3: The genesis and reoccurrence of spontaneous future thoughts: An experimental test of the 'memories of the future' hypothesis	− Are voluntary future event constructions spontaneously re-accessed in a subsequent task? − How do the findings relate to Cole & Kvavilashvili's (2021) dual process model?	− Mixed-design laboratory experiment combining voluntary and spontaneous thought tasks (Study 3)	− Test of a recent theoretical model to directly advance field and drive research on fundamental nature of SFT
Chapter 4: Self-regulatory thought and goal pursuit: Insights from a naturalistic study during COVID-19	− Do self-regulatory thought (SRT) mechanisms operate differently for uncontrollable, pandemic-related goals? − Can the unprompted SRT paradigm be applied to understanding the functional value of SFT?	− Online survey in community sample with pseudo-experimental manipulation of subjective controllability (Study 4)	− Snapshot of self-regulation during COVID-19 pandemic − Methodological innovation for studying functional SFT
Chapter 5: Contributions of spontaneous thought to performance in higher education	− Does the frequency / content of SFTs predict performance in an upcoming knowledge test? − How does an adapted trait measure of *goal-directed spontaneous thought* relate to performance on a subsequent online exam?	− Lab study of SFT content and mock test performance (Study 5) − Prospective study of cognitive-motivational factors contributing to exam performance (Study 6)	− Direct evidence of functional value of SFT − Developing a model to explain interaction of spontaneous thought and motivation
Chapter 6: General discussion	Chapter 6 will synthesise the results and implications of Studies 1–6, drawing upon their theoretical and methodological diversity to arrive at a novel and nuanced account of SFT as a general phenomenon. Its ultimate aim is to explain how thoughts of possible future events, occurring without conscious intent, may play an intermediary role between abstract goals / intentions and the enactment of behaviour to fulfil them. Chapter 6 also outlines a number of as yet unanswered questions and directions for future research on SFT.		

Chapter 2. What's in a Cue? Influences of Cue Content on the Occurrence and Characteristics of Spontaneous Future Thoughts

2.1. Introduction

A commuter sits on a train during her journey into work. Her immediate priority is to get off at the right stop – a feat accomplished by monitoring the environment for the familiar signs (a particular building; the announcement of her stop). Having travelled this route many times before, she allocates minimal resources to the task, letting her mind wander and settle on other things. A while before her stop, the commuter sees a billboard advertising the high-performance car she has been privately coveting, and finds herself imagining the feel of the luxurious interior and the smooth acceleration as she drives off the forecourt.

This is a common everyday scenario in which spontaneous future thought might occur, with an evident correspondence between an environmental cue (car advertisement) and the resulting mental experience (imagined car purchase). Such thoughts are often cue-dependent in this sense (Berntsen, 2019). However, given an existing interest in the car, one might also have spontaneously imagined the purchase in the absence of a cue (Klinger, 1975, 2013); whereas an irrelevant advertisement (e.g., for a snack food) would not be expected to trigger such a thought as it presents little or no *associative overlap* with the event in question (Berntsen et al., 2013). To better understand the dynamics of spontaneous future thought (SFT), such possibilities need to be tested and quantified in controlled experiments. This chapter pursues that line of enquiry, centred on the following research question: How does the content of concurrent environmental information impact the occurrence and characteristics of spontaneous future thoughts?

2.1.1. Involuntary Thoughts and Incidental Cues

SFT commonly occurs during undemanding everyday activities, as illustrated in the above scenario; the subject can be said to experience "mental time travel" to a possible future event outside of the here and now (Berntsen, 2019; Cole et al., 2016; Plimpton et al., 2015). Furthermore, SFTs

come to mind involuntarily: Our hypothetical commuter comes to experience a future car purchase without choosing to direct her attention to that possibility. Instead, her focus shifts automatically from the external environment to the internally generated SFT (i.e., an "uncontrolled shift"; Giambra, 1995). In both senses, SFT resembles canonical mind-wandering (MW), as summarised in Chapter 1 Smallwood & Schooler, 2015, 2006. However, SFTs can be either related or unrelated to environmental input, whereas typical definitions of MW rest on the property of stimulus independence (Antrobus, 1968; Smallwood & Schooler, 2006; Stawarczyk et al., 2011). In assessing SFTs as a distinct class of mental representations, the experiments presented in this chapter will focus upon exactly this issue, examining differences in thought content according to A) whether a given thought was triggered by an external cue; and B) the type of cues to which different groups of participants are exposed.

The typical paradigm used to capture SFTs, first developed for IAM research, involves a primary vigilance task in which the participant must detect occasional vertical line targets among a stream of horizontal fillers (Schlagman & Kvavilashvili, 2008). Involuntary thoughts are then captured either through probes imposed by the experimenter (Mazzoni, 2019; Plimpton et al., 2015) or through "self-caught" reporting at the participant's discretion (Cole & Berntsen, 2016; Schlagman & Kvavilashvili, 2008). In addition, incidental cues are presented throughout the task (typically, verbal cues such as "warm weather" or "relaxing on a beach"; (Mazzoni et al., 2014; Schlagman & Kvavilashvili, 2008)). These are described to participants as "irrelevant" to the task at hand and hence to be ignored, emulating the non-focal nature of everyday cues like the car advertisement in the scenario above. Under these conditions, cues providing distinctive associative links to stored memory content (Berntsen et al., 2013; Conway & Pleydell-Pearce, 2000) can frequently trigger involuntary thoughts. Studies have shown that involuntary thoughts of both temporal orientations (past and future) are frequently attributed to incidental cues (Cole et al., 2016: 69% of IAMs, 58% of SFTs; cf. Berntsen & Jacobsen, 2008). There has been ample research on how cues operate in an involuntary memory context (Berntsen & Hall, 2004; Mace, 2004; Vannucci et al., 2015); yet investigation of cue effects on SFTs has been relatively scarce. Since SFTs are also frequently attributed to cues (Cole et

al., 2016; Plimpton et al., 2015), there is a need for more specific investigation of the mechanisms involved.

2.1.2. Goal-Dependency and Cue Content

A long-established feature of spontaneous thought is that it frequently reflects an individual's current priorities or goals (Klinger, 2013; Klinger et al., 2018). If one is preoccupied with one's weight, for instance, one's stream of consciousness is likely to be interrupted by content relating to this – reflections on past experiences and atemporal self-comparisons, in addition to future-oriented thoughts about losing weight (Jones & Rogers, 2003). The mind-wandering literature evidences a clear predominance of goal-directed content among spontaneous thoughts about the future (Baird et al., 2011; Stawarczyk et al., 2011), while around half of IAMs sampled in everyday life also relate to uncompleted personal goals (Johannessen & Berntsen, 2010).

A recent study by Cole and Berntsen (2016) used Klinger's concept of current concerns (Klinger, 1977, 2013; Klinger & Cox, 2011) to gauge goal-directed content among voluntary and involuntary past and future thoughts. Using the vigilance task described above, with a standard set of cue phrases (Schlagman & Kvavilashvili, 2008), these authors confirmed that SFTs frequently reflect personal current concerns such as passing an exam or improving one's health – mirroring the goal-directed content of everyday spontaneous thought (Klinger, 1975, 1977). In their *future-involuntary* condition, an average of 65% of thoughts were perceived as relevant to participants' reported concerns, exceeding voluntary future constructions (47%) and both memory retrieval conditions (35% overall; Cole & Berntsen, 2016).

Furthermore, several studies have investigated the causal influence of goals on spontaneous thoughts by priming participants to think about their goals before an experience sampling procedure (Jordão et al., 2019; Stawarczyk et al., 2011). Stawarczyk et al. (2011) used an explicit goal-priming procedure in which the experimental group wrote a one-page essay describing their current goals, while the control group performed an equivalent task describing a walking route. This had no effect on overall rates of subsequent mind-wandering, but specifically promoted future-related spontaneous

thoughts in the experimental group. Similarly, Jordão et al. (2019) showed a selective priming effect on spontaneous future thoughts in younger and older adults. Incorporating a card-sorting task halfway through the experience sampling task (to implicitly prime goal representations) resulted in a pronounced increase in SFTs as a proportion of total task-unrelated thoughts (TUTs) across both age groups. Both of these priming studies demonstrate not only that SFTs reflect behavioural goals in terms of their content, but that their occurrence – distinct from other classes of spontaneous thought, such as memories – is specifically driven by the processing of goal-relevant information.

Relatedly, McVay and Kane (2013) manipulated cue content during a mind-wandering task to modulate TUT occurrence within participants. Alongside generic cues, each participant saw some idiosyncratic word triplets during the task, tailored to their goals based on prior assessment (e.g., INCREASE – FACIAL – HAIR for someone reporting the intention to grow a beard). Across a series of experiments, these personalised cues produced a small but reliable increase in mind-wandering rate (3–4%) relative to generic cues (McVay & Kane, 2013), allowing the authors to tie TUT occurrence to specific environmental stimuli and thereby heralding an important methodological and conceptual development in the study of mind-wandering (Christoff et al., 2016; Maillet et al., 2017). Since McVay & Kane (2013) neither analysed their data by temporal orientation (i.e., memories versus future events) nor examined the intentionality of the reported thoughts, one cannot conclude from these results alone that SFTs *per se* are sensitive to the semantic content of cues. Nevertheless, the comparable dual-task procedure (i.e., attentional task plus experience sampling), together with the prospective bias generally found in mind-wandering (Baird et al., 2011; Stawarczyk et al., 2011), imply that at least some of the thoughts sampled would have been both spontaneous and future-oriented. McVay & Kane's (2013) findings therefore motivate a more specific examination of how changes in cue content may facilitate the occurrence of SFTs.

Synthesising from the above literature, SFTs should show specific sensitivity to cues which activate goal representations. The representations in question can be conceived of as *possible selves* – aspects of an individual's self-concept expressing positive and negative future identities, or "hoped-for" and "feared" selves (Markus & Nurius, 1986). Possible selves are continuously in flux, with

numerous such representations concurrently active, consciously or unconsciously, in one's *working self-concept* (Markus & Nurius, 1986). For example, the person immersed in images of their future car demonstrates conscious activation of a "happy car owner" possible self, alongside a series of other selves reflecting current / possible aspects of their identity (e.g., supportive colleague, negligent parent). Similar to current concerns (Klinger, 1975, 2013), the contents of the working self-concept are proposed to exert a pervasive influence over ongoing thought (Markus & Nurius, 1986). Correspondingly, the content of autobiographical thoughts has been found to cluster around points of historical or anticipated change in the self-concept (e.g., becoming a parent; Conway et al., 2019; Demblon & D'Argembeau, 2014; Rathbone et al., 2011). Applying the theory to the present research context, cues which alter the balance of activation in the working self-concept should be highly effective in triggering spontaneous autobiographical thoughts. In particular, cues activating possible *future* selves should trigger SFTs more frequently than generic cues.

2.1.3. Outline of Studies 1 and 2

To summarise the above, incidental cues trigger task-unrelated thoughts (TUTs), including a substantial proportion of SFTs, in dual-task studies of involuntary thought and mind-wandering (Baird et al., 2011; Cole et al., 2016; Plimpton et al., 2015; Stawarczyk et al., 2011; Vannucci et al., 2015, 2017). McVay & Kane (2013) showed that cues reflecting personal goals facilitate the occurrence of TUTs relative to generic cues; this may in part reflect increased triggering of SFTs through the activation of goal representations resembling possible selves (Conway et al., 2019; Markus & Nurius, 1986; see also Figure 1.1, Chapter 1). The present research addresses this question directly by implementing a novel cue manipulation within a standard experience sampling task (Cole et al., 2016; Schlagman & Kvavilashvili, 2008) to selectively probe the mechanisms by which SFTs emerge in consciousness.

Given the specific focus on the mechanisms of SFT, rather than spontaneous thought more generally, it seemed prudent to use a version of the vigilance task paradigm designed to capture only SFTs (Cole et al., 2016). Experience sampling tasks in which participants are instructed to report a

particular class of mental contents only are referred to as *restricted* (Barzykowski & Staugaard, 2016, 2018). Barzykowski and Staugaard (2018) compared the frequency and characteristics of IAMs between restricted and unrestricted (i.e., report any involuntary thought) conditions, finding that the frequency more than doubled in the restricted condition (from four to around 10 reports per participant during a 25-minute vigilance task). The authors interpreted these results in line with a "threshold hypothesis" (Barzykowski & Staugaard, 2016) whereby the threshold for the relevant thoughts to enter awareness is lowered when participants monitor for certain contents, making a wider range of thoughts available to report. This chapter assumes that SFT elicitation will be similarly facilitated under restricted (monitoring) conditions, enhancing the scope to make comparisons within this class of thoughts (cf. Cole et al., 2016).

Rather than generate idiosyncratic cues (McVay & Kane, 2013), the present studies adopted a different approach: Cue type was manipulated between participants using a standardised list of phrases representing normative life goals (Weinstein, 1980) alongside standard cues (Studies 1 and 2) and two exploratory comparison conditions (Study 1). This provides a clear analogue to the everyday context which these studies seek to emulate, in which a variety of environmental information is encountered, sometimes triggering highly personal future thoughts despite its impersonal nature (e.g., the car advertisement is not tailored to an individual observer's goals). Additionally, the self-caught procedure (free thought reporting throughout the task) was used in order to capture both stimulus-dependent (i.e., cue-triggered) and stimulus-independent SFTs equivalently – enabling the outputs of these two potentially distinct mechanisms (Maillet et al., 2017; Ciaramelli & Treves, 2019) to be compared under different cue conditions. By employing this novel design in both a conventional lab setting (Study 1) and online (Study 2), this chapter will contribute to the ongoing conceptual development of SFT (Cole & Kvavilashvili, 2021) and to broader theoretical debates on the relationship between mind-wandering and spontaneous thought (Christoff et al., 2018; Seli, Kane, Smallwood, et al., 2018; Berntsen, 2019).

2.2. Study 1: Laboratory Experiment

2.2.1. Aims and Hypotheses

Study 1 used a laboratory vigilance task (Cole et al., 2016; Plimpton et al., 2015; Schlagman & Kvavilashvili, 2008) to compare SFT occurrence and characteristics across four cue conditions. The key comparison of interest was between *standard cues* (as used in Schlagman & Kvavilashvili, 2008) and a novel set of *goal cues*, representing life goals (hopes and fears) ubiquitous in young adults (Weinstein, 1980). A further control condition featured *future cues*: a set of future-related linguistic expressions lacking clear goal associations (i.e., low in autobiographical significance; Renoult et al., 2012), which were devised to control for the possibility that implied future tense alone might influence the rate at which SFTs occur (cf. Vannucci et al., 2019; visuospatial influences on temporal orientation of MW). Finally, a fourth condition featured *scrambled* cues, a perceptual control for the standard set in which the letters were randomly reordered.

Two novel hypotheses were investigated concerning SFT occurrence:

1. The introduction of goal cues will increase the overall frequency of SFTs, relative to standard cues. This would be consistent with, and expand on, previous studies showing effects of offline goal priming (Jordão et al., 2019; Stawarczyk et al., 2011) and the use of idiosyncratic, goal-related cues (McVay & Kane, 2013). No study has yet attempted to demonstrate an equivalent effect using between-subjects manipulation of cue sets.

2. Goal cues will increase the frequency and / or proportion of SFTs relating to a participant's personal goals, assessed via the short-form Current Concerns Questionnaire (CCQ; Sellen et al., 2006) administered post-task (as in Cole & Berntsen, 2016). This would confirm that cues activating common life goal representations specifically trigger SFTs that are autobiographically relevant and constrained by current goals (e.g., future plans as opposed to mere "scenarios"; Mazzoni, 2019).

Additionally, the majority of SFTs across the experiment were expected to be both cue-triggered and related to goals reported in the CCQ, mirroring typical findings in this paradigm (Jordão et al., 2019; Cole & Berntsen, 2016; Plimpton et al., 2015). We also examined the influence of cue type and trigger category (cue-triggered versus no trigger) on subjective characteristics captured at or after the point of SFT elicitation (cf. Cole et al., 2016; Johnson et al., 1988). These analyses were exploratory and aimed to contextualise the main confirmatory findings relating to SFT occurrence.

2.2.2. Methods

2.2.2.1. Participants

Participants were recruited through the York St John University psychology research participation scheme (n = 63) and physical / email advertisements within the university (n = 26). Psychology students were compensated with course credit, while the latter group were entered into a draw for five £20 cash prizes. Individuals who had completed similar studies in the past (e.g., involuntary thought studies conducted in our lab) were ineligible to take part.

Of a total of 89 participants, data for 78 were included in analyses. Reasons for exclusion comprised non-compliance with instructions (n = 4); data irregularities (e.g., incomplete questionnaires; n = 5); psychological illness (n = 1) and computer error (n = 1). The final sample comprised 58 females and 20 males, with a mean age (± SD) of 21.5 ± 4.9 years. Each participant was randomly assigned to one of four experimental conditions, described below, resulting in similar age profiles ($F < 1$) and gender ratios between groups ($\chi^2_{(3)} = .42$, $p = .94$). While completing the study, participants were unaware of the other experimental conditions.

2.2.2.2. Design

The main independent variable was Cue Type, manipulated in four between-subjects levels (goal cues, future cues, standard cues, scrambled cues). Two within-subjects IVs were defined by separating thoughts by Trigger (cue-triggered, no trigger) and Goal-Relatedness (related, unrelated), giving a mixed design with three factors. Dependent variables reflected aspects of SFT occurrence (frequencies and proportions per participant) and SFTs' subjective characteristics (measured at the thought level, e.g., cognitive effort, vividness; see Materials).

Within-subjects designs are often favoured in SFT research as they are robust to individual variation in spontaneous thought tendencies (e.g., Jordão et al., 2019). Here, however, the use of a between-subjects design enabled four different cue types to be compared with minimal adaptation from previous versions of the task (Cole & Berntsen, 2016; Schlagman & Kvavilashvili, 2008). Another data set contrasting different cue sets within participants revealed a tendency for multiple

successive cues to influence a single thought report (Cole et al., *in preparation*), confounding attempts to assess their independent effects. The study was approved by a University Ethics Committee.

2.2.2.3. Materials

Vigilance Task Paradigm

SFTs were elicited using a dual-task paradigm developed by Schlagman and Kvavilashvili (2008) for capturing involuntary memories and later adapted for SFTs (Cole et al., 2016; Plimpton et al., 2015). The primary task consisted of 600 trials of 1.5s duration, displaying either horizontal or vertical line arrays, presented on E-Prime Professional Version 2.0 software. Participants were required to press the spacebar each time a vertical array appeared, which occurred infrequently (11 times) at fixed pseudorandom intervals throughout the task (every 40-60 trials). Cue phrases were embedded within the line arrays in 120 out of 600 trials (20%), an adjustment designed to minimise potential cue overload (Berntsen et al., 2013) and promote the occurrence of SFTs as opposed to involuntary memories (Vannucci et al., 2017).

Cue Stimuli

Four sets of 120 cues were used, with each participant being exposed to one set according to group assignment (goal, future, standard, scrambled).

Goal cues were constructed afresh and comprised 60 positive (i.e., achieve) and 60 negative (i.e., avoid) life events commonly anticipated by young adults (Weinstein, 1980, 1982). These reflect normative goals likely to map onto aspects of a participant's self-concept (i.e., possible selves, Markus & Nurius, 1986; self-images, Conway et al., 2019). Life events were selected from existing inventories and questionnaires (Brugha & Cragg, 1990; Roberts & Robins, 2000; Twenge et al., 2012; Van Rijsoort et al., 1999; Weinstein, 1980) and filtered to eliminate duplicates (e.g., "being fired from a job", "sacked from a job") and phrases with evident similarity to those in the standard set. The final cue set included "high-flying career" (positive) and "serious illness" (negative).

Future cues were also constructed afresh and aimed to indicate future temporality without referencing meaningful events, to control for the possibility that goal cues might facilitate SFT by

their implied timeframe alone (i.e., references to parenthood or career success prompting future-oriented thinking regardless of particular goal associations). This consideration was informed by evidence of profound influences of visuospatial information linked with a particular temporal orientation on mind-wandering content (Vannucci et al., 2019). The final set of 120 cues included phrases such as "next year" and "I'll let you know".

Standard cues were randomly selected from a long list (N = 800) used by Schlagman and Kvavilashvili (2008), with the constraint of balancing cue valence against the goal cue condition (i.e., 60 positive and 60 negative phrases). The resulting list included phrases such as "warm weather" (positive) and "flat tyre" (negative). Several recent studies have used the same original cue list (Barzykowski et al., 2019; Barzykowski & Staugaard, 2018; Cole & Berntsen, 2016; Vannucci et al., 2015, 2017).

Finally, **scrambled cues** were produced by taking the standard cues and rearranging the letters of each word in a random order. This resulted in nonsensical sequences of letters (e.g., "marw ewathre" for "warm weather"), reducing the scope for fast semantic activations presumed to underlie SFT triggering (Berntsen & Jacobsen, 2008) while controlling for the presence of letters onscreen. A full list of all cue sets is included in Appendix I.

Thought Questionnaires and Current Concerns Questionnaire (CCQ)

Written descriptions and subjective ratings for each SFT were provided using a two-part paper questionnaire based on the Autobiographical Characteristics Questionnaire (Johnson et al., 1988; Cole & Berntsen, 2016). The first part was completed during the primary task upon reporting each thought, and comprised five items: written thought description; free-text trigger description (e.g., "the words *broken friendship* onscreen" or "no trigger"); 5-point Likert rating of cognitive effort in bringing the thought to mind (1 = *No effort at all*; 5 = *Extremely effortful*); temporal distance rating on a calibrated scale (<1 month, 1-3 months, 3-12 months, 1-5 years, >5 years; cf. 7-point scale used by D'Argembeau et al., 2011); and 5-point Likert rating of vividness (1 = *Not at all vivid*; 5 = *Extremely vivid*).

Upon finishing the vigilance task, participants were asked to complete a short-form version of the Current Concerns Questionnaire (CCQ) to assess their current behavioural goals (Sellen et al., 2006). This has been used in previous research on involuntary memories and future thoughts (Johannessen & Berntsen, 2010; Cole & Berntsen, 2016) and elicits five current goals or priorities, positive or negative, giving the (positive) example of "spend more time on my hobbies – especially singing". It also elicits importance ratings for each goal on a 10-point scale (0 = *Not at all important*; 9 = *Extremely important*).

The second part of the thought questionnaire, completed afterwards, consisted of six items: further description detail (optional); binary trigger question ("Was the thought triggered by a phrase you saw onscreen?", yes / no); binary specificity question ("Does the future thought refer to a particular situation on a particular day in your future?"); 5-point Likert ratings of subjective presence (1 = *Did not feel like I was there at all*; 5 = *Felt strongly like I was really there*) and emotional valence (-2 = *Strongly negative*; +2 = *Strongly positive*); and a final binary question asking if the thought was related to any of the current concerns reported previously (henceforth referred to as *goal-relatedness*).

2.2.2.4. Procedure

After providing written informed consent, each participant completed the study in an individual testing room, equipped with a desktop computer and paper thought questionnaires. Two experimenters facilitated the study (the present author and one trained research assistant), both of whom were aware of group assignment and study aims. The vigilance task was presented as a "concentration task" with the sole aim of maintaining focus on the sequence of line arrays to maximise speed and accuracy at detecting the targets. Participants were informed that phrases would appear on some trials, but that these were irrelevant and should be ignored (as a cover story, they were informed that another group would focus on the phrases). Start-up instructions were identical across the four cue conditions. A practice block of 40 trials, including three targets, was used to familiarise participants with the task.

Following the practice block, participants were informed that the monotonous nature of the task could cause "unrelated thoughts, including daydreams, memories and possible future events" to come to mind involuntarily. They were instructed to use the part 1 thought questionnaires to record any "involuntary future events" as they occurred, filling out a separate questionnaire for each thought up to a maximum of 12 (two participants completed all 12 forms). A concise definition of spontaneous future thought (Cole & Kvavilashvili, 2021) was also provided to aid understanding[2]. To minimise demand characteristics, participants were then reminded that the primary aim was to detect the target line arrays and that concentration should be maintained throughout the task.

During the main block of 600 line-detection trials, participants were free to pause the task at any point using a mouse-click (with their dominant hand) in order to record an SFT (a "self-caught" procedure; Cole & Berntsen, 2016; Smallwood & Schooler, 2015). This automatically displayed a screen instructing participants to fill out a thought questionnaire and press enter to return to the task when finished. The dual-task procedure is illustrated in Figure 2.1.

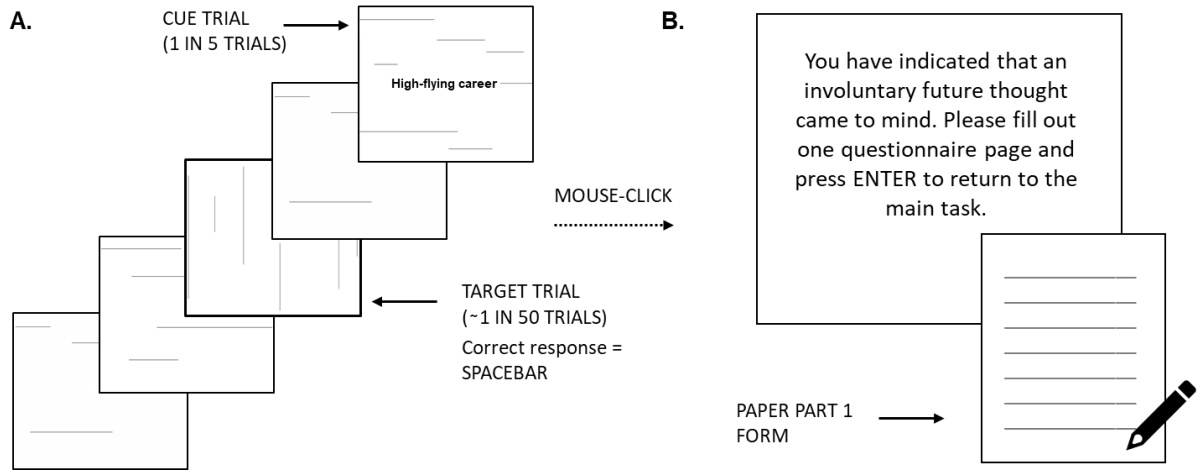


Figure 2.1. Schematic Diagram of Study 1 Task Procedure (A. Vigilance Task; B. Thought Reporting Screen)

[2] "Involuntary future thoughts may be in the very near future or in the distant future. They may vary in detail and specificity… The only criterion we have is that your future thought came to mind spontaneously without you trying to think of something."

The paper CCQ was administered after the vigilance task as an ostensibly unrelated activity. After this, participants received as many part 2 thought questionnaires as they had reported SFTs and referred to the part 1 and CCQ forms when completing these. Finally, participants were debriefed regarding study hypotheses (i.e., the four cue conditions were explained) and thanked for their participation.

2.2.3. Results

2.2.3.1. Vigilance Task Performance

Participants were highly successful at detecting the 11 primary-task target stimuli (mean ± SD proportion correct = 0.95 ± 0.06; correct RT = 663 ± 108ms). To ensure consistency in performance between groups, two analyses were performed. Firstly, a one-way ANOVA on proportion correct between the four cue conditions showed no effect of group ($F_{(3,74)} = 1.34$, $p = .27$). Secondly, a one-way ANOVA on mean RT (correct responses) also showed no effect of group ($F < 1$). Thus, the cue content manipulation did not influence either the accuracy or speed with which participants performed the primary attentional task.

2.2.3.2. Processing of SFT Data

Filtering

The 78 included participants generated a total of 453 thought reports. To exclude past or atemporal events erroneously recorded as SFTs, the author coded temporal orientation for all written thought descriptions. Those tagged for exclusion (e.g., "…a memory of sitting in my biology lesson") were re-coded by four independent raters alongside a random sample of included data, yielding excellent reliability (α = .92). Subsequently, $n = 11$ non-future thoughts were removed from the sample.

Data were further filtered to exclude thoughts triggered by an external source other than the cues ($n = 52$) and where the participant omitted to answer the trigger question ($n = 4$). Externally-triggered thoughts largely referenced the vigilance task (e.g., "waiting for the lines to appear"); such material is typically excluded in comparable studies (see Stawarczyk et al., 2011, *task-related interference*). Hence, all SFTs analysed below fall into one of two categories: "cue-triggered" or "no trigger". The final data set comprised 386 SFTs reported by 78 participants.

Checking Spontaneity

Next, the extent to which filtered data represented truly *spontaneous* thoughts was checked by examining effort ratings across the entire sample. This yielded a mean rating of 1.81 (SD = 0.59, 1–5

Likert). No thoughts were rated as 'extremely effortful' (5/5). Thus, in the absence of direct information on intentionality, the data comprised thoughts of future events coming to mind with little or no effort during an unrelated focal task, hence representing the phenomenon of SFT as intended (Cole & Kvavilashvili, 2021).

Checking CCQ Consistency

Finally, CCQ importance ratings were analysed to ensure consistency across conditions. A one-way ANOVA produced no effect of group ($F < 1$), indicating that this measure was completed equivalently between the four groups, with participants reporting fairly important goals on average (overall mean = 6.83, SD = 1.00).

2.2.3.3. Descriptive Statistics

Table 2.1 summarises SFT occurrence data according to Cue Type, Trigger and Goal-Relatedness, as raw frequencies and proportions (Cole & Berntsen, 2016), for Studies 1 and 2. Table 2.2 summarises data on SFT characteristics across both experiments. Blank cells (-) occur where the relevant measure was not included (e.g., effort, time, etc. in Study 2). As anticipated, Study 1 showed a majority of SFTs to be cue-triggered (69%) and goal-related (64%) across the four cue conditions.

Table 2.1. Mean frequencies and proportions of SFTs by Cue Type, Trigger and Goal-Relatedness in Studies 1 (lab) and 2 (online)

		Goal Cues				Future Cues				Standard Cues				Scrambled Cues			
		No Trigger		Cue-triggered		No Trigger		Cue-triggered		No Trigger		Cue-triggered		No Trigger		Cue-triggered	
		NG	G	NG	G	NG	G	NG	G	NG	G	NG	G	NG	G	NG	G
Study 1	Frequency (SD)	0.26 (0.45)	0.95 (0.91)	2.16 (2.36)	3.16 (3.06)	0.40 (0.82)	0.75 (1.12)	1.30 (1.34)	2.05 (1.96)	0.42 (0.69)	0.58 (0.51)	1.21 (1.36)	2.11 (2.08)	0.45 (0.70)	1.00 (1.25)	1.05 (1.08)	2.00 (2.18)
	Proportion (SD)	0.07 (0.14)	0.20 (0.23)	0.32 (0.26)	0.40 (0.29)	0.06 (0.13)	0.24 (0.33)	0.28 (0.29)	0.42 (0.34)	0.13 (0.19)	0.18 (0.18)	0.25 (0.21)	0.45 (0.29)	0.09 (0.14)	0.27 (0.35)	0.25 (0.26)	0.39 (0.39)
Study 2	Frequency (SD)	0.41 (0.66)	0.50 (0.86)	0.33 (0.74)	0.72 (0.96)					1.00 (1.07)	0.88 (1.05)	0.68 (0.87)	0.76 (1.06)				
	Proportion (SD)	0.21 (0.34)	0.27 (0.40)	0.15 (0.29)	0.37 (0.39)					0.30 (0.30)	0.26 (0.30)	0.24 (0.31)	0.20 (0.29)				

G = goal-related; *NG* = not goal-related

Table 2.2. Mean (SD) SFT characteristics by Cue Type in Studies 1 (lab) and 2 (online)

		N	Total SFTs	Cue-triggered (Proportion)	Effort (1–5)	Spontaneity (1–5)	Time (1–5)	Vividness (1–5)	Presence (1–5)	Valence (-2–2)	Goal-related (Proportion)
Study 1	Goal Cues	19	6.53 (3.50)	0.73 (0.23)	1.91 (0.53)	-	2.85 (1.11)	3.21 (0.64)	3.49 (0.77)	0.19 (0.77)	0.61 (0.31)
	Future Cues	20	4.50 (2.93)	0.70 (0.32)	1.83 (0.56)	-	2.29 (0.69)	2.99 (0.69)	3.21 (0.80)	0.42 (0.98)	0.66 (0.31)
	Standard Cues	19	4.32 (2.60)	0.70[a] (0.30)	1.62 (0.52)	-	1.96 (0.89)	2.90 (0.81)	3.16 (0.99)	0.71 (0.74)	0.63[a] (0.24)
	Scrambled Cues	20	4.50 (2.71)	0.64 (0.36)	1.87 (0.71)	-	2.00 (0.69)	3.13 (0.77)	3.03 (0.84)	0.32 (0.94)	0.66 (0.29)
	Total	78	4.95 (3.03)	0.69 (0.31)	1.81 (0.59)	-	2.28 (0.91)	3.06 (0.72)	3.22 (0.85)	0.41 (0.87)	0.64 (0.28)
Study 2	Goal Cues	34	2.93 (2.92)	0.52[b] (0.45)	-	1.53 (0.66)	-	3.35 (0.99)	-	-	0.63[b] (0.39)
	Standard Cues	34	4.09 (3.63)	0.44[c] (0.40)	-	1.59 (0.68)	-	3.36 (1.05)	-	-	0.45[c] (0.33)

[a] Mean calculated for *n* = 18 due to 1 participant reporting no SFTs; [b] Mean calculated for *n* = 30 due to 4 such participants; [c] Mean calculated for *n* = 33 due to 1 such participant.

2.2.3.4. Effects of Trigger, Goal-Relatedness and Cue Type on SFT occurrence

To test the main hypotheses regarding overall and goal-related SFT frequency, two analyses were performed. The first took raw frequency data as its dependent measure; the second, proportional data (cf. Cole & Berntsen, 2016). Both used conventional mixed ANOVA with two within-subjects factors (Trigger, Goal-Relatedness) and one between-subjects factor (Cue Type).

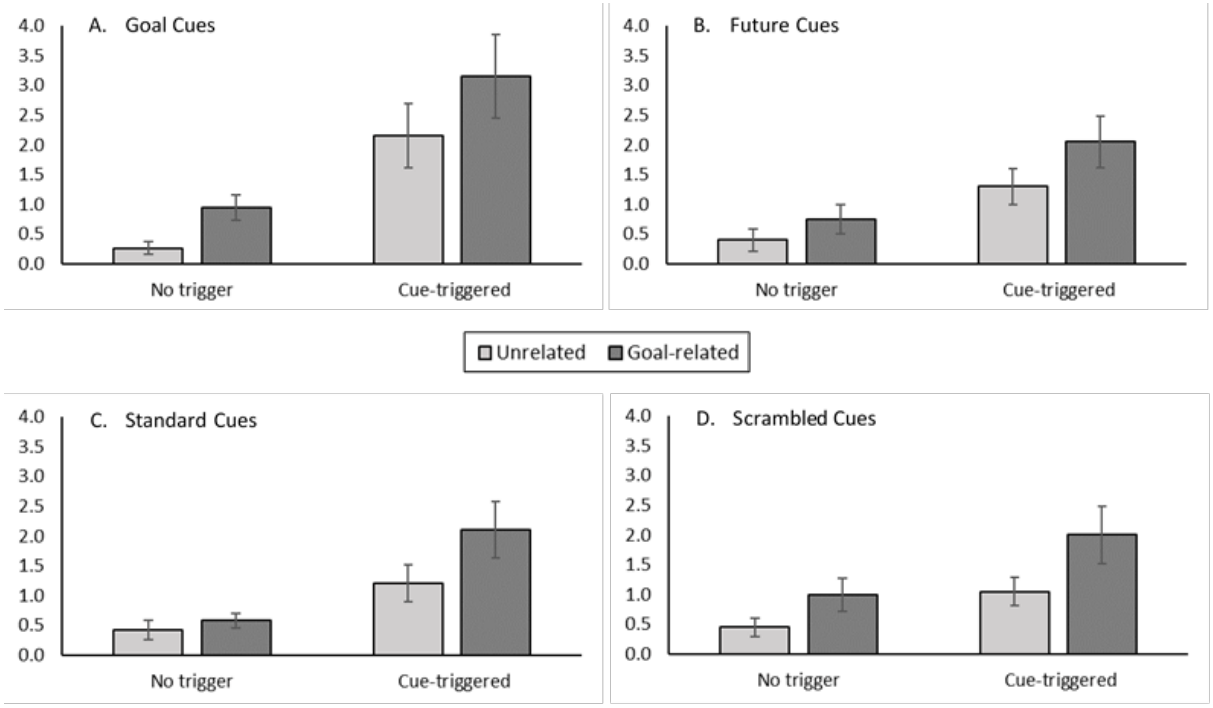


Figure 2.2. Mean SFT Frequency by Trigger, Goal Category and Cue Type:
Goal Cues (A); Future Cues (B); Standard Cues (C); Scrambled Cues (D)
(Error Bars = ± 1 SE)

Analysis by Frequency

Analysis by frequency yielded significant main effects of Trigger ($F_{(1, 74)} = 43.00$, $p < .001$, $\eta_p^2 = .37$) and goal category ($F_{(1, 74)} = 15.24$, $p < .001$, $\eta_p^2 = .17$). Figure 2.2 provides a graphical representation of these results. Overall, SFTs were more often triggered by cues (M = 3.74, SD = 3.05, right-hand clusters) than reported to have no trigger (M = 1.21, SD = 1.20, left-hand clusters); while goal-related SFTs (M = 3.14, SD = 2.46, dark bars) outnumbered those unrelated to participants' five listed current concerns (M = 1.81, SD = 1.72, light bars). No interaction was found between these two factors ($F_{(1, 74)} = 1.99$, $p = .16$), indicating that the main effect of goal category did

not differ between the two levels of Trigger. Hence, both cue-triggered and untriggered SFTs were more often goal-related than unrelated (ts > 3, ps ≤ .003).

Neither within-subjects factor interacted with Cue Type (Fs < 1.90, ps > .10), nor was a three-way interaction evident (F < 1); but the main effect of Cue Type approached significance ($F_{(3, 74)}$ = 2.41, p = .074, η_p^2 = .09). The total number of SFTs was numerically highest for goal cues (M = 6.53, SD = 3. 50; Figure 2.2, panel A total) and lowest for standard cues (M = 4.32, SD = 2.60; Figure 2.2, panel C total); a two-tailed pairwise comparison revealed a significant medium-sized effect ($t_{(36)}$ = 2.21, p = .034, d = .72).

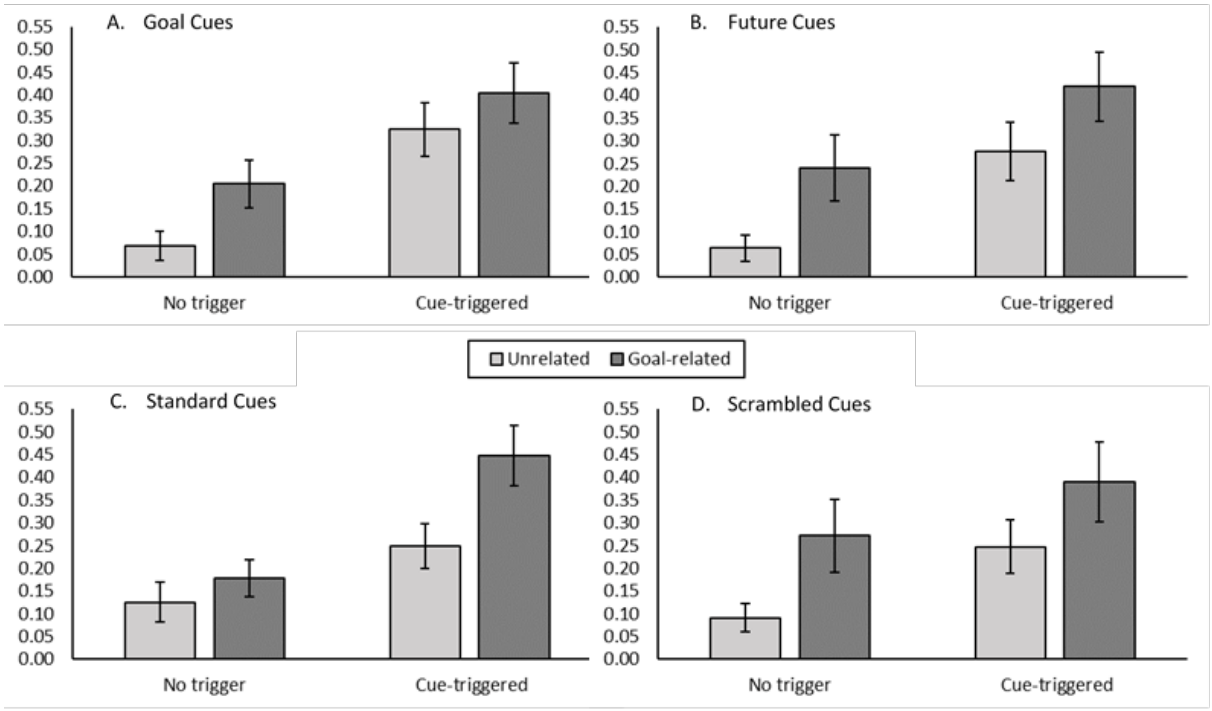


Figure 2.3. Mean SFT Proportion by Trigger, Goal Category and Cue Type:
Goal Cues (A); Future Cues (B); Standard Cues (C); Scrambled Cues (D)
(Error Bars = ± 1 SE)

Analysis by Proportion

The parallel analysis on proportional data also showed significant main effects of Trigger ($F_{(1, 73)}$ = 28.83, p < .001, η_p^2 = .28) and goal category ($F_{(1, 73)}$ = 17.83, p < .001, η_p^2 = .20), as represented in Figure 2.3. Again, no interaction was observed between these two factors (F < 1), indicating that the main effect of goal category (dark versus light bars) did not differ between the two levels of

Trigger (separate clusters). The majority of SFTs, triggered and untriggered, were therefore goal-related (ts > 2.49, ps ≤ .015).

Again, neither within-subjects factor interacted with Cue Type (Fs < 1), nor was a three-way interaction evident (F < 1). Since proportional data must sum to 1 for every participant, overall group differences (i.e., main effect of Cue Type) were not analysed here. In sum, when controlling for individual variation by using proportional data, cue-triggered and goal-related thoughts still predominated across the sample.

2.2.3.5. Effects of Trigger and Cue Type on SFT characteristics

To examine possible influences of cueing dynamics (Trigger and Cue Type) on the subjective characteristics of SFTs, five linear mixed-effects models were constructed with individual thoughts as level 1 units and participants as level 2 units (i.e., clusters; Heck, 2001). This approach is increasingly common in mind-wandering and future thinking research (e.g., D'Argembeau et al., 2011; Spronken et al., 2016; Ben Malek et al., 2018) as it allows for random variation in regression coefficients among participants, thus permitting a more fine-grained treatment of the data than conventional approaches such as ANOVA. The following analyses were conducted using the 'Mixed Models' command in SPSS Version 26 (IBM, 2019), following guidance from (Field, 2013) and (Raudenbush & Bryk, 2002). In each model, Trigger was dummy-coded as 0 (no trigger) or 1 (cue-triggered), and entered as a covariate at the thought level (Field, 2013); Cue Type was entered as a fixed factor across levels (since each participant was only exposed to one cue set). Models were built incrementally, starting with fixed effects only and comparing model fit using the log-likelihood criterion (Field, 2013).

Cognitive Effort

When analysing the effects of Trigger (cue-triggered, untriggered) and Cue Type (goal, future, etc.) on ratings of cognitive effort in a random-intercept model, model fit was significantly improved relative to fixed effects only (Δ-$2LL$ = 28.48, p < .001). Fixed parameter estimates were significant for the intercept (b_0 = 1.70, $F_{(1, 254.22)}$ = 273.67, p < .001) and effect of Trigger (b_1 = .261, $F_{(1, 385.77)}$ = 6.24, p = .013), while the effect of Cue Type was non-significant ($F_{(3, 75.38)}$ = 1.21, p = .31).

Estimated variance in the intercept between participants (representing the random-intercept effect) was significant (Var(u_{0j}) = .156, Wald's Z = 3.30, p < .001). Hence, effort ratings increased from around 1.7 for untriggered thoughts to around 2.0 for cue-triggered thoughts, on average (i.e., $b_0 + b_1$); yet the locus of this difference varied significantly between participants (Figure 2.4, panel A). Adding a random slope parameter produced no improvement in model fit (Δ-$2LL$ = 2.61, p > .10) and a non-significant variance estimate (Var(u_{1j}) = .096, Wald's Z = 1.42, p = .15). Hence, the observed difference in effort ratings according to Trigger (i.e., higher ratings for cue-triggered thoughts; b_1 = .261) did not vary meaningfully between participants.

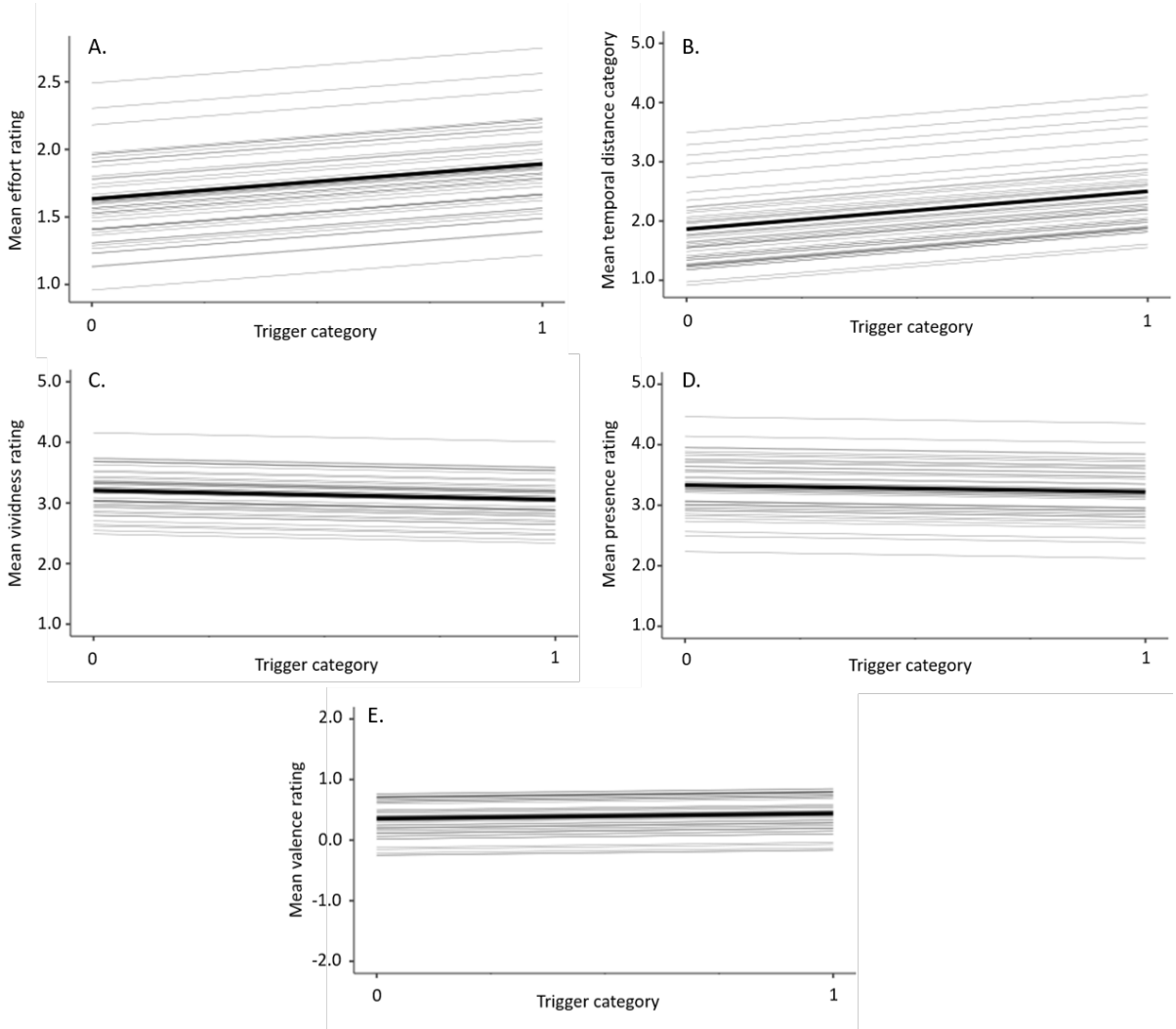


Figure 2.4. Regression Lines for SFT Characteristics* According to Trigger (0 = No Trigger, 1 = Cue-Triggered), on Average (Hard Black Lines) and by Participant (Faint Lines)

**A = cognitive effort; B = temporal distance; C = vividness; D = sense of presence; E = valence*

Temporal Distance

When analysing the effects of Trigger and Cue Type on temporal distance ratings, adding a random-intercept again produced a significant improvement in model fit relative to fixed effects only (Δ-*2LL* = 39.34, $p < .001$). Parameter estimates were significant for the fixed intercept ($b_0 = 1.61$, $F_{(1, 248.17)} = 167.65$, $p < .001$) and fixed effect of Trigger ($b_1 = .639$, $F_{(1, 381.71)} = 18.14$, $p < .001$); the variance estimate for the random intercept term was also significant ($\text{Var}(u_{0j}) = .383$, Wald's $Z = 3.64$, $p < .001$). Average temporal distance therefore increased from around 1.6 for untriggered thoughts to around 2.2 for cue-triggered thoughts ($b_0 + b_1$), with the locus of this difference varying substantially between participants (Figure 2.4, panel B). Again, incorporating a random slope parameter produced no improvement in model fit (Δ-*2LL* < 1, $p > .25$), indicating that the effect of Trigger on temporal distance ratings (b_1) did not vary between participants.

A significant effect of Cue Type ($F_{(3, 79.09)} = 4.78$, $p = .004$) within the random-intercept model demonstrated that temporal distance also differed between groups, with goal cues producing the highest estimate (95% CI = [.312, 1.36]) and standard cues, the lowest estimate (95% CI = [-.594, .499]), taking scrambled cues as the reference group. Average temporal distance ratings were therefore around .8 points higher in the goal cues group compared to the scrambled group (whereas the standard group did not differ). A follow-up pairwise comparison confirmed that SFTs were projected significantly further into the future under exposure to goal cues than to standard cues ($t_{(187.82)} = 4.75$, $p < .001$, $d = .67$). Figure 2.5 compares temporal distance distributions for these two conditions, collapsed across participants.

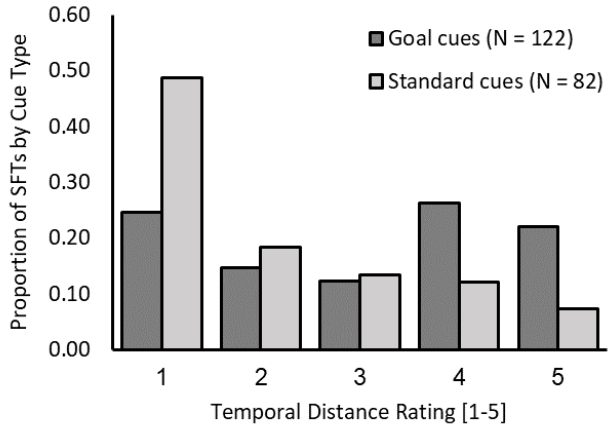


Figure 2.5. Distribution of Temporal Distance Ratings for SFTs in Goal and Standard Cue Conditions (Ratings on Calibrated Likert; 1 = <1 month, 2= 1-3 months, 3 = 3-12 months, 4 = 1-5 years, 5 = >5 years)

Vividness

When analysing the effects of Trigger and Cue Type on vividness ratings, adding a random intercept term again significantly improved model fit relative to fixed effects only (Δ-*2LL* = 23.78, $p < .001$). The estimate for the fixed intercept was significant ($b_0 = 3.28$, $F_{(1, 262.553)} = 653.79$, $p < .001$), whereas the fixed effects of Trigger ($b_1 = -.146$, $F_{(1, 385.99)} = 1.17$, $p = .28$) and Cue Type ($F_{(3, 75.18)} < 1$, $p = .49$) were not. Nonetheless, the estimate of random intercept variance was significant (Var(u_{0j}) = .219, Wald's $Z = 3.04$, $p = .002$), indicating that the locus of vividness ratings, across conditions, varied substantially between participants (Figure 2.4, panel C). Again, incorporating a random slope parameter produced no improvement in model fit (Δ-*2LL* < 1, $p > .25$) and a non-significant variance estimate (Var(u_{1j}) = .115, Wald's $Z = .930$, $p = .35$). This is to be expected given the lack of a fixed main effect in the previous model.

Sense of Presence

When analysing the effects of Trigger and Cue Type on sense-of-presence ratings, model fit was significantly improved by incorporating a random intercept term, relative to fixed effects only (Δ-*2LL* = 25.83, $p < .001$). As in the vividness model, the estimate for the fixed intercept was significant ($b_0 = 3.13$, $F_{(1, 237.95)} = 597.29$, $p < .001$), whereas the fixed effects of Trigger ($b_1 = -.110$, $F_{(1, 385.27)} < 1$, $p = .45$) and Cue Type ($F_{(3, 68.01)} = 1.37$, $p = .26$) were not. The estimate of random intercept variance was however significant (Var(u_{0j}) = .321, Wald's $Z = 3.23$, $p = .001$). Hence, average presence ratings

were numerically lower for cue-triggered thoughts ($b_1 < 0$), yet the difference was non-significant (p = .45); while the locus of presence ratings across trigger categories and cue types varied significantly by participant (Figure 2.4, panel D). Incorporating a random slope parameter again produced no improvement in model fit (Δ-*2LL* = 1.46, $p > .10$) and a non-significant variance estimate (Var(u_{1j}) = .148, Wald's $Z = 1.11$, $p = .27$). The close correspondence between models for vividness and sense of presence likely relates to sizeable correlations between these variables at both the thought level ($r_{(385)} = .43$, $p < .001$) and the participant level ($r_{(77)} = .41$, $p < .001$).

Emotional Valence

The final model analysed the effects of Trigger and Cue Type on valence ratings and was not improved by the addition of either a random intercept or a random slope term (Δ-*2LL* = 1.46, $p > .10$; Δ-*2LL* < 1, $p > .50$) (Figure 2.4, panel E). The initial fixed-effects model produced a significant intercept ($b_0 = .292$, $F_{(1, 386)} = 5.207$, $p = .023$), while the effect of Trigger was non-significant (b_1 = .094, $F_{(1, 386)} < 1$, $p = .59$). Thus, there was no difference in valence for cue-triggered versus untriggered thoughts, although thoughts were generally rated as mildly positive overall ($b_0 = .292$, > 0). Furthermore, a significant effect of Cue Type in the fixed-effects model ($F_{(3, 386)} = 3.74$, $p = .011$) demonstrated that valence differed between groups, with goal cues producing the lowest estimate (95% CI = [-.699, .107]) and standard cues, the highest estimate (95% CI = [-.063, .822]), taking scrambled cues as the reference group. Average valence ratings were therefore around .3 points lower in the goal cues group, and .4 points higher in the standard cues group, compared with the scrambled group. A follow-up pairwise comparison confirmed that thoughts were significantly more positive in response to standard than to goal cues ($t_{(190.26)} = -3.18$, $p = .001$, $d = .45$).

Summary of Results from Mixed-Effects Models

To summarise, cue-triggered SFTs were accompanied by higher ratings of cognitive effort, and depicted events occurring further into the future, across cue types; while SFTs elicited in the goal cues condition, whether triggered or not, were generally further into the future and somewhat less positive than in the standard cues condition. Furthermore, significant random intercept estimates for all outcome variables except emotional valence showed inter-individual variability in the scale

numbers assigned to both types of thoughts (untriggered and triggered). Notably, the four models in question (effort, temporal distance, vividness, presence) were all measured on 1–5 Likert scales (cf. results from 1–7 Likert scales in D'Argembeau et al., 2011).

2.2.4. Discussion

Study 1 aimed to test two specific hypotheses concerning SFT occurrence in the context of different environmental information, using a tailored paradigm for capturing spontaneous thoughts (Schlagman & Kvavilashvili, 2008; Cole et al., 2016; Vannucci et al., 2017). Firstly, it was hypothesised that cues reflecting common life goals would boost the overall frequency of SFTs relative to standard cues; and secondly, that this would be accompanied by a shift in the content of SFTs towards being more goal-related (operationalised through current concerns; Cole & Berntsen, 2016; Klinger, 1975, 2013). The study also examined subjective thought characteristics (Johnson et al., 1988; Cole et al., 2016) to contextualise the confirmatory results.

2.2.4.1. Influence of cue content on SFT frequency

As predicted, replacing standard cues with cues reflecting common life goals yielded a substantial increase in SFT frequency (medium effect size, d = .72; Cohen, 1988). This result is reminiscent of the opening scenario in which an individual's thoughts of buying a car are triggered by a relevant cue (i.e., cue specificity; Berntsen et al., 2013; Berntsen, 2019). Underlining this specificity, SFTs occurred at a rate of around four per participant under exposure to various cue types (future, standard, scrambled), increasing to around six in the goal cues group alone. This finding may reflect selective activation of possible selves (Markus & Nurius, 1986) corresponding to life goals expressed in the cue phrases (e.g., an image of oneself as a parent activated by the phrase "Raising a family"). This can be understood in terms of *cultural life scripts* – commonly held schemata encompassing the typical milestones of adult life (Berntsen & Rubin, 2004). Life scripts are known to play an organising role in autobiographical memory (Rathbone et al., 2011), and, likewise, to constrain the self-images that one may entertain with respect to the future (Berntsen & Jacobsen, 2008; Conway et al., 2019). Within a group of Western undergraduates, many individuals will have largely similar expectations about their future life course (Berntsen & Rubin, 2004; Weinstein, 1980), potentially explaining the enhanced potency of life goal cues to activate particular future selves and thereby trigger SFTs.

Involuntary thought studies have shown the presence of verbal cues to favour past- as opposed to future-oriented thoughts (Vannucci et al., 2017; Plimpton et al., 2015). One might therefore conclude that IAMs are inherently more cue-dependent than SFTs (Berntsen, 2019). However, the standard cue list used in this literature was constructed to mimic naturally-occurring *memory* cues (Schlagman & Kvavilashvili, 2008). To the extent that SFT relies on distinct neurocognitive processes (Mazzoni, 2019) and is underpinned by different autobiographical knowledge structures (Conway et al., 2019), it is unsurprising that these cues should be less effective in triggering SFTs. The present data suggest that involuntary future representations may also be highly cue-dependent, if only the content of the cues is calibrated so as to target relevant underlying self-knowledge (e.g., possible future selves; Markus & Nurius, 1986; Conway et al., 2019). Future research could probe this further by presenting life goal cues in a context of unrestricted reporting, i.e., when participants can report any spontaneous mental contents rather than just SFTs (Barzykowski & Staugaard, 2018).

Importantly, the equivalence of future and standard conditions indicates that it is not implied future tense driving the frequency increase for goal cues. The future condition was included in view of compelling evidence that subtle visuospatial cues can sway the predominant temporal orientation of spontaneous thoughts (Vannucci et al., 2019). Specifically, left- and right-facing arrows increased the relative proportion of past- versus future-oriented thoughts, respectively, during a comparable vigilance task procedure (Vannucci et al., 2019). If simple visual stimuli like right-facing arrows could skew spontaneous thoughts towards the future, it seemed plausible that cue phrases bearing an implication of future tense (e.g., “raising a family”, seen by a 20-year-old student) would similarly elicit more future thoughts than the standard set. The results, however, oppose this possibility – strengthening the previous interpretation based on highly goal-relevant cue content.

2.2.4.2. Examining the dynamics of triggering

If goal cues exert their effect individually, through the activation of specific self-images (cf. idiosyncratic cues in McVay & Kane, 2013), one would only expect an increase in the frequency of *cue-triggered* SFTs. Yet, somewhat paradoxically, an equivalent increase was observed in thoughts

not attributed to a cue (see Figure 2.2), as confirmed by a lack of interactions between cue type and trigger. The above interpretation – that goal cues trigger more SFTs through specific, direct associative links (Berntsen et al., 2013; Berntsen, 2019) – therefore needs to be refined.

One possibility is that a priming process is involved, similar to those effected in Stawarczyk et al. (2011) and Jordão et al. (2019) by deliberately activating goal representations in a prior task. Although direct comparison is hampered by methodological differences (e.g., unrestricted reporting; different primary tasks), this is supported by the comparable effect size found here (d = .72, η_p^2 = .09; cf. Stawarczyk et al., 2011: η_p^2 = .10; Jordão et al., 2019: η^2 = .13[3]). The question then arises as to how such a priming effect may have occurred in the present study.

In this study, only the cues presented in the primary task differed between groups. Thus, priming may have manifested as a gradual biasing of spontaneous thought content through cumulative exposure to goal-relevant cues (cf. Mace, 2004; Mace & Unlu, 2020). Continuous long-term priming of this type is thought to be ubiquitous in waking life, producing transient activation of both abstract and autobiographical concepts (e.g., abstract facts versus personal goals; Renoult et al., 2012) as relevant information is encountered (Mace & Unlu, 2020; Barsalou, 2015). Most of this activation occurs beneath the threshold of conscious awareness; yet when a particular concept surpasses the threshold, conscious thoughts are experienced. Importantly, this can occur in the absence of a singular preceding cue, as conceptual activation can build incrementally (Mace & Unlu, 2020). Hence, in the present study, some SFTs identified as having "no trigger" might actually have arisen from the cumulative, sub-threshold activation of autobiographical concepts *by the cue set as a whole* – leading us to underestimate the impact of the cues. This tendency could have been most pronounced in the goal cues condition due to the semantically interrelated nature of the cue set (cf. schema effects in memory recall; Alba & Hasher, 1983; Roediger & McDermott, 1995), explaining why an increase was observed for both triggered and non-triggered SFTs.

[3] Stawarczyk et al. (2011): reported effect size for planned comparison of SFTs between priming and control group; Jordão et al. (2019): estimate calculated from summary data for SFTs before versus after intercalated priming task (within younger adult group).

Another possibility is that of a *chaining* process like those documented in autobiographical memory recall (Mace, 2009) and voluntary future thinking (Demblon & D'Argembeau, 2014). In this process, experiencing a given autobiographical event can prompt the occurrence of other, related events through the spreading of activation over associative connections. If this were occurring here, some SFTs might receive the label of "no trigger" despite ultimately being traceable to a particular cue through an intervening associative "chain" from another, cue-triggered thought. Such a mechanism might help to explain why apparently non-triggered SFTs occurred more frequently when goal cues were presented. Hence, present results may underestimate the impact of cues due to the undetected, indirect effects of phrases that trigger an associative chain (Mace, 2009; Demblon & D'Argembeau, 2014).

Alternatively, the discussion may be reframed in light of the distinction in the mind-wandering literature between stimulus-dependent thoughts (SDTs) and stimulus-independent thoughts (SITs; Maillet et al., 2017). SDTs are proposed to be sensitive to specific cues, their elicitation depending on principles of associative overlap and cue distinctiveness (cf. Berntsen et al., 2013); while SITs occur regardless of environmental input and are constrained only by internal factors such as personal goals (Maillet et al., 2017; Klinger, 2013). In this framework, spontaneous autobiographical thoughts can be distinguished according to whether they are cue-triggered or not (see Jordão et al., 2019). Since SITs are not in principle affected by environmental input, their rate of occurrence should only be subject to random individual variation, remaining unchanged by task manipulations such as a change in cue type. Hence, the present pattern of results may in part reflect trivial, chance differences in the frequency of (truly) non-triggered thoughts (i.e., SITs), independent of stimulus effects such as triggering, priming or chaining. If most individuals in the goal cue group had a higher-than-usual propensity to experience SITs, this could help to explain the unexpected increase in thoughts labelled as having no trigger.

The foregoing possibilities are of course not mutually exclusive; both stimulus-based mechanisms (continuous priming and chaining) may be operating to varying extents, alongside a background level of unpredictable self-generated thoughts that occur freely in this type of experiment.

In any case, the results warrant further investigation of the (perhaps multiple) mechanisms by which cues influence SFT occurrence, questioning the assumption that they generally act in a direct, one-to-one manner to trigger each thought (cf. McVay & Kane, 2013).

2.2.4.3. Incidence of goal-related SFTs

The second main hypothesis, regarding goal-relatedness, was tested in the same set of analyses by incorporating a factor of self-rated goal category (related, unrelated). Contrary to expectations, this factor was not found to interact with cue type, despite an emerging main effect of the latter. The hypothesis that goal cues promote SFT by selectively activating specific goal representations (individually or collectively, Mace, 2009; Mace & Unlu, 2020) implies that the resulting thoughts are more likely to be perceived as goal-related. Yet in the present sample, an equivalent proportion of SFTs were identified as goal-related across all cue types.

It should be noted that goal-related SFTs were predominant overall (combined mean = 64%), which is comparable to previous work (65%; Cole & Berntsen, 2016). One possibility is therefore that the majority of SFTs relate to personal goals, regardless of how they occur, yet there is also a consistent minority of less constrained, more hypothetical events (Mazzoni, 2019; Warden et al., 2019) which, whether cue-triggered or not, are less associated with future autobiographical knowledge (Conway et al., 2019; Renoult et al., 2012) and hence unlikely to be tagged as goal-related. Consistent with this, apparently hypothetical thoughts like “playing in a forest in autumn” and clearly goal-directed thoughts like “I need to go to the doctor’s” were both reported to be triggered by goal cues in the present study.

2.2.4.4. Subjective characteristics of SFTs

Several subjective characteristics of the reported SFTs were also measured: cognitive effort, temporal distance, vividness, sense of presence, and emotional valence (cf. Berntsen & Jacobsen, 2008; Cole et al., 2016; D’Argembeau & Van Der Linden, 2004). Results were analysed using linear mixed-effects models (Raudenbush & Bryk, 2002; D’Argembeau et al., 2011). These exploratory findings can be integrated with those above to better characterise participants’ experience when

reporting SFTs, thereby enriching our understanding of the phenomenon (Cole & Kvavilashvili, 2019, 2021).

Cognitive effort ratings were generally low (mean = 1.81 on 1–5 Likert), confirming the assumption that SFT is an automatic, relatively effortless process (Cole et al., 2016; Cole & Kvavilashvili, 2021). Nonetheless, it is noteworthy that thoughts occurring in response to an external cue were somewhat *more* effortful than those occurring without (cf. Mace et al., 2021). Previous studies (Cole et al., 2016; Plimpton et al., 2015; Jordão et al., 2019) have not the presence / absence of triggers as a factor influencing SFTs' subjective characteristics, leaving this open to interpretation. One tentative suggestion, on the basis of the aforementioned SDT / SIT distinction (Maillet et al., 2017), is that if SITs arise through idiosyncratic, arbitrary patterns of associative activity unrelated to the current environment (i.e., reprocessing of information from other contexts; Seligman et al., 2016), perhaps it is unsurprising that they should arise with little or no mental effort. On the other hand, thoughts arising in relation to an external cue (i.e., SDTs), still spontaneous in the sense of lacking intention, require a certain level of external perceptual engagement. Participants' subjective ratings may be sensitive to this distinction, hence the higher effort ratings (e.g., 2 or 3 out of 5) assigned to cue-triggered SFTs. Ultimately, asking participants to rate "cognitive effort" may be too ambiguous, sometimes eliciting responses based on feelings of perceptual engagement and other times on the degree of spontaneity experienced. Consistent with this, random participant-level variation was statistically significant here, suggesting that individuals used different anchor points on the 1-5 rating scale, potentially reflecting different judgment criteria. For these reasons, it was decided that Study 2 would incorporate an explicit spontaneity scale (Barzykowski & Niedźwieńska, 2016; Jordão et al., 2019) in place of effort ratings.

When analysing temporal distance, trigger had a significant influence, with cue-triggered thoughts projected further into the future. This result is straightforward to account for, given that many of the cues might be expected to evoke distant or infrequent events (e.g., "years from now", future condition) or carry associations with subsequent life periods ("healthy marriage", goal condition; Conway et al., 2019; Berntsen & Rubin, 2004). Hence, intrinsic aspects of the cues

influenced the resulting thought contents (consistent with the general notion of cue specificity; Berntsen et al., 2013; Berntsen, 2019), and thoughts reflecting events associated with later life periods were, in turn, dated more remotely (Addis, 2018; Hassabis & Maguire, 2007; Rubin & Umanath, 2015). Cue type was also a significant predictor of temporal distance, with goal cues eliciting the most distant SFTs; this may reflect the greater concentration of subsequent life period associations intended in this cue set. Ratings also showed a relatively flat distribution in the goal cues condition (Figure 2.5), in contrast to the declining logarithmic function usually found in the spontaneous and voluntary literatures (Cole et al., 2016; Berntsen & Jacobsen, 2008; Rathbone et al., 2011; Spreng & Levine, 2006). By comparison, temporal distance ratings in the standard cue group were concentrated close to the present, echoing standard findings (Figure 2.5). The origins of this "rarefication" of the temporal distance function for goal cues could be further explored using more tightly constrained cue content. For instance, one could manipulate cues within participants to refer to either proximal or distant events (e.g., "end of term" versus "graduation"; "upcoming event" versus "long-term plan") and examine the frequency with which SFTs were successfully triggered.

Results for vividness and sense of presence patterned together, with no significant effects aside from random participant-level variation (Figure 2.4, panels C and D). Overall means close to the scale midpoint (vividness: 3.06 ± 0.72; presence: 3.22 ± 0.85) confirm that SFTs across the study featured a moderate level of sensory-perceptual detail and a moderate sense of being present in the imagined event (i.e., autonoetic consciousness; Tulving, 1985; Wheeler et al., 1997). In this case, it is likely that the high between-participant variation reflects meaningful individual differences in visualisation / mental imagery ability (D'Argembeau & Van der Linden, 2006; Moulton & Kosslyn, 2009) in addition to possible differences in scale interpretation.

Finally, ratings of emotional valence were clustered near the neutral point (i.e., 0 on a scale of -2 to +2), although reported SFTs were, on the whole, mildly positive (overall mean = 0.41; Table 2.1). Although trigger had no impact, a difference was found between cue types, with SFTs in the standard cue condition somewhat more positive than in the goal cue condition. This equates to a medium-sized standard effect (d = .45), which was not anticipated given efforts to balance cue

valence in these two conditions (section 2.2.2.3). Nonetheless, considered more concretely, an average difference of less than one scale point may be of little theoretical import. The average rating in the standard cue condition of approximately 1 (i.e., somewhat positive) coheres with evidence of a "positivity bias" in future thinking / mind-wandering (D'Argembeau & Van der Linden, 2006; Berntsen & Jacobsen, 2008; Baird et al., 2011). Future research might further probe emotional differences as a function of cue type by controlling more precisely for the valence, and related properties, of individual words within the cues (Bradley & Lang, 1999).

2.2.4.5. Limitations

A key limitation is the non-exhaustive nature of the measure used to assess goals: the five-item CCQ (Sellen et al., 2006). Although participants consistently provided five current concerns with associated importance ratings as instructed, it is unlikely that this shortlist reflects the full range of a person's aspirations. Goals pertaining to further-flung life periods, for example – perhaps associated with parenthood or career progression (see Figure 1.1, Chapter 1) – are unlikely to be reported since they are essentially not yet "current". These longer-term life goals may nonetheless exert an important motivating force in a young adult's life (Weinstein, 1980; Berntsen & Rubin, 2004). As a result, some of the 36% of SFTs "unrelated" to goals in the current sample might have been classified differently, were the method more sensitive to the full range of a person's goals extending into the future (Austin & Vancouver, 1996).

It should also be noted that future thinking comprises more than just the simulation of desired experiences (e.g., obtaining one's dream car). It also includes predictions, appraisals, etc., that may be more abstractly connected to pursuing goals (Szpunar et al., 2014; Baumeister et al., 2016). Current concerns, on the other hand, specifically reflect goals to which an individual is already committed (Klinger, 2013), and are hence narrower in scope. Hence, classifying SFTs based on CCQ responses might fail to capture some forms of goal-related future thought (e.g., a person with no pre-existing wish to own a certain car, spontaneously pondering whether it would be desirable). Future work should consider alternate ways of operationalising goal-relatedness so as to encompass a broader range of possibilities, for instance through retrospective judgments on a number of dimensions (cf.

multiple functions of future thought; Stawarczyk et al., 2011; Duffy & Cole, 2020). Thought descriptions could also be coded to distinguish, say, outcome simulation from the specification of necessary steps (e.g., driving off the forecourt vs. starting a dedicated savings account; Plimpton et al., 2015; Warden et al., 2019). Such methods would enable a more holistic assessment of the pragmatic value of SFT, extending beyond the most clear-cut instances of "goal-related" thought. To maximise the utility of results, response options and coding categories should be grounded in a coherent over-arching theory (e.g., pragmatic prospection; Baumeister et al., 2016).

2.2.4.6. Summary and Conclusions

Study 1 combined a novel manipulation of the cues typically used to elicit SFTs (Cole & Berntsen, 2016; Plimpton et al., 2015; Vannucci et al., 2017) with an assessment of their goal-directed content (cf. Cole & Berntsen, 2016) and subjective characteristics (Johnson et al., 1988; Cole et al., 2016).

Firstly, results showed a general increase in the frequency of both cue-triggered and non-triggered SFTs in the presence of life goal cues. This can be accounted for by proposing that exposure to goal-relevant cues transiently activates specific future self-images (Markus & Nurius, 1986; Rathbone et al., 2011) embedded in long-term self-knowledge (Conway et al., 2019), thereby promoting the occurrence of SFTs through both direct and indirect routes (e.g., cumulative long-term priming; Mace & Unlu, 2020). Secondly, this pattern did not differ according to goal-relatedness, assessed via relevance to participants' current concerns. This is challenging to reconcile with the previous result, although it may reflect problems with the sensitivity of the method. Ultimately, a more robustly powered sample would be required to settle this question. Finally, some noteworthy findings emerged from exploratory analysis of subjective characteristics, including that the average temporal distance of imagined events was highest for goal cues, consistent with the cue content involved (goals associated with later life periods; Conway et al., 2019; Berntsen & Rubin, 2004).

Study 2 was designed to probe the reliability of these findings, using only two cue conditions (goal versus standard) and measuring spontaneity directly rather than via the proxy of effort. Paid online recruitment was used to obtain a specified sample size in spite of COVID-19 restrictions.

2.3. Study 2: Online Replication

2.3.1. Aims and Hypotheses

2.3.1.1. Rationale for an Online Study

The rationale for designing an online follow-up to Study 1 was twofold: Firstly, the unpredictable pandemic context and intermittent restrictions in late 2020 precluded conventional data collection even with COVID-19 safety measures in place. Secondly, adapting the commonly used vigilance task for online testing represented an investment in the methodological toolkit available to future SFT research.

Study 2 was programmed using Gorilla online experiment builder (https://www.gorilla.sc; Anwyl-Irvine et al., 2020), with data collected and stored in a single, central location (a secure computer server). Pairing this with the Prolific online recruitment platform (https://www.prolific.co) gave access to a pool of over 80,000 eligible participants, thereby streamlining the recruitment process. Prior experience with Study 4 (Chapter 4) inspired confidence in the efficiency of data collection via Prolific (cf. Palan & Schitter, 2018).

It should be noted that the decision to run this study online may have brought about subtle changes in the sample demographic. Although age and native language screening was possible, occupation / student status could not be ascertained, nor were any particular psychological screening criteria implemented. Hence, caution is advised when interpreting results collectively across the two studies.

2.3.1.2. Hypotheses

The primary aim of this study was to strengthen the reliability of results obtained in Study 1. It was therefore important to maintain methodological consistency wherever possible when adapting materials to run online. Future and scrambled cue conditions were eliminated from the original four-group design to enable closer focus on the two key conditions (goal cues and standard cues). This reduced the total sample size required. A formal statement of hypotheses is as follows:

1. The goal cue group would, on average, report a greater overall SFT frequency than the standard cue group, replicating the main finding of Study 1. Power calculations for the present study were based on this key confirmatory result (d = .72; see *Methods*).

2. The goal cue group would, on average, report a higher rate of SFTs related to personal goals (assessed via the CCQ; Cole & Berntsen, 2016). This prediction was unconfirmed in Study 1, yet this may have been attributable to insufficient sample size (hence Type II error; see Faul et al., 2007) rather than a true null effect.

Additionally, the new spontaneity scale was expected to function equivalently to the proxy measure of cognitive effort employed in Study 1; this assumption would be checked with reference to the data.

2.3.2. Methods

2.3.2.1. Participants

Sample size was based on an a priori power calculation using G*Power (Faul et al., 2007), indicating a required sample size of 68 to detect an equivalent effect to that found in Study 1 (frequency difference by cue type; $\eta_p^2 = .09$ / $d = .72$) with statistical power of 80%. All participants were recruited via Prolific and compensated at a rate of £7.50 per hour. Pre-screening based on age (18-45 years), current residence (UK) and native language (English) was implemented to ensure a comparable demographic to Study 1.

Using iterative data quality checks, 97 participants were recruited before obtaining the required sample. Reasons for exclusions ($n = 29$) comprised non-compliance with attention task instructions (i.e., complete failure to detect the targets; $n = 2$), extreme responding (i.e., performance measures >3SD from the sample mean; $n = 6$), and a complete lack of thought reports before data filtering ($n = 21$). The latter criterion is justified since only two participants in Study 1 reported zero thoughts (one of whom had misunderstood the instructions and was excluded). Hence, it is likely that the high rate of non-reporting is due to the online context rather than a true absence of relevant thoughts (see Chmielewski & Kucker, 2020, for a review of online data quality issues). The final sample ($n = 68$) comprised 45 females and 23 males, with a mean age (± SD) of 29.7 ± 8.3 years. Each participant was randomly assigned to one of two groups, yielding similar age profiles ($t_{(66)} = .25$, $p = .80$) and gender ratios ($\chi^2_{(1)} = .44$, $p = .59$). While completing the study, participants were unaware of the other experimental condition.

2.3.2.2. Design

A 2 × 2 × 2 mixed factorial design was employed, with a between-subjects factor of Cue Type (simplified to two levels: goal cues, standard cues) and within-subjects factors of Trigger (cue-triggered, no trigger) and Goal-Relatedness (related, unrelated). Dependent variables were SFT frequencies and proportions by participant and subjective characteristics at individual thought level. The study was approved by a University Ethics Committee.

2.3.2.3. Materials and Procedure

Online Adaptation of Experimental Paradigm

The general paradigm was retained from Study 1, comprising a 600-trial vigilance task with 11 target trials and the option to pause and report thoughts at any time. However, all tasks were programmed and sequenced using Gorilla (http://www.gorilla.sc/). Materials are available on request for replication purposes.

Principal changes included an integrated thought-reporting loop in the primary task to replace the previous paper forms; removal of several subjective measures to streamline the procedure (Figure 2.6); and adapting the CCQ and retrospective rating procedure to run in Gorilla. Thus, rather than switching between computer and paper formats, all parts of the study were completed in a single browser window after entering through Prolific. A computer (desktop or laptop) was required to ensure physical keyboard use and retain some control over display size; any common browser was accepted (e.g., Chrome, Firefox, Edge). A debrief document summarising true study aims and reiterating the right to withdraw was displayed at the end. The whole study lasted approximately 35 minutes.

Modified Cue Stimuli

Two sets of 120 cues were used (goal cues, standard cues), with each participant being exposed to one set by group assignment. Cue presentation was maintained at 1 in 5 trials (20%) on average, in the same pseudorandom sequence. Standard cues were exactly the same as before (e.g., “warm weather”, “flat tyre”); whereas 23 goal cues were modified by synonym replacement (e.g., “being lonely” to “loneliness”) or close equivalents (“behind on work” to “overworked”) to equalise average character length (goal cues: 13.73 characters, standard cues: 13.50; $t_{(238)} = .55$, $p = .58$) relative to Study 1 (goal: 14.53, standard: 13.50; $t_{(238)} = 2.65$, $p < .01$). A list of modified goal cues is included in Appendix II.

Changes to Procedure from Study 1

In the vigilance task, participants were instructed to respond to vertical target arrays by pressing the "v" key, rather than the spacebar. The 40-trial practice block was retained. SFTs could be reported at any time by pressing the "s" key, which enacted a separate display sequence (Figure 2.6) capturing descriptions and ratings. Of the five items presented in Study 1, only the thought description, free-text trigger description, and vividness rating were retained here, plus an explicit 5-point Likert measuring spontaneity (1 = *Spontaneous [without intention]*; 3 = *Unsure*; 5 = *Voluntary [with intention]*; Barzykowski & Staugaard, 2016; Jordão et al., 2019).

As before, the CCQ elicited five current goals and associated importance ratings, in this case via a computerised Gorilla questionnaire. These responses were stored as embedded data and automatically retrieved, along with any SFT descriptions, for retrospective rating on goal-relatedness. This yielded the necessary data to address our hypotheses without extraneous measures increasing study duration and complexity.

In Study 2, no limit was imposed on the number of SFT reports. Pilot testing indicated that individual SFT rates (after relevant exclusions) would be unlikely to exceed the previous limit of 12, which had largely been imposed for practical reasons (i.e., avoiding excessive paper forms), irrelevant in an online context.

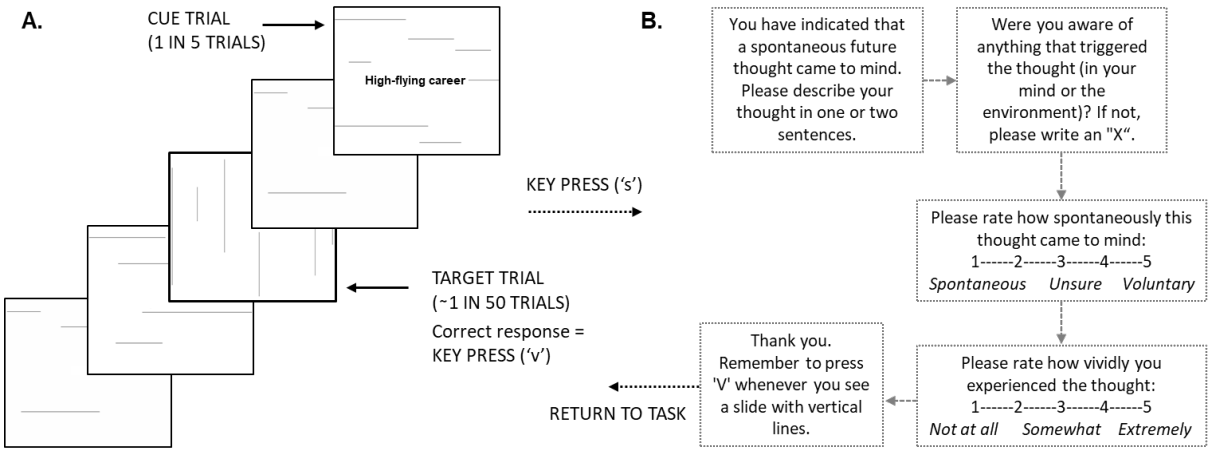


Figure 2.6. Schematic Diagram of Study 2 Task Procedure (A. Vigilance Task; B. Thought Reporting Loop)

2.3.3. Results

2.3.3.1. Vigilance Task Performance

Participants were highly successful at detecting the 11 target stimuli in the vigilance task (mean ± SD proportion correct = 0.92 ± 0.09; correct RT = 720 ± 100ms). Accuracy differed slightly between standard (0.94 ± 0.06) and goal cue conditions (0.89 ± 0.10; $p = .03$), although RTs were indistinguishable ($p > .5$, *ns*). Hence, Cue Type had little or no effect on primary task performance.

2.3.3.2. Filtering and Data Checks

The 68 included participants generated a total of 343 thought reports. All thought descriptions were coded by the author to identify any clearly not referring to future events; those shortlisted were re-coded by an independent rater alongside a random sample of genuine SFTs, yielding excellent reliability ($\kappa = .77$). Disagreements were resolved by discussion, and $n = 35$ non-future thought reports were subsequently removed from the sample.

As in Study 1, data were then filtered to exclude thoughts perceived to be triggered by an external source ($n = 51$). The following analyses therefore comprise SFTs with no known trigger and those attributed to a cue seen onscreen. Additionally, thoughts with a spontaneity rating of 4 ("somewhat voluntary") or 5 ("voluntary [with clear intention]") were removed ($n = 34$). The final data set comprised 223 SFTs reported by 68 participants.

Again, preliminary analysis of CCQ importance ratings was conducted to ensure consistency between groups. An independent-samples t-test ($t_{(66)} = 1.06$, $p = .29$) confirmed that average importance ratings were similar (overall mean = 7.14, SD = 0.99).

2.3.3.3. Descriptive Statistics

Table 2.1 summarises SFT frequencies and proportions for each factor combination, across both studies; Table 2.2 displays descriptive statistics for subjective characteristics. In Study 2, participants in the goal cue condition reported mostly cue-triggered (52%) and goal-related thoughts

(63%); whereas those exposed to standard cues reported a minority in each of these categories (44% and 45%, respectively; Table 2.2).

2.3.3.4. Effects of Trigger, Goal Category and Cue Type on SFT Occurrence

Analysis by Frequency

As before, a mixed ANOVA was conducted on SFT frequency, using within-subjects factors of Trigger (no trigger, cue-triggered) and Goal-Relatedness (unrelated, related) and a between-subjects factor of Cue Type (standard cues, goal cues). Figure 2.7 shows means and standard errors for all factor combinations (top panel: standard cue group; bottom panel: goal cue group). In addition to a priori participant exclusions (section 2.3.2.1), six participants (two in the goal cues group, four in the standard group) were excluded from this analysis due to one or more of their frequency data points lying > 3SD from the sample mean; hence $n = 62$.

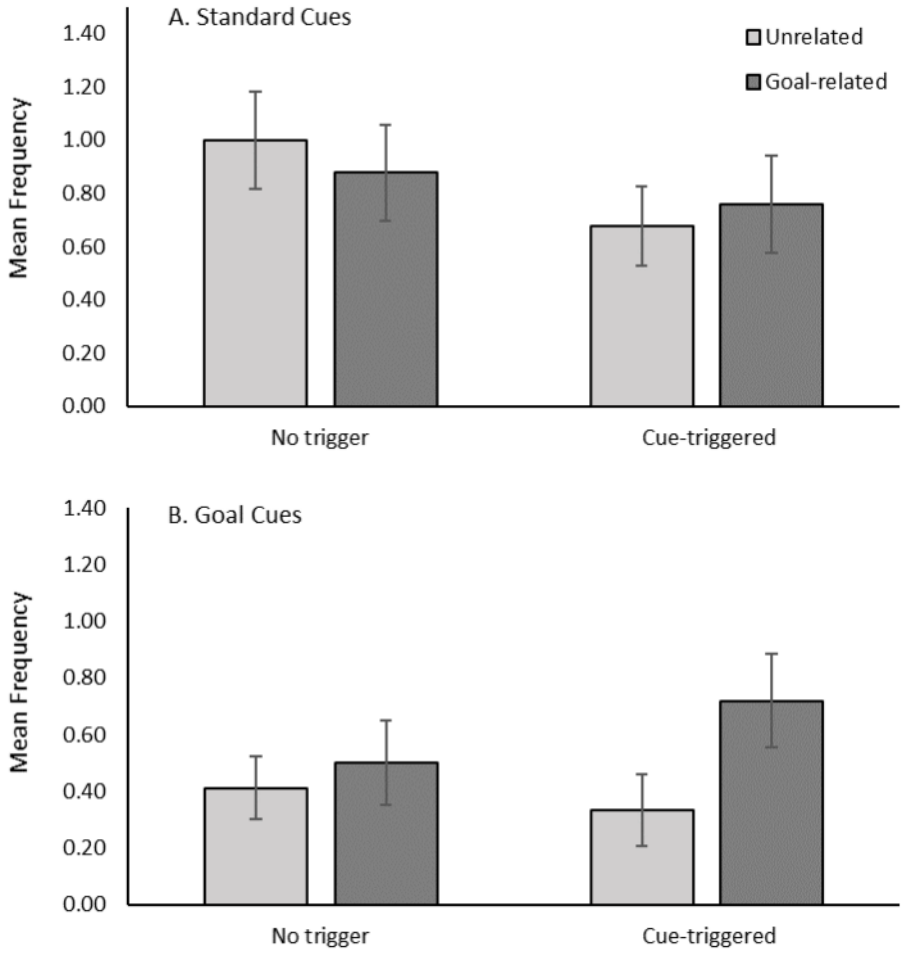


Figure 2.7. SFT Frequency by Trigger and Goal Category, for (A) Standard Cue and (B) Goal Cue Groups
Error Bars = ± 1 SE

This analysis produced no within-subjects effects or interactions (Fs < 1.80, ps > .18, η_p^2s < .03), but a between-subjects main effect of Cue Type was evident ($F_{(1, 60)} = 5.42$, $p = .023$, $\eta_p^2 = .08$), with the total number of SFTs being higher in the standard cues group (Mean = 3.13, SD = 2.54) than the goal cues group (Mean = 1.94, SD = 1.00). Thus, when analysed by frequency, participants exposed to standard cues produced more SFTs overall than those exposed to goal cues in Study 2.

Analysis by Proportion

A parallel ANOVA was conducted on proportional data; Figure 2.8 shows the relevant means and standard errors. Participants with total SFT frequency of zero after filtering were excluded by mathematical necessity (one from standard group, four from goal group; hence $n = 63$).

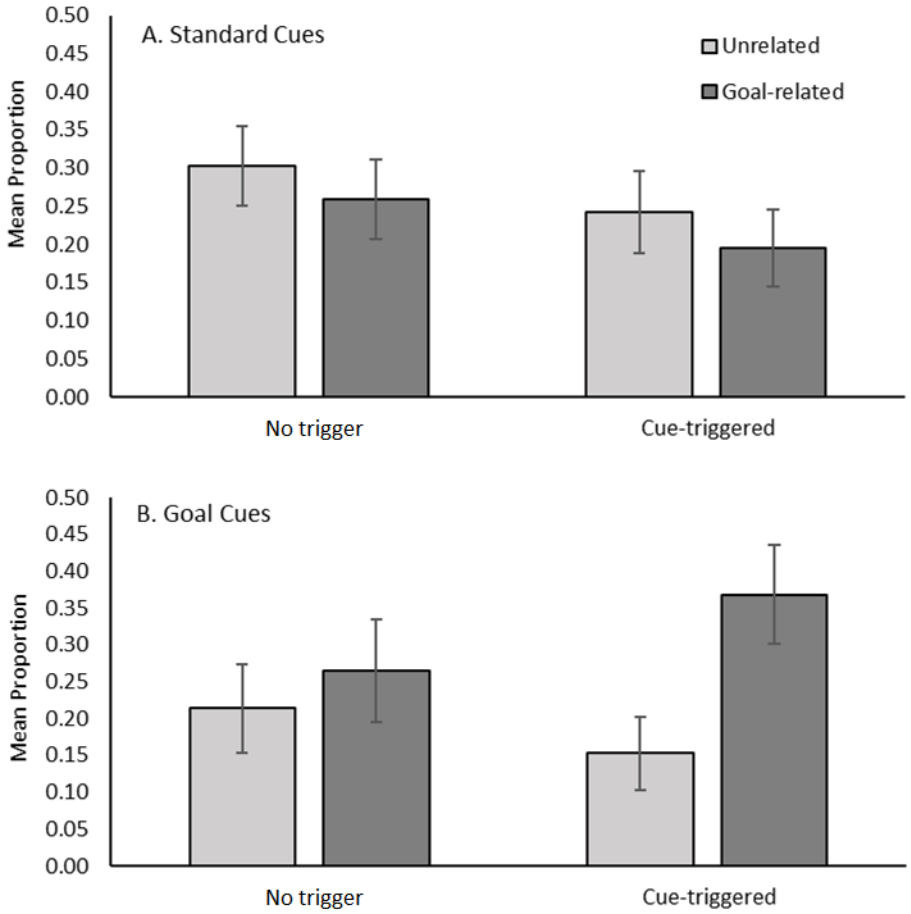


Figure 2.8. SFT Proportion by Trigger and Goal-Relatedness, for (A) Standard and (B) Goal Cue Groups
Error Bars = ± 1 SE

This analysis produced no main effects of Trigger, Goal-Relatedness or Cue Type (Fs < 1.50, ps > .23, η_p^2s < .03), but a marginally significant interaction emerged between goal category and Cue Type ($F_{(1, 61)} = 3.85$, $p = .054$, $\eta_p^2 = .06$), with an average of 45% goal-related SFTs in the standard cue group versus 63% in the goal group ($t_{(61)} = -1.97$, $p = .054$, $d = .25$; Figure 2.8, dark bars). No other interactions approached significance (Fs < 1). Therefore, when controlling for overall frequency, participants exposed to goal cues tended to report relatively more goal-related SFTs (i.e., related to one or more of their current concerns).

2.3.3.5. Modelling Spontaneity and Vividness

Two linear mixed-effects models (Raudenbush & Bryk, 2002; Field, 2013) were computed using the 'Mixed Models' command in SPSS Version 26 (IBM, 2019). The first predicted thought-

level spontaneity ratings as a function of Trigger, Cue Type and random participant-level variation. The second model predicted vividness ratings on the same basis.

Spontaneity

When modelling the effects of Trigger (no trigger, cue-triggered) and Cue Type (standard cues, goal cues) on spontaneity ratings, model fit was significantly improved by adding a random intercept parameter (Δ-*2LL* = 34.28, $p < .001$). Parameter estimates were significant for the fixed intercept ($b_0 = 1.48$, $F_{(1, 98.98)} = 330.01$, $p < .001$) and fixed effect of Trigger ($b_1 = .249$, $F_{(1, 220)} = 7.38$, $p = .007$), while the fixed effect of Cue Type was non-significant ($F_{(1, 56.04)} < 1$, $p = .78$). The random intercept parameter was also significant (Var(u_{0j}) = .175, Wald's $Z = 3.24$, $p = .001$). Thus, average spontaneity ratings increased from around 1.5 for untriggered thoughts to around 1.7 for cue-triggered thoughts ($b_0 + b_1$), with the starting point varying significantly between participants (Figure 2.9, panel A). These results closely match those for cognitive effort in Study 1.

Vividness

When modelling effects on vividness ratings, model fit was again significantly improved by adding a random intercept term (Δ-*2LL* = 21.58, $p < .001$). The estimate for the fixed intercept was significant ($b_0 = 3.36$, $F_{(1, 117.43)} = 781.49$, $p < .001$), whereas the fixed effects of Trigger ($b_1 = -.037$, $F_{(1, 217.63)} < 1$, $p = .80$) and Cue Type ($F_{(1, 61.70)} < 1$, $p = .83$) were not. The random intercept parameter was nonetheless significant (Var(u_{0j}) = .255, Wald's $Z = 2.76$, $p = .006$) (Figure 2.9, panel B). Hence, average vividness ratings were around 3.4 for both untriggered and cue-triggered thoughts ($b_1 \approx 0$), with the starting point varying significantly between participants. Again, this echoes the corresponding analysis in Study 1 (see section 2.2.4.4).

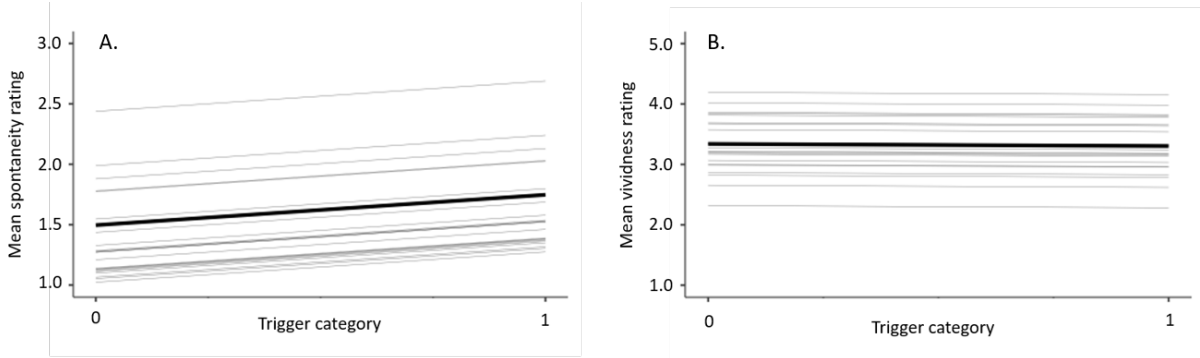


Figure 2.9. Regression Lines for Spontaneity (A) and Vividness Ratings (B) According to Trigger (0 = No Trigger, 1 = Cue-Triggered), on Average (Hard Black Lines) and by Participant (Faint Lines)

2.3.3.6. Relationships with Vigilance Performance and Correspondence with Study 1

Given the different patterns of SFT results in the two studies (Table 2.1), further analyses were conducted to examine these in relation to vigilance task speed and accuracy data. It was theorised that differences in spontaneous thought might be explained by contrasting patterns of overall task engagement or attentional allocation (Robison et al., 2020; Rummel & Boywitt, 2014) arising in the context of online task completion (Chmielewski & Kucker, 2020).

Firstly, correlations were computed between the principal vigilance measures, proportion correct and mean RT, and variables reflecting participants' SFT reporting behaviour (raw report frequency, total SFT frequency, frequency per IV combination; see Figure 2.7). No significant correlations were found for proportion correct (absolute *r*s < .21, *p*s > .10); but RT was positively related to raw report frequency ($r = .31$, $p < .01$), total SFT frequency ($r = .27$, $p = .025$) and cue-triggered frequency across both goal categories ($r = .29$, $p = .02$, unrelated; $r = .30$, $p = .02$, goal-related). These relationships were not evident in the Study 1 data (*r*s < .2, *p*s > .26). It therefore appears that performance across the two concurrent tasks, vigilance and SFT reporting, was more tightly coupled in Study 2, with participants who reported more (cue-triggered) SFTs being consistently slower to detect the targets.

Next, vigilance task data were compared directly between the two studies. A 2 (study) x 2 (group: goal cues vs. standard cues) ANOVA on proportion correct found significant main effects of study ($F_{(1, 102)} = 4.43$, $p = .038$, $\eta_p^2 = .04$) and group ($F_{(1, 102)} = 5.97$, $p = .016$, $\eta_p^2 = .06$), yet no

interaction ($F < 1$). Participants were generally less accurate in Study 2 (Mean ± SD = 0.92 ± 0.09) than in Study 1 (Mean ± SD = 0.95 ± 0.07), and accuracy was consistently lower in the goal cue condition (Mean ± SD = 0.91 ± 0.09) than the standard condition in both studies (Mean ± SD = 0.95 ± 0.06).

A similar 2 x 2 ANOVA on mean RTs (correct trials only) found a significant main effect of study ($F_{(1, 102)} = 11.55$, $p = .001$, $\eta_p^2 = .10$), yet no main effect of group or interaction (Fs < 1). Besides being less accurate, participants were therefore slower to detect the targets in Study 2 (Mean ± SD = 721 ± 100ms) than in Study 1 (Mean ± SD = 655 ± 84ms). Numerically, RTs were higher (i.e., slower) in the goal cues condition in Study 1, but in the standard cues condition in Study 2. Taken together, these results suggest a marked disparity in vigilance task performance between the two studies, with online participants both slower and less accurate than those taking part in the lab.

In sum, it appears that the online Study 2 garnered both poorer and more variable performance, covarying with thought reporting such that faster responses corresponded with a lower rate of SFTs. Specifically, the faster half of responders across both cue conditions in Study 2 ($n = 34$) reported significantly fewer SFTs than the pooled mean for both groups ($n = 38$) in Study 1 ($t_{(70)} = -3.39$, $p = .001$, $d = .80$). This was not the case for the slower half of responders in Study 2 ($t_{(70)} = -1.68$, $p = .097$, $d = .40$). Hence, although vigilance task performance was generally poorer in Study 2 (lower accuracy, higher RT), relatively fast responding entailed a cost to SFT reporting that was not evident in Study 1. This backdrop of unequal task performance and different dual-task dynamics might partially explain the disparities observed between the two sets of SFT data.

2.4. General Discussion

This chapter reported two studies investigating the influence of contrasting cue types on the occurrence and characteristics of spontaneous future thoughts. Study 1 took place in a laboratory setting, with participants completing the vigilance task and reporting SFTs in a quiet, solitary testing room. Results showed a higher frequency of both triggered and non-triggered SFTs for participants exposed to goal cues (e.g., "high-flying career") than to standard cues (e.g., "warm weather"), partially confirming the stated hypotheses. However, this frequency advantage remained irrespective of whether the thoughts related to participants' current concerns. The lack of interaction between cue type and goal-relatedness presented a challenge to interpretation, as one would expect thoughts resulting from the selective activation of specific goal representations (Markus & Nurius, 1986; Conway et al., 2019; Mace & Unlu, 2020) to be more often perceived as goal-related. Nonetheless, sample size was limited (total $n = 78$ across four groups), warranting further investigation within a larger sample.

Study 2 was designed to replicate the previous results within a larger, online sample to enhance reliability and generalisability. A similar cue manipulation (with just two groups) was implemented within Gorilla experiment builder. Participants were recruited from the Prolific participant pool, screened for age (18-45 years), native language (English), and residence (UK) and obliged to complete the study on a PC / laptop. Results showed considerably reduced overall SFT frequencies relative to Study 1 (≈ 3.5 versus ≈ 5.5 per participant), with a group difference in the opposite direction (i.e., higher frequency in the standard cue group). Nonetheless, there was suggestive evidence ($p = .054$) of an interaction between cue type and goal-relatedness in this sample, with participants in the goal cues group reporting a higher proportion of goal-related thoughts (63%) compared to the standard cues group (45%). Hence, in contrast to Study 1, Study 2 provided tentative support for hypothesis 2, suggesting enhanced activation of goal-specific autobiographical information (e.g., possible future selves; Markus & Nurius, 1986) through cumulative exposure to phrases reflecting commonly held life goals (Berntsen & Rubin, 2004; see also Rathbone et al., 2011; Conway et al., 2019).

Analyses of subjective characteristics produced comparable results in both studies. In Study 2, only spontaneity (Barzykowski & Niedźwieńska, 2016; Jordão et al., 2019) and vividness were measured. Results for spontaneity showed higher (i.e., less spontaneous) ratings for cue-triggered than for non-triggered thoughts, but no difference between the two cue groups. Hence, the type of cues did not appear to alter the subjective experience of an SFT "popping" into one's mind (Berntsen, 2019; Cole & Kvavilashvili, 2021). However, a random intercept term improved the model, indicating that participants varied significantly in their use of the spontaneity scale (Figure 2.9). These results closely replicate those for cognitive effort in Study 1, arguing against the possibility that effort ratings were confounded by feelings of external perceptual engagement (see section 2.2.4.4). Instead, it would appear that cognitive effort is an adequate proxy for assessing how spontaneous thoughts arise (Christoff et al., 2016; Irving & Thompson, 2018). For vividness, results were again consistent between the two studies, with SFTs across both groups and trigger categories being rated as relatively vivid (i.e., means above scale midpoint of 3). Average ratings varied substantially between participants (Figure 2.9), potentially reflecting individual differences in visual imagery experience (D'Argembeau & Van der Linden, 2006; Moulton & Kosslyn, 2009).

2.4.1. Dual-task dynamics: Explaining the lab-versus-online discrepancy

Fundamentally, Study 2 did not function as intended. Instead of verifying the previous pattern of results, it appeared to refute them both by failing to replicate the key positive finding of Study 1 and by hinting at a theoretically significant interaction effect not found previously. Of course, it must be acknowledged that limited sample size (19 per group for the key comparison in Study 1) has implications for the reliability of results, both positive and negative (i.e., small sample sizes increase the risk of both Type I and Type II errors; Button et al., 2013). Thus, a true null effect of cue type and a true positive interaction between cue type and goal category might equally have failed to emerge in Study 1, yet emerged faithfully in the better-powered Study 2. Yet the small estimated effect size for the interaction in Study 2 ($\eta_p^2 = .06$), and its borderline *p*-value, caution against the assumption that the second pattern of results is categorically the more reliable. In drawing final conclusions from both studies, it may be more instructive to focus on important methodological differences.

In both studies, participants were asked to pause a "primary" attentional task to report relevant thoughts via a self-caught method (Cole et al., 2016; Schlagman & Kvavilashvili, 2008; Smallwood & Schooler, 2015). Additional analyses were therefore performed to determine whether the divergence in SFT data was related to primary-task performance; in other words, an attempt was made to characterise dual-task performance dynamics based on the available data (cf. McVay & Kane, 2010; Randall et al., 2014; Rummel et al., 2017). These analyses demonstrated that in the online vigilance task (Study 2), performance was generally poorer, and correlations were evident between vigilance response times and thought reporting such that faster responders reported fewer SFTs. This relationship was not present in the lab data from Study 1.

In standard models of dual-task performance, greater focus on the primary task would be expected to reduce the frequency of task-unrelated thoughts, including SFTs, due to a trade-off of attentional resources (McVay & Kane, 2010; Rummel et al., 2017). The correlation found between RT and SFT frequency in Study 2 fits this model; yet in Study 1, both vigilance task performance and SFT frequency were higher overall and were uncorrelated. Thus, it would appear that in the lab context, frequent SFT reporting – presumably indicating increased attentiveness to internal mental contents (Schooler et al., 2011) – could occur at minimal cost to primary task performance. Why should this be the case in the lab, but not in the online setting of Study 2?

Perhaps average working memory capacity was simply lower in the online sample, hindering participants' ability to perform two simultaneous tasks (although such differences tend to emerge in more demanding task contexts; Baird et al., 2011; Randall et al., 2019; Robison et al., 2020). Ultimately, an explanation based on overall engagement levels seems more persuasive: Those who participated online, likely in their home environment, achieved lower primary task performance *and* reported fewer SFTs because they were fundamentally less engaged with the study than those who were tested in lab conditions (Chmielewski & Kucker, 2020). External distractions, familiar from the broader mind-wandering literature (Smallwood & Schooler, 2015; Stawarczyk et al., 2011), are undoubtedly more common in a setting where one may be engaging in several activities simultaneously (e.g., eating, entertainment), and might be interrupted by external stimuli during the

study (e.g., pets, door-knocking, etc.). This could explain the performance trade-off seen in Study 2: Because participants are engaged in not just two but potentially multiple tasks, a more limited pool of attentional resources is allocated to the study as a whole. These must be further divided between rapid line detection and consistently identifying and reporting on thoughts, producing a trade-off between the two tasks despite low intrinsic task difficulty (cf. Rummel et al., 2017; Plimpton et al., 2015).

2.4.2. Implications of Studies 1 and 2 for emerging understanding of SFT

Far from concluding that the two studies are contradictory and therefore uninformative, it is important to affirm their distinct and combined strengths. Study 1 has the benefit of controlled laboratory conditions, and can hence tell us about how SFTs arise when participants are engaged in a simple task with minimal external distractions. Study 2, though noisier, tells us about the naturalistic context in which a participant has many calls on their attention. This is likely much more representative of everyday life (Finnbogadóttir & Berntsen, 2013; Song & Wang, 2012; Warden et al., 2019). Both studies hence have value in explaining the phenomenon from differing angles, while collectively, they confirm that spontaneous thoughts of vivid, personal future events emerge during undemanding tasks – often cued in a transparent, associative manner by information in the environment.

Conflicting results on the impact of novel life goal cues, for which a clear theoretical rationale was established in the Introduction (section 2.1.2), can be taken as evidence that study platform (lab versus online) may be an important moderating factor. The majority of SFTs (52%) occurred without a known trigger in the online context; this adds to the impression that online participants were not fully concentrating on the study, since there is a clear preponderance of cue-triggered thoughts when SFTs are sampled in the lab (Study 1; Cole et al., 2016; Plimpton et al., 2015). Perhaps the instruction to ignore “irrelevant” verbal material (Schlagman & Kvavilashvili, 2008; Cole et al., 2016) was more faithfully adhered to in the online study. On the other hand, when onscreen cues “broke through” sufficiently to trigger an SFT, the thoughts very often reflected participants’ current concerns for goal cues (72%), but not for the standard set (45%). These data imply that the online platform, despite

lower overall concentration, may provide a more sensitive test of our second hypothesis – that goal cues would more often elicit goal-relevant thoughts.

The finding of an overall frequency increase for goal cues in Study 1, not moderated by trigger, necessitated an explanation for how a change in cue type could influence the rate of SFTs without a reported trigger. We considered long-term priming as a possible explanation for this, with autobiographical representations continuously activated by environmental information and occasionally surpassing the awareness threshold (Mace et al., 2019; Mace & Unlu, 2020). This mechanism might also be relevant in explaining the emergence of an interaction in Study 2 between cue type and goal category, again unmoderated by trigger. Goal cues may have exerted an influence on the goal-related content of untriggered thoughts, as well as those they precipitated directly, by activating future autobiographical concepts (e.g., academic or professional success; Berntsen & Rubin, 2004; Conway et al., 2019) below the level of conscious awareness. Thus, untriggered SFTs would then arise when the ongoing, incremental activation of these concepts (e.g., through a sequence of interrelated cue phrases) surpassed a certain threshold.

Arguably, what is most of interest in this research is the *function* of SFT (cf. Cole & Berntsen, 2016; Duffy & Cole, 2020). Furthermore, there is a compelling argument to distinguish stimulus-independent from stimulus-dependent thoughts (Maillet et al., 2017). Perhaps future analyses should therefore focus on the direct pathway from given, controllable cues to specific thought contents and functions, while still acknowledging that some stimulus-independent mind-wandering (SFTs included) will inevitably coincide with this and might implicate a second, indirect pathway.

2.4.3. Summary and Conclusions

The two studies presented in this chapter aimed to further SFT research by addressing the following question: How does the content of concurrent environmental information (i.e., cues) impact the occurrence and characteristics of SFTs? A novel cue manipulation was implemented in a standard dual-task paradigm for eliciting involuntary thoughts (Cole et al., 2016; Schlagman & Kvavilashvili, 2008), selectively capturing SFTs to more closely examine the mechanisms by which they emerge in

consciousness. This stemmed from the theoretical proposal that SFTs would be more effectively triggered by cues activating specific future goal representations such as possible selves (Markus & Nurius, 1986; Conway et al., 2019).

In both studies, cue type was manipulated between participants using a standardised list of phrases representing positive and negative life goals (e.g., "high-flying career", "serious illness"; Weinstein, 1980) alongside standard cues from existing literature (e.g., "warm weather"; Schlagman & Kvavilashvili, 2008). The self-caught procedure enabled participants to report both stimulus-dependent (i.e., cue-triggered) and stimulus-independent SFTs freely throughout the primary task, so that effects of the cue type manipulation could be examined separately for each of these potentially distinct mechanisms (Berntsen, 2019; Maillet et al., 2017). Study 1 partially confirmed the stated hypotheses, with goal cues garnering a higher overall SFT frequency than standard cues, within a small sample. Despite careful efforts to maintain parity of design and procedure, the online Study 2 produced a divergent pattern of results. Here, tentative evidence that the presence of life goal cues may increase the likelihood of current goal-related thoughts was the only confirmatory finding. Future research could expand on this by stratifying cue content more precisely, for instance distinguishing between different levels of a goal hierarchy (Austin & Vancouver, 1996) or designing cues to target particular future life periods (Berntsen & Hall, 2004; Conway et al., 2019).

Exploratory analyses of SFTs' subjective characteristics across both studies provided some valuable insights that echo and extend earlier findings (Berntsen & Jacobsen, 2008; Cole et al., 2016; D'Argembeau et al., 2011). One such result is particularly noteworthy: the comparison of temporal distance distributions between goal and standard cue conditions in Study 1 (see Figure 2.5). For standard cues, the typical non-linear, declining function is observed (cf. Berntsen & Jacobsen, 2008; Cole et al., 2016; Spreng & Levine, 2006), whereas for goal cues, the distribution is distinctly flatter. This presents another promising avenue for future research, as it may turn out that cue content manipulations exert a more consistent influence on the *content and characteristics* of SFTs, rather than their occurrence dynamics.

Collapsing across cue types, the results of Study 1 closely resemble those of previous laboratory SFT studies (Cole & Berntsen, 2016; Jordao et al., 2019; Mazzoni, 2019): A clear predominance of both cue-triggered and goal-related content demonstrates continuity in terms of young adults' general propensity to experience thoughts of future events without intention during a simple attentional task. Study 2, on the other hand, appears to have "changed the goal posts": Generally lower primary task performance, inversely related to SFT reporting, implies fundamental differences in the (uncontrolled) attentional context of completing the study online, versus in the lab. Hence, an additional contribution of this chapter is in outlining the particular challenges inherent in running dual-task experiments online.

Questions surrounding participant engagement and data quality in online research are as old as the technology itself (Buhrmester et al., 2011; Chmielewski & Kucker, 2020). In spite of recent efforts to show that online experimental data can be of sufficient quality when working with more conventional cognitive tasks (Anwyl-Irvine et al., 2021), it appears that the dual-task paradigm used here presents a specific challenge due to the existing requirement to divide attentional resources (Rummel et al., 2017; Kvavilashvili & Rummel, 2020) coupled with the myriad sources of external distraction that may be present in an uncontrolled setting (e.g., the participant's home). In sum, it is important to bear in mind the complex dynamics involved in dual-task performance when adapting this type of experiment online, and especially when attempting to draw comparisons or synthesise results from laboratory and online data sets.

Chapter 3. The Genesis and Reoccurrence of Spontaneous Future Thoughts: An Experimental Test of the 'Memories of the Future' Hypothesis

3.1. Introduction

Recent theory (Cole & Kvavilashvili, 2021) has delineated two alternate processes by which thoughts of future events can enter consciousness. One is slow, effortful and deliberate – the "voluntary mode" of future thinking widely studied under the banners of episodic future thinking, prospection and mental time travel (Schacter & Addis, 2007; Schacter et al., 2012); the other is rapid, relatively effortless and occurs without conscious intent. This latter, spontaneous mode gains evidential support from studies of involuntary future thought (Berntsen, 2019) and mind-wandering (Smallwood & Schooler, 2015) – both contexts in which participants report future events coming to mind unintentionally despite instructions to focus one's attention on an unrelated cognitive task. Up until now there has been limited research combining both methodologies.

The present study combined insights from voluntary and involuntary future thinking research in a direct test of the hitherto speculative suggestion that some naturally occurring future thoughts are in fact "memories of the future" – coherent mnemonic representations of possible future events, voluntarily constructed and later retrieved in the spontaneous mode (Cole & Kvavilashvili, 2021). In the following sections, two distinct fields of research (and associated theory) will be summarised in relation to this question, followed by a more precise statement of study hypotheses.

3.1.1. Episodic future thinking: From constructive simulation to direct access

Episodic future thinking has been defined as "a projection of the self into the future to pre-experience an event" (Atance & O'Neill, 2001, p. 533) and is associated with rich sensory and emotional detail (Seligman et al., 2016) and a subjective sense that one is mentally travelling through time (Tulving, 2005; Suddendorf & Corballis, 2007). For instance, when considering holiday destinations for next year, one can imagine in great detail the sights, sounds and feelings of an

afternoon on a white sand beach, placing oneself there in the mind's eye as if one is *pre-experiencing* a future event (Tulving, 2005; Hassabis et al., 2007). This complex ability has been extensively researched using cue-word paradigms inherited from studies of episodic memory (e.g., the modified future Crovitz test, MCFT; Crovitz & Schiffman, 1974; Spreng & Levine, 2006). In this type of task, participants are presented with a series of words, usually common nouns such as *umbrella* or *friend*, and asked to imagine themselves experiencing a plausible future event in relation to each cue. Various cognitive and phenomenological properties of these events can then be assessed (e.g., level of episodic detail), using a variety of manipulations to probe the mechanisms involved (reviewed in Schacter et al., 2012, and D'Argembeau, 2020). Studies applying this methodology in neurological patients (Wheeler et al., 1997; Hassabis et al., 2007) and combining it with neuroimaging techniques (reviewed in Schacter et al., 2017) have made great progress in understanding the brain systems engaged when constructing such rich, personally relevant simulations associated with a future time point.

The first theories of episodic future thinking emphasised the overlap in brain areas activated when participants construct such future scenarios and when they recall past episodes (Schacter & Addis, 2007; Wheeler et al., 1997; Suddendorf & Corballis, 2007) – most notably medial prefrontal areas and medio-temporal areas including the hippocampus (Addis et al., 2007, 2009). Medial prefrontal cortex, implicated in a wide range of cognitive capacities including navigation and theory of mind, belongs to the *default network* of brain regions (Raichle et al., 2001) proposed to support processes involving the self (Buckner & Carroll, 2007). Self-projection backwards or forwards in subjective time – the hallmark of episodic memory and future thinking (Tulving, 2005) – therefore accounts for the involvement of medial prefrontal brain areas in future thinking tasks. Meanwhile, the engagement of the hippocampus – long associated with episodic memory (Scoville & Milner, 1957; Tulving, 1985) – was thought to reflect the retrieval and recombination of details stored in long-term memory when revisiting past events and constructing possible future ones (Schacter & Addis, 2007; Schacter et al., 2012). More recently, these conclusions have been qualified and updated to account for similar patterns of hippocampal activation (and associated cognitive characteristics) in imagined

events not associated with the personal past or future (atemporal events; de Vito et al., 2012; Mullally & Maguire, 2014). Aligned with this work, the theory of *scene construction* (Hassabis & Maguire, 2007, 2009) holds that the hippocampus is engaged whenever disparate sensory details must be combined into a coherent spatiotemporal scene – including when imagining events that have no personal relevance or subjective sense of time. To summarise, the dominant theories of episodic memory and future thinking (Tulving, 2005; Schacter & Addis, 2007; Hassabis & Maguire, 2007) diverge in the extent to which the underlying neural mechanisms are seen as specific to imagining oneself at different points in time.

In any case, imagining future events is not simply a matter of recombining episodic details; to be experienced as part of one's personal future, an event must also be connected with semantic information about the self, as well as general expectations about the structure of events (Irish & Piguet, 2013; Brainerd & Reyna, 2002). In particular, future thinking relies on autobiographical information (i.e., general knowledge about oneself and one's life story; Conway, 2005; Conway et al., 2019) to 'scaffold' the process of event construction, furnishing event representations with a temporal dimension (cf. Mullally & Maguire, 2014) and thus enabling the experience of future mental time travel (Irish & Piguet, 2013; Lehner & D'Argembeau, 2016). One form of scaffolding information is uncompleted personal goals – behavioural priorities associated with cognitive commitment, striving and planning (Emmons, 1986; Klinger, 2013). Research using the voluntary word-cueing paradigm has shown that – when subject to the requirement of plausibility – future thoughts are frequently produced through direct consideration of personal goals (D'Argembeau & Mathy, 2011). Furthermore, Lehner and D'Argembeau (2016) showed that future thoughts generated from personal goal cues, by the same group of participants, were experienced with greater feelings of autonoetic consciousness (i.e., more clearly located in subjective time; Klein, 2016) than thoughts elicited by generic verbal cues. These results are consistent with the idea that goals are highly accessible constructs (Klinger, 2013), and people are sensitised to information in the environment (e.g., verbal cues) relevant to their goals, thus eliciting thoughts and plans which may contribute to achieving these ends. This is also a central tenet of this thesis (see Chapter 1, section 1.5).

Recent studies using similar word-cueing paradigms have identified two distinct processes by which a cue can elicit an episodic thought (past or future), differing in the effort required to bring the thought to mind and the explicit use of personal semantic information (Jeunehomme & D'Argembeau, 2016; Uzer et al., 2012). First, Uzer et al. (2012) showed that most personal memories cued by object and emotion words were in fact retrieved *directly*, as reflected by rapid report latencies and low reliance on semantic information, as well as participants' subjective judgments. This prompted them to question the dominant theoretical view that autobiographical memories are typically constructed in an effortful way through a *generative* search of stored knowledge (Conway, 2005; Conway & Pleydell-Pearce, 2000). Subsequently, Jeunehomme and D'Argembeau (2016) applied this distinction in the context of future thinking, showing that direct future thoughts outnumbered their generative counterparts across three experiments using common nouns (e.g., *friend*, *restaurant*) as cues. Of particular import, directly accessed future thoughts were overwhelmingly reported to have been experienced before (Jeunehomme & D'Argembeau, 2016, expt. 1) – therefore their original construction from disparate episodic details (Schacter & Addis, 2007) must have predated the testing session. A further experiment ruled out the possibility that direct future thoughts reflected "recastings" of veridical past events (Jeunehomme & D'Argembeau, 2016, expt. 2). In concrete terms, one might recognise one's directly cued thought of a future restaurant meal as having come to mind before, without its being a simple replica of a previous experience in a restaurant.

In summary, while the explicit use of autobiographical information such as one's goals can benefit the construction of future events via effortful, generative processing (D'Argembeau & Mathy, 2011; Lehner & D'Argembeau, 2016), episodic future projections frequently occur without such support, requiring little cognitive effort, in response to the same generic cues (Jeunehomme & D'Argembeau, 2016). This class of highly accessible event representations are in part distinguished by their high likelihood of having been thought of before. If they are not recastings of past memories, as the authors are careful to establish (Jeunehomme & D'Argembeau, 2016, expt. 2), is it possible that they are nonetheless – at the point of "direct" access – mnemonic representations of a different kind?

This possibility is central to the present study's rationale, and will be further explored after outlining a contrasting approach in which the present work is grounded.

3.1.2. Spontaneous future thinking: An alternate perspective

We take a different theoretical standpoint from the mainstream episodic future thinking literature discussed above (the "standard approach"; Cole & Kvavilashvili, 2021). Those lines of research, while influential on our work, take the deliberate construction of possible future events (Schacter & Addis, 2007; Szpunar, 2010) as the default mechanism by which humans imagine the future (Suddendorf & Corballis, 2007). Accordingly, the supporting empirical work uses Crovitz-type cueing procedures in which participants are explicitly instructed to imagine and report possible future events (henceforth *voluntary methods*; reviewed in Schacter et al., 2012). However, in view of the regularity with which individuals think about the future in their daily lives (Baumeister et al., 2020; D'Argembeau et al., 2011), one could argue that the methods used to study future thinking should aim to better reflect the conditions under which such thoughts naturally occur. As such, our primary interest lies in *spontaneous* future thoughts (SFTs): episodic representations similar to those already discussed, but with the defining characteristic that they come to mind unintentionally and without subjective effort (Cole & Kvavilashvili, 2021; Berntsen, 2019).

Aligned with this perspective is a distinct methodological framework, owing much to the fields of involuntary memory and mind-wandering (see Berntsen, 2019; Smallwood & Schooler, 2015), within which future thoughts are reported as they spontaneously occur – in the absence of explicit instructions to produce them (*involuntary methods*; Chapter 1). Studies of this type instruct participants to focus on a primary task which is then interrupted by the experimenter or paused by the participant in order to capture their thoughts without encouraging explicit thinking strategies. Although other tasks have been used (Smallwood et al., 2011; Stawarczyk et al., 2011), a typical focal task in these studies is a cognitively undemanding visual attention or vigilance task in which participants are asked to detect very occasional deviants among an otherwise monotonous series of stimuli (e.g., vertical versus horizontal line patterns; Schlagman & Kvavilashvili, 2008; Cole et al., 2016; Plimpton et al., 2015; Vannucci et al., 2015, 2017).

Research in this vein has shown both similarities and differences between voluntary and involuntary (spontaneous) future thinking. For instance, personal semantic information – knowledge about the self and one's goals – is also relevant to the occurrence and content of SFTs, both when mental contents are freely sampled (Cole & Berntsen, 2016; Duffy & Cole, 2020) and when goal- and self-relevant information is manipulated (Jordão et al., 2019; Smallwood et al., 2011; Stawarczyk et al., 2011). Recently, however, Duffy and Cole (2020) contrasted spontaneous reporting with voluntary construction, showing that SFTs were *more* likely to include reference to a participant's specific current goals. Similarly, comparing the phenomenological characteristics of voluntary and involuntary thoughts directly has shown that spontaneously imagined future events are closer to the present, more specifically located in time, and more emotionally intense than those in the voluntary mode; while voluntary event constructions feature greater sensory-perceptual vividness and are perceived as more important to one's life story (Cole et al., 2016). Underlining the distinction, Cole et al. (2016) found that involuntary thoughts were reported much more rapidly, at latencies of around three seconds from cue presentation to self-initiated report (versus 11 in the voluntary mode). Taken together, although semantic information like goals contributes to both modes of thought, the pattern of differences between the two modes calls for further examination of the origins and possible functions of SFTs as distinct from the more widely studied voluntary constructions (Cole & Kvavilashvili, 2019, 2021).

An important commonality between the voluntary and involuntary approaches is that they both elicit future thoughts in response to verbal cues. While the voluntary method requires participants to intentionally process each cue to arrive at a reportable future event, involuntary studies incorporating ostensibly irrelevant verbal material within a primary attentional task have shown that these "incidental" cues nonetheless reliably elicit SFTs (Cole et al., 2016; Plimpton et al., 2015; Vannucci et al., 2015, 2017; Chapter 2). Specifically, Cole et al. (2016) reported that 58% of SFTs were triggered by incidental cues and 12% by other external and internal information, while the remaining ≈ 30% had no known trigger. Thus, some SFTs seem to appear "out of the blue", but the majority are cue-dependent (Berntsen, 2019; cf. Maillet et al., 2017). Building on studies of goal-related mind-wandering (Jordão et al., 2019; McVay & Kane, 2013), Chapter 2 set out to investigate

whether manipulation of cue content can influence effectiveness in triggering various types of SFTs. Altogether, work on cue-triggered SFTs has the potential to test theories of how internal goals may constrain spontaneous thought by modulating an individual's response to environmental information (see current concern theory; Klinger, 2013; Klinger et al., 2018). Moreover, the observation that SFTs can occur in response to cues provides a link between voluntary and spontaneous future thinking that can be harnessed in the present study since the same phrases can in principle be used to cue thoughts in either of the two modes.

Fundamentally, the deliberate, effortful construction of future events through generative processing of cue information (Conway et al., 2019) may not be the typical or default mechanism by which such events are experienced. Similar to the arguments made by Uzer et al. (2012) in favour of direct retrieval as the basic mode of autobiographical memory, spontaneous future thinking is not only a distinct process, but potentially a more representative reflection of how future thoughts occur in everyday life, for instance during periods of low attentional demand (Berntsen, 2019; Kvavilashvili & Rummel, 2020). Such conditions are simulated by the low-demand attentional tasks used to sample thoughts in the involuntary approach. Voluntary tasks, by contrast, artificially demand that a future event be imagined in response to every cue – producing a heterogeneous mix of generative and direct responses (Jeunehomme & D'Argembeau, 2016), presumably depending on the situationally conditioned meaning of each cue for each participant (Barsalou, 2015).

Since SFTs are known to be readily triggered by verbal material (Plimpton et al., 2015; Cole et al., 2016), it is entirely plausible that some trials in a "voluntary" task (e.g., Lehner & D'Argembeau, 2016; studies reviewed by Schacter et al., 2012) actually elicit future thoughts via the same involuntary process – despite instructions to respond using an intentional strategy. One could reinterpret Jeunehomme and D'Argembeau's (2016) distinction between direct and generative modes in this light: "Direct" future thoughts may arise on trials where there is no impetus to enact the voluntary instructions (i.e., conduct a top-down search; cf. Conway & Pleydell-Pearce, 2000) because a relevant thought comes to mind spontaneously in response to the given cue (Berntsen, 2019; Berntsen et al., 2013).

3.1.3. The memories of the future hypothesis

The shared neural architecture underlying the recombination of episodic details in past and future thinking is well attested (see Schacter et al., 2012, for a review); in this regard, voluntary future thinking clearly relies on memory to supply the contents of novel future scenarios. Less certain, however, is the speculation that some naturally occurring future thoughts may themselves be mnemonic representations, or "memories of the future", which once encoded are then retrieved analogously to memories of past events (Cole et al., 2016; Szpunar et al., 2013; Ingvar, 1985; but see Jeunehomme & D'Argembeau, 2017, 2021, for supporting evidence using voluntary methods). Data from Mazzoni (2019) demonstrating greater demands on executive resources when reporting SFTs than IAMs would suggest that not all SFTs are pre-stored representations; yet studies using both voluntary and involuntary methods converge on the possibility that certain future thoughts commonly reoccur in a more immediate, less deliberate way (Cole & Kvavilashvili, 2021; Jeunehomme & D'Argembeau, 2016).

In support of the notion of memories of the future, explicit encoding studies by Klein and colleagues (Klein et al., 2010, 2012) have shown that information encoded in relation to a hypothetical future event (e.g., "Imagine using each of these objects next time you go camping") is subsequently recalled in greater detail than if it is encoded according to traditional episodic memory instructions (or indeed, via atemporal simulation; Klein et al., 2010). Klein et al. (2012) interpret this in functional terms, noting that a key benefit of episodic future simulation is to construct plans that can later be acted upon. In line with recent theoretical views that see the core function of episodic memory as enhanced future planning ability (Seligman et al., 2016; Suddendorf, 2010), Klein et al.'s (2012) data suggest that episodic future simulations – the products of voluntary future thinking – exist to be retained in long-term memory and acted upon at a subsequent point (Szpunar, Addis, et al., 2013). These effective memories of the future may be more accessible than those relating to past events, to enable their rapid retrieval at the point when a plan needs to be initiated, often days or months after its original formulation (Klein et al., 2012).

Cole et al. (2016) speculated that future thoughts which arise spontaneously, often in response to a verbal cue, might reflect previously constructed representations being re-accessed involuntarily. If correct, the suggested two-stage process (voluntary construction followed by spontaneous retrieval) would closely resemble the occurrence of involuntary memories (Berntsen, 2019, 2010), which are sensitive to triggering by relevant cues after first being encoded voluntarily (Berntsen et al., 2013; Mace, 2006). Overall, then, it is conceivable that some proportion of future thoughts captured in "voluntary" tasks are actually brought to mind involuntarily after being constructed at some prior point, reflecting the same process that is captured in studies of spontaneous future thinking. This possibility is in close accord with Jeunehomme and D'Argembeau's (2016) comments on the direct-versus-generative distinction: "…the future thoughts that were directly produced… could more appropriately be conceptualised as 'memories of the future' – that is, future events envisioned on a previous occasion" (p. 268). The present study aims to address the memories of the future hypothesis directly by drawing on the strengths of both voluntary and involuntary methods.

3.1.4. The present study: Aims and hypotheses

In examining the link between the intentional construction and spontaneous reoccurrence of possible future events, it may be possible to reconcile Jeunehomme and D'Argembeau's (2016) results with the spontaneous future thinking and mind-wandering literature (Cole et al., 2016; Plimpton et al., 2015; Vannucci et al., 2015, 2017). In these studies, thoughts of a strikingly similar cognitive-phenomenological character (rapid, frequently rehearsed, emotionally intense) commonly occur with no explicit attempt to produce them. Unifying the two fields in this way would be beneficial since they might, at present, have essentially the same phenomena in their sights and yet remain unreconciled due to differences of perspective and methodology. Furthermore, direct evidence of a temporal relationship between the two proposed modes of future thinking (i.e., voluntary encoding followed by spontaneous retrieval; Cole & Kvavilashvili, 2021) would drive the SFT field forward by moving beyond consideration of how SFTs momentarily occur (as in Chapter 2) towards a deeper explanation of the *genesis* of such mental representations.

The present study aimed to build upon previous SFT research (Cole et al., 2016; Duffy & Cole, 2020) which highlighted similarities and differences in the thoughts occurring in parallel voluntary and involuntary conditions. The specific aim of this novel experiment, however, was to test for the presence of a *temporal relation* between these two processes: Do voluntary future thoughts, elicited under controlled conditions in response to a generic set of cues, readily reoccur when participants are once again presented with those cues in a context favouring spontaneous thought? The methodology developed to test this question is reminiscent of that used by Mace (2006) to detect spontaneous reocurrences of intentionally encoded memories: in effect, involuntary "echoes" of memories constructed beforehand in a voluntary mode. We combined voluntary and spontaneous thinking tasks sequentially for the same group of participants, enabling us to detect any such echoes occurring downstream of voluntary event construction. Additionally, a control group completed a non-future-construction task before the spontaneous thought task, to provide a causal test of our question.

For both groups, spontaneous thought contents were sampled using the vigilance task common in SFT research (Cole et al., 2016; Plimpton et al., 2015; Schlagman & Kvavilashvili, 2008; Vannucci et al., 2015, 2017). We modified the version used in our previous studies (Cole et al., 2016; Duffy & Cole, 2020; Chapter 2) so as to avoid specific emphasis on "future thoughts". Reoccurring thoughts based on previous constructions might reasonably be interpreted as memories; hence, if participants were asked to report only future events, the data most pertinent to testing the central question of this study might elude capture. An unrestricted, probe-caught procedure was therefore used (cf. Barzykowski & Staugaard, 2016, 2018; Jordão et al., 2019; Plimpton et al., 2015), in which participants are invited to report *any spontaneous mental contents* at intervals throughout the vigilance task. Post-hoc coding of written thought descriptions (Mazzoni, 2019) was used to distinguish thoughts that were thematically linked ("related") to scenarios imagined in the voluntary (future construction or control) task.

Additionally, verbal cues in the spontaneous thought task were manipulated so that each participant would encounter phrases *seen* in the preceding voluntary task on one half of occasions,

and previously *unseen* phrases on the other half. This was to enable us to gauge the extent to which reoccurring future thoughts exhibit cue specificity (cf. Berntsen et al., 2013). According to the underlying theory (Cole & Kvavilashvili, 2021), such thoughts should occur more readily in response to seen than to unseen cues, in the experimental group; whereas any SFTs reported by control participants (as in any unrestricted thought sampling task; cf. (Barzykowski & Staugaard, 2018; Plimpton et al., 2015)) should be insensitive to cue type. With its design thus refined, the experiment provides a more sensitive test of the question of reoccurrence, accounting for cue specificity (Berntsen et al., 2013; Berntsen, 2019) and the possibility of an overall increase in SFTs in the experimental group through general priming of future autobiographical knowledge (cf. Jordão et al, 2019; Stawarczyk et al., 2011).

The hypotheses of the present study were therefore as follows:

1. Voluntary future thoughts constructed in the first phase of the experiment will reoccur spontaneously in the second, in response to "seen" cues (e.g., *Bus stop*, for a participant who constructed a voluntary event based on this cue). This will be assessed by examining the three-way interaction in the proportion of spontaneous thoughts, according to experimental group, Cue Type (seen / unseen) and thought Relatedness (related / unrelated).
2. The voluntary future thinking task will facilitate subsequent spontaneous (future) thought irrespective of Cue Type and Relatedness. This will be assessed by examining the rate of spontaneous thoughts (corrected for overall thought reports) between the two groups.

Hypothesis 2 is included to acknowledge the results of previous studies that have shown general increases in SFT / future mind-wandering (i.e., priming effects) following tasks that may engage deliberate future thought, without analysing specific thought content or triggers (Jordão et al, 2019; Stawarczyk et al, 2011; Smallwood et al, 2011).

3.2. Methods

3.2.1. Participants

Based on an *a priori* power calculation (see *Design*), the target sample size was 76. The final sample consisted of 90 undergraduate students participating in return for course credit (n = 80) or a £10 retail voucher (n = 10). Participants had a mean age of 21.3 years (SD = 5.2) and comprised 73 females, 16 males and one participant who chose not to specify their gender. On signing up for the study, participants were randomly allocated to either the future construction (n = 44) or the control group (n = 46). Mean age was equivalent between the two groups (M_{diff} = .03, $t_{(88)}$ = .03, p > .9, *ns*); gender ratios were also balanced ($\chi^2_{(2)}$ = 1.08, p > .5, *ns*).

3.2.2. Design

The study used a 2 x 2 x 2 mixed factorial design with a between-subjects factor of Group (future event construction, control) and within-subjects factors of Cue Type (seen, unseen) and Relatedness (related, unrelated). Dependent variables were derived from thought frequencies recorded in the vigilance task (see *Materials and Measures*). Target sample size was established in advance using G*Power (Faul et al., 2007), based on an acceptable power level of 80% to detect a medium-sized interaction in mixed ANOVA (f = 0.33; Lenhard & Lenhard, 2016). Further details on power calculation can be found in the study pre-registration document at http://www.osf.io/cu59n. The study was approved by a University Ethics Committee.

3.2.3. Materials and Measures

3.2.3.1. Phase 1: Future Construction and Control Writing Tasks

Phase 1 of the experiment consisted of either a voluntary future event construction task or a control writing task (see Figure 3.1), presented on paper (n = 11, prior to lockdown) or using Qualtrics survey software (n = 79, with COVID-safe lab guidelines in place). In the voluntary construction task, participants were asked to "…imagine yourself in each of the following locations, providing one or two sentences of detail to describe the imagined experience". The task resembled the modified

Crovitz cueing procedure (Crovitz & Schiffman, 1974) typically used in studies of future mental time travel (e.g., Addis et al., 2007; review by Schacter et al., 2012), with the principal difference that all cues were location phrases (taken from Cole et al., *in preparation*). Participants were presented with 15 prompts, each consisting of a location phrase (e.g., *bus stop*, *museum*) and a future time point (*1 week* / *1 year* / *5 years from now*; 5 trials at each time point in a fixed pseudo-random order). The use of pre-specified time points aimed to maximise consistency of event representations within the experimental group, given that temporal distance has known effects on the characteristics of such representations (D'Argembeau & Van der Linden, 2012; D'Argembeau & Van Der Linden, 2004).

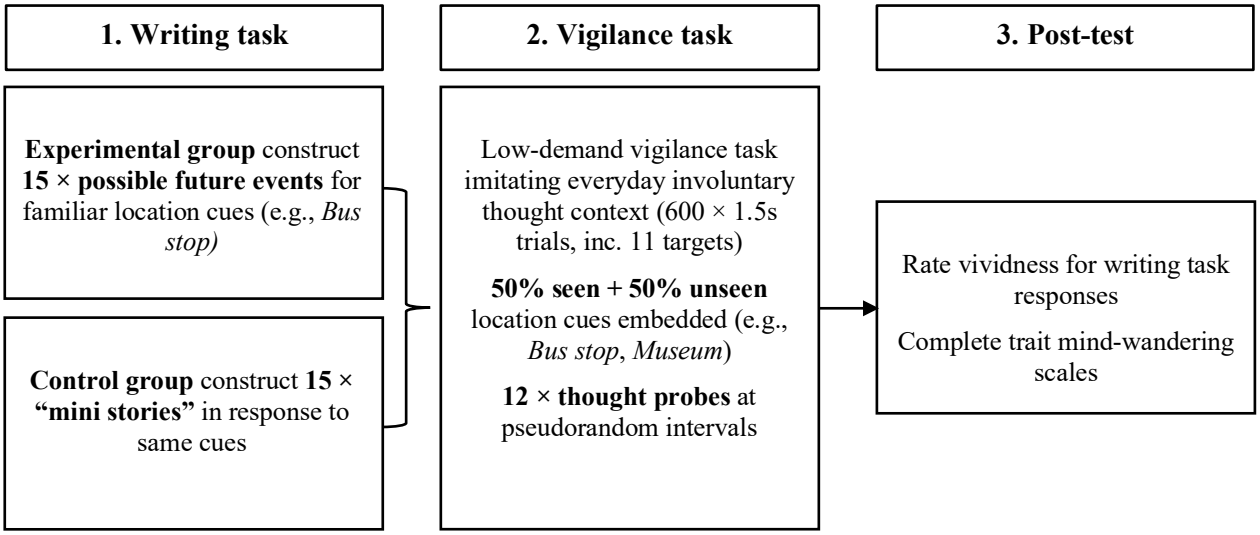


Figure 3.1. Outline of Design and Procedure for Study 3

Participants in the control condition were instead asked to write a "mini story", also one or two sentences long, based on a given location phrase and verb (e.g., *bus stop* and *show*). The control task was designed to closely mimic the experimental task in terms of stimuli (locations), response format and duration, yet without eliciting future event construction. The verbs were introduced after piloting to balance task difficulty with the future-event version while avoiding reference to specific time points to discourage autobiographical thinking. For both groups of participants, an example prompt and response were given at the start to aid understanding of the task. In the experimental task, the example response was explicitly future-oriented; in the control task, the example response was written in the past tense to reduce the likelihood of future event simulation.

Both writing tasks used the same list of 30 location phrases, adapted from recent work on recombination in SFT (Cole et al., *in preparation*). These were randomly divided into two lists of 15, which did not differ in terms of length ($t_{(28)}$ = .15, p = .88) or log-10 frequency from the SUBTLEX database ($t_{(25)}$ = -1.36, p = .19; Brysbaert & New, 2009). Additional lexical characteristics were checked where the exact phrase or a clear synonym was available in the (Clark & Paivio, 2004) extended norms (e.g., *market* for *marketplace*; *hall* for *auditorium*). Comparison of the two lists showed no differences in concreteness ($t_{(12)}$ = -.43, p = .68), context availability ($t_{(12)}$ = .82, p = .43), or imagery ($t_{(13)}$ = 1.68, p = .12). Finally, mean semantic similarity – expressing the vector distance between words or texts in multidimensional semantic space (Landauer & Dumais, 1997) – did not differ between the lists ($t_{(28)}$ = .47, p = .64). The two cue lists were then counterbalanced so that half of participants in both groups responded to one list, half to the other. The 15 verbs used in the control task were selected from the SUBTLEX norms (Brysbaert & New, 2009), using an arbitrary criterion of log-10 frequency values between 4 and 4.5 (i.e., occurring about 200-600 times per million words). This step ensured that a consistent set of moderately common verbs was chosen (e.g., *show*, *move*).

3.2.3.2. Phase 2: Vigilance Task with Spontaneous Thought Probes

Phase 2 of the experiment consisted of a probe-caught spontaneous thought task (Vannucci et al., 2017; Plimpton et al., 2015; Jordão et al., 2019). This comprised a primary attentional vigilance task, presented on a desktop computer using E-Prime Professional Version 3.0 software, interrupted at varying intervals by a prompt to record any momentary spontaneous thoughts on an adjacent iPad (using Qualtrics software). The attention task consisted of 600 trials, each of 1.5 s duration, displaying either horizontal (n = 589) or vertical line arrays (n = 11), with participants instructed to detect the vertical target stimuli and respond each time with a keyboard press.

Cue phrases were embedded within the line arrays on 120 trials (i.e., 20%), to act as triggers for spontaneous thoughts in line with previous studies (Vannucci et al., 2015; Chapter 2). The overall list of 120 cues was generated by repeating all 30 location phrases four times in a fixed order (full cue list available at https://osf.io/zfta6/?view_only=7fa3acea6bf449aea5d10d19cc0a28f5). The order was determined by first randomly ordering the cues and then adjusting using latent semantic analysis

(LSA; Landauer & Dumais, 1997) to minimise similarity between consecutive and near-consecutive cues[4]. This process was intended to make successive cues more distinctive, therefore reducing the chance of multiple phrases interacting to trigger SFTs – known to occur in this type of task (Cole et al., *in preparation*). As noted above, cues encountered in Phase 1 are referred to as *seen* (and hence capable of acting as specific cues for retrieval of previous event representations); those not previously encountered are referred to as *unseen*. Thus, each participant was exposed to 15 seen and 15 unseen cues, each repeated four times, during the spontaneous thought task.

Finally, 12 thought probes occurred at fixed intervals of every 24 to 70 trials throughout the task (average probe-probe distance = 47 trials). On each occasion, the task paused and participants were directed to the iPad, where they responded to a series of questions. Participants were first asked to rate their current concentration level, using a 1-5 Likert scale (Plimpton et al., 2015; Jordão et al., 2019). This was followed by the question "Did you have any thoughts at the moment when you were stopped?" with a binary response (yes / no). Whenever participants responded with "no", the probe terminated and instructed them to return to the attention task on the computer. Whenever they responded "yes", they were required to provide certain information about the relevant mental contents: a short description of the thought; whether there was a trigger ("Was there anything that triggered the thought – in your mind or in the environment?"); brief description of the trigger if applicable; whether they had previously experienced the thought ("Have you ever thought about this before today's session?"); and a spontaneity rating on a 1-5 Likert scale (1 = *Spontaneous / out of the blue*; 3 = *Somewhat spontaneous / not sure*; 5 = *Voluntary / actively chose to think about it*).

Since it has been established that cued SFTs occur with a mean latency of about 3 seconds (Cole et al., 2016; Cole et al., *in preparation*; cf. Barzykowski & Staugaard, 2016), probe positioning was constrained by the requirement to ensure an equal chance of capturing thoughts triggered by seen and by unseen cues. Thus, six probes (50%) were set to occur within 1-3 trials of seen cues, while the

[4] "Near-consecutive" = within 3 trials either way. As an example, the initial list contained the sequence *sports field - gym*, giving an LSA similarity value of 0.32 (M = 0.15, SD = 0.11 for the whole set). In the adjusted list, these two cues were separated by a minimum of 6 trials on each occurrence.

other six were placed within 1-3 trials of unseen cues[5]. Setting cue-probe latencies in this way should mean that spontaneous thoughts triggered by either type of cue have an equal chance of being captured. Our hypotheses regarding seen versus unseen cues can hence be tested on an equal footing.

3.2.3.3. Post-test control measures

Participants also provided control measures of mean event vividness in the writing task (1-7 Likert, *not at all vivid* to *extremely vivid*) and everyday spontaneous and deliberate mind-wandering (MW-S and MW-D scales, respectively; Carriere et al., 2013). These measures were included in view of, respectively, substantial individual differences in visual imagery / sensory-perceptual experience of future thinking (D'Argembeau & Van der Linden, 2006) and variation in habitual mind-wandering tendencies which can impact laboratory thought sampling (Kane et al., 2017). They could then be examined in relation to thought sampling variables and incorporated in multivariate analyses where appropriate to avoid potential confounds.

3.2.4. Procedure

After providing informed consent, each participant completed the experiment in an individual lab room, equipped with a desktop computer and iPad (with appropriate COVID-safe measures in place where applicable). There was one sole experimenter (HCM), who was aware of group assignment and study aims. In Phase 1, the experimenter introduced both versions of the writing task as a "verbal processing task", informing participants they would have a maximum of 20 minutes to complete this and should therefore spend about one minute on each of the 15 prompts. For n = 79 participants performing all tasks in digital format, a time limit of 80 s was imposed on each prompt and total task duration recorded in Qualtrics to facilitate comparison of the experimental and control versions.

[5] For 41 of 90 participants, vigilance task trials were randomly (rather than pseudorandomly) presented due to a systematic technical error. An algorithm was therefore devised to determine Cue Type for each thought probe in these cases (i.e., by examining the preceding cues in experiment output files).

The spontaneous thought task in Phase 2 was introduced as a "visuospatial attention" task in which the sole aim was to maintain concentration, responding to vertical line stimuli as quickly and accurately as possible. Participants were informed that phrases would appear onscreen during the task, but that these were irrelevant and should be ignored. A practice block of 40 trials, including 3 targets, was used to familiarise participants with the task (the cues appearing in this block did not appear elsewhere in the experiment). After the practice block, participants were informed that their concentration level would be monitored by occasional probes occurring at random intervals. It was explained that each time the attention task was automatically paused, they should switch to the iPad to rate their concentration level and answer a few brief questions.

After completing Phase 2, participants were asked to revisit their writing task responses and provide a rating of vividness for each of the events / stories they had written (see Figure 3.1, *Post-test*). The same instruction was given to participants in both groups: "Go back through [your responses], and for each one, rate how vividly you imagined the scenario". Responses were re-displayed using the 'piped text' feature in Qualtrics, with no time limit. Finally, participants were administered the MW-S and MW-D scales, debriefed, and reminded of their right to withdraw.

3.3. Results

3.3.1. Descriptive statistics and preliminary analyses

Descriptive statistics for each measure are presented according to task and experimental group in Table 3.1. Preliminary analyses were conducted to ensure consistency between groups prior to running the confirmatory tests.

Table 3.1. Descriptive statistics for all measures (means with SDs in parentheses).

Component	Measure (unit/ range)	Future Group	Control Group	Total
Writing task	Duration (mm:ss)	14:31 (03:06)	13:36 (03:40)	14:03 (03:25)
	Word count	21.1 (5.28)	18.6 (4.05)	19.8 (4.83)
	Vividness (1–7)	4.30 (0.87)	4.04 (1.18)	4.17 (1.04)
Vigilance task	Proportion correct	0.97 (0.06)	0.97 (0.06)	0.97 (0.06)
	Reaction time (ms)	602 (99)	631 (88)	616 (95)
	Concentration (1–5)	3.39 (0.67)	3.37 (0.70)	3.38 (0.68)
	Total thoughts	4.91 (2.92)	5.80 (2.83)	5.37 (2.89)
MW scales	MW-S (4–28)	20.4 (4.31)	21.5 (3.99)	21.0 (4.16)
	MW-D (4–28)	17.9 (5.50)	19.5 (4.72)	18.7 (5.15)

3.3.1.1. Writing task performance

An independent samples t-test indicated that an equivalent amount of time was spent on the future (M = 871 s, SD = 186 s) and control tasks (M = 816 s, SD = 220 s; $t_{(88)} = 1.29$, $p = .201$, *ns*). However, future simulation responses showed longer average word counts (M = 21.1, SD = 5.28) than control responses (M = 18.6, SD = 4.05; $t_{(88)} = 2.54$, $p = .013$, $d = .54$). Vividness ratings, provided at post-test, suggested that both future simulations (M = 4.30, SD = 0.87) and control ("mini story") responses (M = 4.04, SD = 1.18) were imagined in an equivalent level of detail ($t_{(88)} = 1.17$, $p = .245$, *ns*).

3.3.1.2. Vigilance task performance

Vigilance task performance was equivalent between groups, both in terms of accuracy ($t_{(88)}$ = -.270, p = .788, *ns*) and RT ($t_{(88)}$ = 1.47, p = .145, *ns*). Hence, primary task performance was not influenced by the prior writing task manipulation. Average primary-task concentration ratings (1–5 Likert) captured in the thought probes were also equivalent between the future (M = 3.39, SD = 0.67) and control groups (M = 3.37, SD = 0.70; $t_{(88)}$ = .142, p = .887, *ns*); the total number of thought reports was also unaffected by the manipulation (future M = 4.91, SD = 2.92; control M = 5.80, SD = 2.83; $t_{(88)}$ = -1.48, p = .143, *ns*).

3.3.1.3. Mind-wandering scales (MW-S and MW-D)

No differences in trait mind-wandering were detected between groups: MW-S scores were similar in the future (M = 20.4, SD = 4.31) and control groups (M = 21.5, SD = 3.99; $t_{(88)}$ = -1.22, p = .225, *ns*); as were MW-D scores (future M = 17.9, SD = 5.50; control M = 19.5, SD = 4.72; $t_{(88)}$ = -1.45, p = .15, *ns*). In the sample as a whole, MW-S scores (M = 21.0, SD = 4.16) were significantly higher than MW-D scores (M = 18.7, SD = 5.15; $t_{(89)}$ = 3.79, p < .001, d = .40), and the two measures were positively correlated ($r_{(90)}$ = .29, p = .006). Thus, participants in general reported a greater tendency towards spontaneous than deliberate mind-wandering, with a higher score on one measure predicting a higher score on the other; yet neither trait differed between the two participant groups.

3.3.2. Confirmatory analyses

3.3.2.1. Spontaneous thoughts: Data processing

Several stages of data processing were required to derive the indices necessary for confirmatory analysis. First, *writing task responses* (× 15) and *thought probe responses* (× 12) were combined in a single spreadsheet for every participant (n = 90), with participant group removed. Adjacent to the column containing thought probe responses, Cue Type was recorded for each probe (i.e., seen / unseen).

Second, two trained research assistants who were blind to study hypotheses (including the existence of two experimental groups) compared each thought probe response with the relevant participant's writing task responses, making a binary judgment of Relatedness (related / unrelated) for each one. The raters were instructed to be lenient in their coding decisions, favouring a "related" judgment in cases where they were uncertain. To illustrate this, for a participant who had written a future scenario set in the location *campsite*, the subsequent thought "I wonder where the nearest campsite is" was coded as related despite not including an explicit restatement of the scenario. Reliability analysis showed acceptable consistency between the two raters' judgments, with 21% and 13% of total probe responses (N = 484) coded as related ($\kappa = .664$). Disagreements were resolved by the author using the same spreadsheet (i.e., blind to participant group), and the final coded dataset comprised 86 (17.8%) related and 398 (82.2%) unrelated thoughts.

Coded data were then filtered by spontaneity (retaining those rated 1–3 out of 5) from the raw thought probe data (leaving 325 thoughts, of which 22.2% were related). Novelty judgments ("Have you ever thought about this before today's session?") were also incorporated as an additional filter variable (leaving 177 thoughts, 17.9% related). Finally, each participant's spontaneous thoughts were distinguished according to Cue Type and Relatedness, and proportional values computed for each resulting factor combination. This was done separately with and without the additional filter of novelty. At this point, nine participants were excluded due to having zero remaining (i.e., spontaneous) thoughts; two of these had reported zero thoughts in total during the vigilance task. The use of proportional measures, as in Studies 1 and 2, aims to control for the substantial individual variation in raw thought frequency (coefficient of variation in total probe responses = 53.8%; in spontaneous thoughts = 65.4%). The following analyses were therefore run with $n = 81$, comprising 39 future simulation and 42 control participants.

3.3.2.2. Spontaneous thoughts: Confirmatory tests

Since none of the potential covariates (event vividness, MW-S, MW-D) was found to differ between groups, the central hypothesis regarding related event reoccurrence was tested using mixed factorial ANOVA with a between-subjects factor of Group (future, control) and within-subjects

factors of Cue Type (seen, unseen) and Relatedness (related, unrelated)[6]. Two such analyses were run: firstly, on proportional data reflecting all spontaneous thoughts; and secondly, with the additional filter of novelty imposed (i.e., only thoughts never previously experienced were used to compute proportions).

In the first analysis, the main effect of Cue Type was non-significant ($F_{(1, 79)} = 1.10$, $p = .298$, $\eta_p^2 = .01$, *ns*), although the interaction between Cue Type and Group showed a trend ($F_{(1, 79)} = 3.27$, $p = .074$, $\eta_p^2 = .04$). The main effect of Relatedness was significant ($F_{(1, 79)} = 85.9$, $p < .001$, $\eta_p^2 = .52$), as was the interaction between Relatedness and Group ($F_{(1, 79)} = 9.09$, $p = .003$, $\eta_p^2 = .10$). The interaction between Cue Type and Relatedness also showed a trend ($F_{(1, 79)} = 3.00$, $p = .087$, $\eta_p^2 = .04$)[7], but the three-way interaction did not ($F < 1$, $p > .5$, *ns*).

Figure 3.2 presents marginal means and 95% confidence intervals for the above analysis. As shown in the figure, related thoughts (light bars) were relatively more predominant in the future (M = .31, SD = .34) than the control group (M = .14, SD = .18), whereas unrelated thoughts (dark bars) were more relatively predominant in the control (M = .86, SD = .18) than the future group (M = .69, SD = .34).

[6] There were also no significant correlations between average word count and spontaneous thought indices (absolute *r*s < .1, *p*s > .9), so ANCOVA was not required.

[7] A single one-tailed comparison indicated that the difference in proportion of related versus unrelated thoughts was higher following seen cues (M = .34, SD = .42) than unseen cues (M = .22, SD = .41; $t_{(80)} = 1.76$, $p = .041$, $d = .20$). Since this difference was always positive (unrelated > related), this is theoretically uninteresting and can be disregarded.

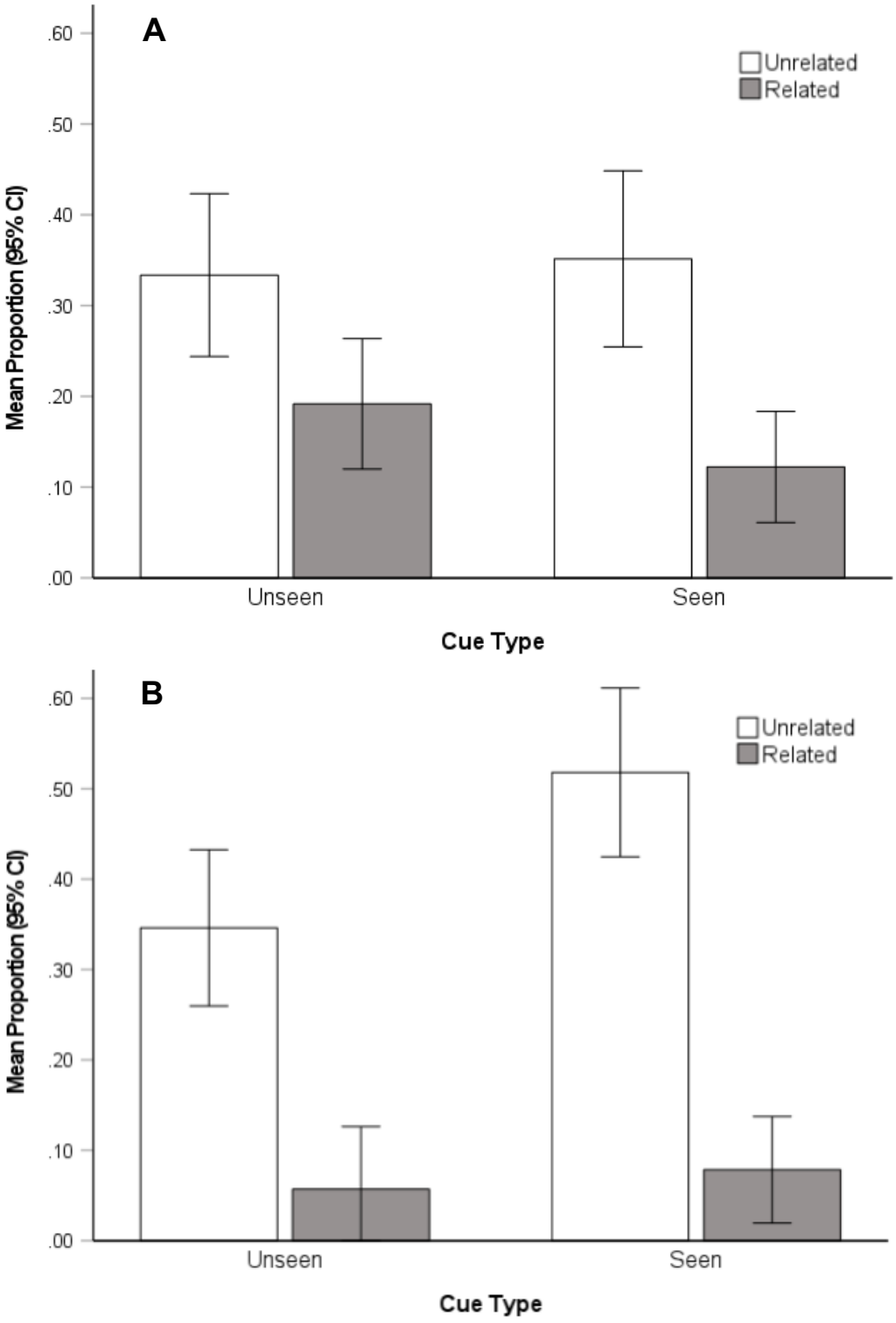


Figure 3.2. Mean Proportion of Spontaneous Thoughts as a Function of Cue Type and Relatedness
A. Future Group; B. Control Group

In the second analysis (novel spontaneous thoughts only), the main effect of Cue Type was again non-significant ($F_{(1, 79)} = .455$, $p = .502$, *ns*), as was the interaction between Cue Type and Group ($F_{(1, 79)} = .367$, $p = .546$, *ns*). The main effect of Relatedness was significant ($F_{(1, 79)} = 42.6$, $p < .001$, $\eta_p^2 = .35$), but the interaction between Relatedness and Group was not ($F_{(1, 79)} = 1.77$, $p = .187$, $\eta_p^2 = .02$, *ns*). The interactions between Cue Type and Relatedness, and the three-way interaction, were also non-significant (Fs < 1, ps > .4, *ns*). Figure 3.3 presents marginal means and 95% CIs for novel spontaneous thoughts only, for comparison with Figure 3.2.

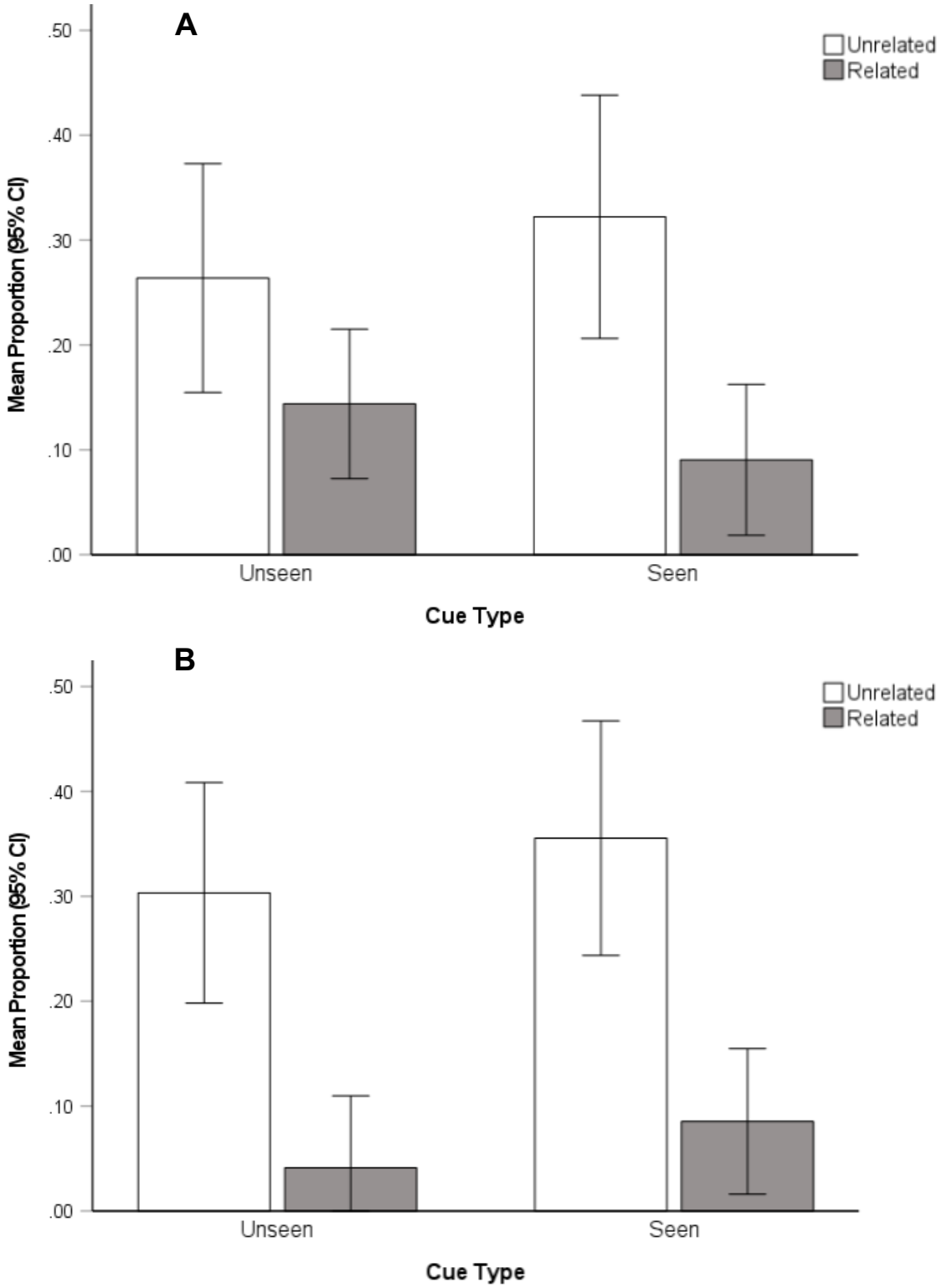


Figure 3.3. Mean Proportion of *Novel* Spontaneous Thoughts as a Function of Cue Type and Relatedness
A. Future Group; B. Control Group

Finally, the hypothesis regarding overall spontaneous thought rates (Hypothesis 2, section 3.1.4) was evaluated using an independent-samples *t*-test on the proportion of spontaneous thoughts out of each participant's total (see "total thoughts", Table 3.1). The result was non-significant ($t_{(79)}$ = -.032, p = .975, *ns*). Numerically, the proportion of spontaneous thoughts was almost identical in the future group (M = 0.676, SD = 0.274) and the control group (M = 0.678, SD = 0.242).

3.4. Discussion

The present study provided an experimental test of the possibility that certain future event representations remain highly accessible to conscious awareness after being constructed voluntarily (i.e., memories of the future; Cole et al., 2016; Ingvar, 1985; Jeunehomme & D'Argembeau, 2016, 2017; Szpunar et al., 2013). By combining the methods of voluntary and involuntary future thinking research in a sequential manner (cf. previous work by Cole et al., 2016; Duffy & Cole, 2020), this study aimed to identify and characterise the temporal relation between voluntarily constructed events and the content of subsequent spontaneous thought. In the experimental group, instructed to imagine 15 future scenarios in response to location cues such as "bus stop" and "supermarket", spontaneous thoughts reflecting these scenarios were expected to occur during a subsequent vigilance task when the relevant cues were encountered again. In the control group, who instead wrote "mini stories" not associated with future subjective time (Tulving, 1985; Atance & O'Neill, 2001; Klein, 2016), this should not occur to the same extent despite the same cues being used.

3.4.1. Hypothesis 1: Cued reoccurrence of constructed events?

The first hypothesis was tested by examining the three-way interaction between Group, Cue Type and Relatedness in a mixed factorial ANOVA. We anticipated a significant effect driven by an increased proportion of related thoughts (echoing voluntary constructions), triggered by previously-seen cues, in the future group. While this was numerically the case (future group: M = .091; control group: M = .085; see Figure 3.2), the three-way interaction was not significant (p = .187). However, a two-way interaction emerged between Group and Relatedness, corresponding to a higher proportion of related thoughts in the future than the control group, and vice versa for unrelated thoughts (Figure 3.2). This is theoretically interesting as it suggests that voluntarily constructed future scenarios (i.e., episodic future thoughts; Atance & O'Neill, 2001; Schacter & Addis, 2007; Schacter et al., 2012) are indeed more accessible than similar non-future constructions; yet their spontaneous reoccurrence in consciousness is not dependent on highly specific environmental cues. This runs counter to the

theoretical predictions made at the outset, based on studies of voluntary and involuntary autobiographical memories (Berntsen et al., 2013; Mace, 2006).

As discussed in Chapter 1, involuntary autobiographical memories are highly sensitive to triggering by environmental cues (Berntsen, 1998; Mace, 2004; Schlagman & Kvavilashvili, 2008; Vannucci et al., 2017). Furthermore, Berntsen et al. (2013) used a novel paradigm in which the episodic memories of events were encoded, as well as retrieved, under controlled conditions – finding that involuntary retrieval was most likely with cues bearing a high level of associative overlap to the encoding context. If the same underlying mechanisms govern the triggering of SFTs, one would therefore expect the *seen* cues in the present experiment (which were actually present at encoding, in Phase 1) to be more successful in triggering such thoughts than the *unseen* cues. Hence, the absence of a significant three-way interaction reported above indicates that future events – though they may reoccur, once constructed, in an analogous manner – differ fundamentally from past experiences in their sensitivity to triggering by environmental cues. This conclusion is consistent with points raised in Chapter 2 (e.g., around the lack of interaction between Cue Type and Trigger in Studies 1 and 2), and will be further elaborated in Chapter 6 when articulating the thesis' more general conclusions surrounding the mechanisms of SFT.

The finding that thematically related thoughts were more likely to occur after the future construction than the control writing task (i.e., the significant two-way interaction) provides direct support for the dual process account of future thinking (Cole & Kvavilashvili, 2021), and in particular its prediction of a temporal relation between the two modes, voluntary and involuntary. Whereas previous research has simply invoked this possibility when explaining differences in rehearsal frequency between the two modes (i.e., measured in parallel; Cole et al., 2016), this study has shown direct evidence of both processes, and the relation between them, operating in real time (cf. Mace, 2006, for voluntary and involuntary memories). Notwithstanding the apparent lack of cue specificity, the present study – through its adoption of a novel, hybrid paradigm capturing both voluntary encoding and spontaneous retrieval – lends support to the existence of possible future events as

coherent representations in long-term memory, or memories of the future (Jeunehomme & D'Argembeau, 2017; Szpunar et al., 2013).

A further implication of these results is in prompting us to re-evaluate findings in the standard approach regarding different modes of production. For instance, Jeunehomme and D'Argembeau (2016) showed pronounced differences between direct and generative modes (i.e., directly produced future thoughts were more rapid, required less search effort and used less autobiographical information) alongside higher estimates of previous rehearsal ("To what extent have you previously thought about this event?") for directly produced future events. Although these authors endorsed the possibility of pre-constructed future event representations, and have conducted subsequent "memories of the future" research on this basis (Jeunehomme & D'Argembeau, 2017, 2021), they were clear in stating that "…the concepts of involuntary retrieval and direct access are not equivalent" (Jeunehomme & D'Argembeau, 2016, p. 255). However, the empirical similarity between their comparison of direct and generative and Cole et al.'s (2016) comparison of involuntary and voluntary thought modes – coupled with the present evidence of spontaneously reoccurring future events – prompts us to reconsider this claim. Perhaps some proportion of trials in a typical episodic future thinking study elicit spontaneous responses, in the sense that a participant only has to decode a word cue to arrive at a previously constructed future event to report – without engaging the deliberate, effortful constructive processes that are generally assumed (Addis et al., 2009; Schacter & Addis, 2007).

3.4.1.1. Filtering by thought novelty

An additional filter of thought novelty was imposed in the subsequent analysis, aiming to increase the stringency of the test (i.e., only analysing thoughts which participants indicated they had "never thought about before the session"[8]). Results were somewhat different here, with the two-way interaction between Group and Relatedness not reaching significance (p = .187). However, visual

[8] On reflection, the wording of this question is potentially ambiguous; participants might read it either as "never thought about *this specific event*" or "never thought about *this general topic*", leading to arbitrary exclusions in the latter case. For this reason, interpretations are focussed around the results of the previous analysis.

comparison of Figures 3.2 and 3.3 suggests that the pattern of the data was much the same, with numerical differences between groups running in opposite directions according to Relatedness (i.e., related thoughts higher in future group; unrelated thoughts higher in controls). Running a one-tailed comparison between the right-hand bars in Figure 3.3 confirms this: Even when filtered by novelty, the proportion of related thoughts averaged across cue types was higher for the future group (M = .117, SE = .024) than for the control group (M = .063, SE = .023; $t_{(79)} = 3.25$, $p < .001$, $d = .36$). This was not the case for unrelated thoughts (left-hand bars; $t_{(79)} = -1.52$, $p = .07$). Thus, while the data present a noisier picture when novelty is factored in (eliminating 148 out of 325 spontaneous thoughts, or 45.4% of the data set), similar conclusions can be drawn regarding the effect of a future construction task on the occurrence of related spontaneous thoughts, irrespective of cues.

3.4.2. Hypothesis 2: Overall rate of spontaneous thoughts

In addition to the theoretically-driven Hypothesis 1, total spontaneous (future) thoughts during the vigilance task were expected to be higher for those in the future group, in line with previous research (Jordão et al., 2019; Smallwood et al., 2011; Stawarczyk et al., 2011). Jordão et al. (2019) found a specific increase in the rate of SFTs following an intercalated goal processing task during a version of the vigilance task; the other cited studies found shifts in the temporal focus of mind-wandering following the processing of goals or self-referential information (Stawarczyk et al., 2011; Smallwood et al., 2011).

Hypothesis 2 was not confirmed by the present data. Instead, mean proportions of spontaneous thoughts were almost exactly equal in both groups (around 68%). However, the precedent for making this prediction was in studies which have shown an increase in the proportion of spontaneous *future* thoughts (or future, task-unrelated thoughts; Stawarczyk et al., 2011; Smallwood et al., 2011) occurring during comparable attentional tasks. Since our thought reporting procedure deliberately avoided probing temporal orientation (so as to prevent confusion between "future" thoughts and potential "memories" of future events), one cannot ascertain to what extent the 68% of thoughts rated as spontaneous were really future-oriented across the two groups. The observed invariance in spontaneous thought rate (alongside equality in trait mind-wandering measures; section

3.3.1) in fact reinforces the validity of the task manipulation as it suggests that the more fine-grained differences according to Relatedness occurred in a context of equal tendencies to experience spontaneous thoughts (cf. Stawarczyk et al., 2011).

3.4.3. Limitations

A potential limitation of the present study is the sole use of location phrases as cues across the writing and spontaneous thought tasks. In particular, the choice to use a fairly uniform set of *familiar locations* (Cole et al., *in preparation*) may have impacted the triggering dynamics at play in the vigilance task. Given the inevitable semantic interrelatedness of phrases such as "bus stop" (list 1) and "train station" (list 2), it is perhaps unsurprising that viewing one of these phrases should have the potential to trigger spontaneous thoughts associated with another (Mace, 2006, 2009; Demblon & D'Argembeau, 2014). Such semantic relationships were in fact quantified using latent semantic analysis (Landauer & Dumais, 1997), with the aim of minimising similarity between successive cues (e.g., "bus stop" and "train station" were separated by at least two other cues; section 3.2.3) – a measure intended to maximise cue *distinctiveness* with respect to triggering specific event representations (Berntsen et al., 2013). However, there is a separate possibility that by using a generally highly-interconnected set of cue stimuli (compared to the more generic cues used in studies like Schlagman & Kvavilashvili, 2008; Cole & Berntsen, 2016; Vannucci et al., 2017), each list was insufficiently distinct from the other *as a set*. It is even likely that, after several repeat presentations of all the location stimuli, participants might have struggled to distinguish between those they had seen in the writing task and those they had not (essentially a matter of source misattribution; Schacter et al., 1984, 2001). This might therefore have obscured the effect of Cue Type as unseen cues were (almost) equally likely to trigger thoughts of previously constructed events (cf. chaining effects in autobiographical memory and future thinking; Mace, 2009; Demblon & D'Argembeau, 2014).

Furthermore, the uniformity of the cues used brought the unintended corollary that all candidate memories of the future were constructed uniformly around particular locations (and time points), rather than any of the other key components of a typical episodic future thought (e.g., people, objects, actions; Addis et al., 2009; Jeunehomme & D'Argembeau, 2017, 2021; Dijkstra & Misirlisoy,

2006). The dynamics of thought reoccurrence might have been different had participants been able to construct their initial events more flexibly (i.e., with a generic but varied cue list referring to family, work, etc., as in the standard approach; see review by Schacter et al., 2012). Finally, it is also possible that constructing events in response to location cues simply does not reflect the typical (naturalistic) process of voluntary future thought – the latter being more likely to begin with goals and hence only gravitate around a location if this is a core component of the goal (Lehner & D'Argembeau, 2016; D'Argembeau, 2016).

A second key limitation relates to the trial sequencing error reported in section 3.2.3 (footnote 5). Because, for nearly half of participants, trials in the vigilance task were randomly reordered, the intended cue–probe latencies were not constant across the sample. The potential effects of this cannot be readily ascertained as the error was present only for participants assigned to *one* of the two counterbalanced cue lists (section 3.2.3). Consistency of cue–probe latencies is therefore confounded with cue list, such that any differences between affected and unaffected participants (which would be subject to diminishing statistical power; Button et al., 2013) could not easily be attributed to either factor. Fortunately, the observed differences in proportion of related thoughts according to condition are not contaminated by the error, as an equivalent number of future (n = 16) and control group participants (n = 17) included in the proportional analysis were affected ($\chi^2_{(1)} < .01$, $p > .9$, *ns*). However, it is conceivable that the lack of a significant three-way interaction is in part attributable to the inconsistency in cue latencies produced by the trial sequencing error.

3.4.4. Summary and conclusions

The study presented in this chapter makes two clear contributions to the emerging literature on spontaneous future thought. Firstly, the novel combination of voluntary and involuntary methods offered an unprecedented opportunity to look directly at the temporal relation between the two proposed modes of future thought (Cole & Kvavilashvili, 2021). Secondly, by confirming that thematically related thoughts reoccur more readily after constructing a series of vivid, personal future constructions, the study lends empirical weight to the hitherto speculative notion of memories of the future. Furthermore, although the findings did not implicate cue specificity as an important factor in

the retrieval of such representations (cf. Berntsen et al., 2013; Mace, 2006), an intriguing parallel can be drawn between this pattern and the initially counterintuitive results on thought triggering in Chapter 2. Ultimately, it appears that the dynamics by which spontaneous future thoughts occur – whether their original encoding is manipulated and observed (as in this chapter) or inaccessible to the researcher (Chapter 2; Cole et al., 2016; cf. Jeunehomme & D'Argembeau, 2016) – differ from those of involuntary autobiographical memory.

Chapter 4. Self-Regulatory Thought and Goal Pursuit: Insights from a Naturalistic Study During COVID-19

4.1. Introduction

4.1.1. A conceptual leap: From thoughts to goals

So far, this thesis has defined "future thinking" in terms of concrete events or episodes occurring in consciousness, analogous to specific autobiographical memories (Schacter et al., 2012; Berntsen, 2021; Cole & Kvavilashvili, 2019). Just as reliving specific events from the past relies on the activation of associated autobiographical knowledge (Conway, 2005; Conway & Pleydell-Pearce, 2000), future thinking involves a process of "scaffolding", where conceptual information about the future is activated to contextualise the event and locate it in subjective time (Irish & Piguet, 2013; Tulving, 2002). As noted by D'Argembeau (2020), goals play an important role in the scaffolding process: "For an imagined event to be experienced as a possible future occurrence, it has to be meaningfully integrated with personal goals…" (p. 2042). And yet, a tendency to consider goals only superficially, as mere reference points for classifying thought contents, is evident in both conventional EFT research and the spontaneous / involuntary literature (Lehner & D'Argembeau, 2016; Baird et al., 2011; Cole & Berntsen, 2016; but see also Jordão et al., 2019; McVay & Kane, 2013). Consistent with this trend, the experiments reported in Chapter 2 considered the relationship between lab-elicited SFTs and personal goal representations as operationalised by current concerns (Cole & Berntsen, 2016; Johannessen & Berntsen, 2010); yet these latter representations were not, in themselves, examined in detail.

This lack of emphasis on goals in themselves to some extent reflects an inevitable limitation of laboratory paradigms that elicit future thoughts on a single occasion, in an artificial context divorced from real-world goal pursuit. Arguably, though, it should be a priority for future thinking research to overcome this limitation: probing thoughts in combination with goals, in a more naturalistic context, to more closely scrutinise the relationship between the two as they naturally occur (Kvavilashvili &

Rummel, 2020). This, as outlined in Chapter 1, is an important objective of the present thesis, furthering our theoretical understanding by more explicitly examining the form of the personal goals which might drive or constrain the particular thoughts people have. This chapter therefore represents a shift in focus from the cognitive dynamics of SFT to the motivational and self-regulatory dynamics which form a backdrop to the everyday occurrence of future thoughts (Baumeister et al., 2016, 2020; Berntsen, 2019; Klinger, 2013).

4.1.2. Taking goals on their own terms

An alternative viewpoint on the psychology of thinking about the future takes cognitive representations of goals as primary (Klinger, 1975, 2013; Oettingen et al., 2018). This approach, drawing on social cognition and motivational psychology, underlies the theory of pragmatic prospection presented by Baumeister and colleagues (2016). In this account, future thinking – whether spontaneous or deliberate – is fundamentally a manifestation of humans' capacity to adaptively anticipate and plan for future success (cf. Seligman et al., 2016). Hence, rather than treating goals as a concomitant or constituent feature of future thinking (Baird et al., 2011; Cole & Berntsen, 2016; D'Argembeau & Mathy, 2011; Lehner & D'Argembeau, 2016), the associated literature starts by examining goals in themselves, and only secondarily the ways in which they might give rise to specific thoughts about the future (e.g., Baumeister et al., 2020). A distinguishing feature of this approach lies in the characterisation of goals as enduring cognitive representations likely to influence thought and behaviour over a period of time (Zeigarnik, 1927; Klinger, 1975; Moskowitz & Grant, 2009). By contrast, future thoughts – such as those deliberately generated in a cue-word task – may be transient constructions with little relevance for authentic, real-world behaviour (Kvavilashvili & Rummel, 2020). Unsurprisingly, this difference of emphasis between enduring (semantic) goal representations and transient (episodic) future thoughts is reflected in the diverging methodologies employed in the two research areas, discussed next.

While future thinking paradigms target specific event constructions, often prompted by generic or arbitrary cue words (Crovitz & Schiffman, 1974; Schacter et al., 2012), the goal-based approach gives more attention to participants' meaningful, pre-existing aspirations and concerns and is hence

more idiographic in nature (Emmons, 1996; Moskowitz & Grant, 2009). Often, goal descriptions are elicited in an open-ended way, enabling participants to characterise their goals on their own terms (the *personal projects* approach of Emmons, 1986, 1996 is a salient example of this). This has formed the basis of interventions aiming to improve goal pursuit by promoting motivationally beneficial modes of thought (e.g., Gollwitzer & Oettingen, 2012; Klinger & Cox, 2011). In particular, Oettingen (2012) reviews evidence showing that applying the *mental contrasting* mode of thought when describing one's goals (as introduced in Chapter 1) alters self-reported motivation (Locke & Latham, 1990) and brings about more pragmatic goal pursuit (cf. Baumeister et al., 2016). The cognitive mechanisms responsible for such effects have also been examined, implicating changes in the associative links between goals, current states and potential actions (Kappes et al., 2013; Kappes & Oettingen, 2014; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006).

The studies of Gabriele Oettingen and colleagues (Oettingen et al., 2001, 2010; Sevincer & Oettingen, 2013) employ precise operational definitions and elicit open-text responses from which various thought modes can be determined (and hence, compliance with intervention protocols checked; e.g., Oettingen et al., 2010). Numerical rating scales are used to assess relevant motivational parameters (e.g., expectation; Bandura, 1997; Oettingen, 2012). Where possible, behavioural outcome measures are obtained, such as effort or performance against objective standards (e.g., a weight loss target or resolution of a social concern; Oettingen et al., 2001; Oettingen & Wadden, 1991). This underwrites the external validity of the approach; rather than simply show that people "change their minds" by coming to view their goals differently, such studies demonstrate concrete changes in people's actions – with obvious advantages for promoting health and other behaviours (Armitage & Conner, 2001; Conroy et al., 2015; Cross & Sheffield, 2019; Milyavskaya & Werner, 2018).

Specific future event simulations are not the primary concern of this "goal-centric" literature, although they are doubtlessly a common feature of thinking about one's goals (Stawarczyk et al., 2011; Lehner & D'Argembeau, 2016; Jordão et al., 2019). Indeed, points of crossover are evident, as in the work of Shelley Taylor and colleagues on mental simulation and self-regulation (Taylor & Schneider, 1989; Pham & Taylor, 1999; see Chapter 5).

The present chapter maintains a specific focus on self-regulatory thought as an indicator of the enduring representations of goals (and their probable behavioural consequences) rather than the momentary images and constructions more typically studied under the heading of future thinking (D'Argembeau, 2020; Kvavilashvili & Rummel, 2020). As such, the next section introduces the conceptual framework of mental contrasting in greater detail.

4.1.3. Mental contrasting: A brief overview

A common theme in the goal pursuit literature is that merely harbouring a goal, or having strong intentions or high expectations, does not ensure success. Rather, goal attainment also depends on the use of self-regulatory strategies operating on the level of conscious, deliberative thought (Gollwitzer & Sheeran, 2006; Oettingen, 2000, 2012; Pham & Taylor, 1999; Conroy et al., 2015). Fantasy realisation theory (Oettingen, 1996, 2000, 2012) defines several self-regulatory thought (SRT) modes, including mental contrasting. In this mode of thought, subjects first consider a desired future state, followed by present obstacles to fulfilment (Oettingen, 2000). Contrasting the two aspects – desired future and present reality, *in that order* – brings motivation and performance into alignment with one's underlying expectations of success (Oettingen, 2012)[9].

Where expectations are high, mental contrasting reinforces motivation and behaviour towards achieving a goal; where they are low, it renders the goal less salient, thus reducing commitment and freeing up resources for other goal pursuits (Oettingen, 2012; Muraven & Baumeister, 2000). The same *expectancy-dependent* effects have been found in a range of domains (e.g., health behaviours, academic attainment, interpersonal relations; Cross & Sheffield, 2019; Mann et al., 2013; Hauser, 2018; Oettingen, 2012). For instance, a person wishing to lose weight might consider the benefits of achieving that goal, followed by the obstacles posed by their current situation (e.g., a tendency to overeat or a sedentary lifestyle). The use of mental contrasting would either boost or attenuate motivation depending on how they viewed their chances of success.

[9] Although one's particular expectations are ultimately formed by previous experiences, personality traits, etc., they are assumed to be a primary determinant of motivation in the context of a particular goal (Armor & Taylor, 1998; Bandura, 1997; Carver & Scheier, 2005).

Research on the underlying cognitive mechanisms of mental contrasting has shown that it facilitates the identification of current obstacles in relation to desired outcomes (Kappes et al., 2013), thereby modulating the strength of associations between obstacles and outcomes (Kappes & Oettingen, 2014). Hence, goals viewed as achievable are linked with the hurdles that must be overcome – highlighting avenues to success – while less achievable goals become disconnected from present reality and thereby cease to act as incentives for behaviour. In short, mental contrasting is functional in that it favours selective goal pursuit: Only those desired futures which might realistically come to pass are retained as goals (Kappes & Oettingen, 2014; Oettingen, 2012; Klinger & Cox, 2011).

Furthermore, mental contrasting can occur "spontaneously" (i.e., without specific instruction)[10] when people freely describe their goals in a given domain (Sevincer & Oettingen, 2013; Sevincer et al., 2017). *Unprompted mental contrasting* confers an equivalent motivational benefit as when it is experimenter-induced. Sevincer and Oettingen (2013) found across three studies that 9-27% of individuals engaged in unprompted mental contrasting when asked to describe a current interpersonal or academic goal. These participants showed a stronger positive relationship between expectation and indicators of goal striving than those who simply indulged in positive fantasies (e.g., "I expect to come top of my class"), dwelled on present obstacles ("my current living situation is really disrupting my studies"), or considered present and *then* future aspects of their goal (i.e., *reverse contrasting*; Oettingen, 2012). Sevincer and Oettingen (2013) concluded that this paradigm could be utilised to explore differences in naturally occurring SRT according to personal and contextual factors, yet work on this topic remains scarce (see Sevincer et al., 2017). The present study aims to further this line of enquiry by examining the well-understood mechanisms of unprompted SRT in a novel context characterised by unstable societal conditions.

[10] In light of the different concept of spontaneity central to this thesis (see Chapter 1), the alternate term *unprompted* (also used by Sevincer & Oettingen, 2013) is preferred throughout this chapter. However, these two uses of *spontaneous* bear more than a trivial resemblance, in that both applications denote the sampling of thought contents with minimal experimenter influence.

4.1.4. Goals and self-regulation during the pandemic: What's changed?

The coronavirus (SARS-2-COVID-19) pandemic has been an unprecedented public health emergency in terms of its worldwide reach and impact (World Health Organization, 2021). In the UK, total cases have exceeded 20 million, with over 170,000 fatalities (Johns Hopkins / Dong et al., 2020) and repeated lockdowns enforced to limit transmission of the virus (Barber et al., 2021). Although most psychological research on COVID-19 has focussed on its detrimental effects on mental health (Y. Huang & Zhao, 2020; Park et al., 2021; Shamblaw et al., 2021; Wang et al., 2020; Yan et al., 2021), a pandemic on this scale also provides a unique test-bed to examine how previously recognised social cognitive mechanisms operate in the context of this crisis (van Bavel et al., 2020). Specifically, the global and national context of great uncertainty regarding jobs, finance and health could impact how individuals think about and pursue their future plans and goals (Kokkoris & Stavrova, 2021; Ritchie et al., 2021), urging us to rethink our understanding of these processes.

Precisely how might the COVID-19 context alter the dynamics of goal pursuit? Most obviously, an individual might acquire new goals in response to crisis-specific demands (e.g., coping with social isolation; Bland et al., 2020). Simultaneously, however, some existing goals are likely to remain valid incentives for behaviour, irrespective of the pandemic (e.g., losing weight; Oettingen & Wadden, 1991). Given the salience of negative aspects in people's appraisals of the pandemic (Shamblaw et al., 2021; S. Taylor et al., 2020; Wang et al., 2020; Zacher & Rudolph, 2021), one would expect many COVID-related goals to be negatively motivated ongoing concerns (e.g., negotiating prolonged threats to one's health or financial security; cf. Elliot, 2006).

Perceptions of control are another important aspect to consider in the pandemic context (Rothbaum et al., 1982; Russell, 1982; Sheeran et al., 2003). Infectious diseases pose an unpredictable external threat (Pappas et al., 2009), and in the case of COVID-19, its rapid spread, relatively high mortality rate, and uncertainties surrounding transmission have contributed to widespread fear of the virus (Ahorsu et al., 2020). One would therefore expect COVID-related goals to be accompanied by low perceived control (Russell, 1982; Sheeran et al., 2003) and a tendency towards avoidance motivation (Elliot, 2006; Zacher & Rudolph, 2021). If one perceives the pandemic to be

fundamentally uncontrollable, one's goals and concerns surrounding it may be forlorn hopes lacking a sense of agency. The pandemic therefore presented an unparalleled opportunity to conduct a natural experiment on the role of perceived control in self-regulation and goal pursuit (cf. Russell, 1982; Thurber & Weisz, 1997; Sheeran et al., 2003).

4.1.5. Study 4: Aims and Hypotheses

Study 4 had two main aims: A) To capitalise on an unprecedented societal crisis (the COVID-19 pandemic) to capture topical real-world data concerning how people think about their goals "in real life"; and B) To examine the unprompted mental contrasting framework as a tool for assessing the goal representations that may underlie functional SFT.

This study investigated the occurrence and motivational consequences of different SRT modes for two types of goals: COVID-related goals (perceived to be relatively uncontrollable) and COVID-unrelated goals (perceived to be more controllable). Our principal question was whether this difference in controllability would produce contrasting patterns of results. We tested this by examining the natural prevalence of particular SRT modes (mental contrasting, dwelling, etc.) for the two goal types (cf. Sevincer & Oettingen, 2013) and assessing whether the typical motivational benefit of mental contrasting would extend to this novel context (cf. Cross & Sheffield, 2019; Hauser, 2018; Oettingen, 2012).

We used a cross-sectional online survey to obtain information on participants' most important goal or concern *related to the ongoing COVID-19 pandemic* and their most important goal or concern *unrelated to the pandemic*.[11]. To our knowledge, this is the first study to compare concurrent goals in two distinct domains within a single sample, while capturing self-regulatory thought as it naturally occurs (cf. H. B. Kappes et al., 2011; Sevincer & Oettingen, 2013; Sevincer et al., 2017). Examining goals both related and unrelated to COVID-19 will provide insight into individuals' experience of the pandemic by probing differences in both cognitive style (i.e., engagement of particular SRT modes)

[11] As in Eric Klinger's influential current concerns theory of motivation, which treats the terms "goal" and "concern" as synonymous (Klinger, 1975, 1987; Klinger & Cox, 2011; cf. Oettingen et al., 2001).

and associated patterns of motivation (i.e., impact on the expectation-commitment relation). The study has the potential to show how societal changes can inform (and potentially modify) well-established psychological theory; and for the purposes of this thesis, it offers a platform to explore the unprompted SRT paradigm as a potential framework for studying spontaneous thought and goal pursuit.

4.1.5.1. Hypotheses

There were two main hypotheses. Firstly, the relative prevalence of the different SRT modes (mental contrasting, dwelling, etc.; Oettingen, 2012) was expected to differ between the two goal types. The pandemic was presumed to have caused people to adopt new personal concerns (e.g., keeping one's family safe from the virus) over which they felt little personal control (Park et al., 2021; Russell, 1982). These would often be focussed on avoiding, or managing, threats (Bacon & Corr, 2020; Zacher & Rudolph, 2021), hence one would expect a preponderance of dwelling responses when participants describe their COVID-related goals (e.g., "Members of my family are vulnerable and at risk due to the nature of their occupations").

Secondly, COVID-unrelated goals were expected to replicate typical findings on unprompted mental contrasting (i.e., an enhanced positive relationship between expectations of success and goal commitment; Oettingen, 2000, 2012). This would be consistent with previous research showing the same motivational effect across life domains and contextual factors such as mood (Sevincer & Oettingen, 2013; H. B. Kappes et al., 2011). Conversely, for COVID-related goals, where lower controllability ratings are anticipated, it is unclear how mentally contrasting an outcome (e.g., remaining uninfected) with present obstacles (e.g., ongoing infection risk) should benefit motivation. Instead, where obstacles to success are unpredictable or overwhelming, the usual mechanisms by which mental contrasting operates will be disrupted, reducing its efficacy (cf. Kappes et al., 2013; Kappes & Oettingen, 2014).

4.2. Methods

4.2.1. Participants

The online platform Prolific (https://www.prolific.co/) was used to recruit a cross-sectional survey sample rapidly according to specific pre-screening parameters. The target demographic was adults residing in the UK with no recent health problems, selected in view of the varying severity of the crisis in different countries (Pearce et al., 2020) and because both current illness and overall poor health status have been shown to influence psychological responses to the COVID-19 pandemic (Wang et al., 2020). Data were collected between May 6th and May 13th, 2020, hence all participants were currently subject to UK government lockdown restrictions, yet not experiencing direct medical effects of the virus nor any other acute illness.

A target sample size of 275 was determined based on comparable online studies of unprompted mental contrasting (Sevincer & Oettingen, 2013, study 1; Sevincer et al., 2017). Of 290 participants recruited through Prolific, two were excluded as they gave over-consistent numerical responses (e.g., a rating of '1' on all 7-point Likert scales) and / or explicitly declined to describe any goals. The final sample of 288 comprised 200 females, 83 males and 5 other gender identities / undisclosed (mean ± SD age = 31.1 ± 11.4 years). This provides estimated power of 85% to detect small effects in multiple regression (R^2 change = 0.03; Faul et al., 2007). Participants were compensated £1.60 for their time (standard hourly rate of £8.00).

4.2.2. Design

The study employed a cross-sectional repeated measures design, with each participant providing data on one goal of each type (COVID-related, COVID-unrelated). Chi-square and logistic regression analyses were used to probe associations between goal type and SRT mode. Hierarchical multiple regression was used to examine relationships between expectations and commitment, using a dummy-coded, binary predictor of SRT mode (mental contrasting vs. all other modes) and an interaction term of expectations by SRT mode to assess the expectancy-dependent effect of mental contrasting (following Sevincer & Oettingen, 2013). Participants also completed several control

measures, described below. The main analyses were pre-registered at https://aspredicted.org/LBE_TIH. The study was approved by a University Ethics Committee.

4.2.3. Materials and procedure

The survey was administered online via Qualtrics, with participants redirected automatically from the Prolific site. It was presented as a survey on "Attitudes and experiences during the COVID-19 pandemic", omitting any mention of self-regulatory thought or mental contrasting while remaining transparent about the general topic. Participants were given a summary of what would be required and asked to provide informed consent before beginning the survey. Answers were required for every section, with reminders appearing if any fields were left blank. Approximate survey duration was advertised as 12 minutes, based on prior piloting of materials. Upon completion, participants were debriefed regarding study aims and hypotheses and their data were automatically saved on Qualtrics and later transferred to password-protected offline storage for analysis.

4.2.3.1. Goal processing measures

The first part of the survey elicited information on participants' COVID-related and COVID-unrelated goals, one after the other in separate question blocks. Block order was randomised. In the COVID-related block, participants were asked to state a current goal in response to the following instruction:

> *The COVID-19 crisis is currently impacting many areas of public life as well as individuals' personal lives. Please state the personal goal or concern* ***relating to the COVID-19 crisis*** *that is most on your mind at present.* [Emphasis in original]

In the COVID-unrelated block, the corresponding instruction was:

> *Please state the personal goal or concern* ***unrelated to the COVID-19 crisis*** *that is most on your mind at present.* [Emphasis in original]

Otherwise, all measures were identical across the two blocks. The phrase "personal goal or concern" was formulated deliberately to encompass both discrete achievement goals and ongoing

personal concerns (Austin & Vancouver, 1996), on the assumption that the latter may be particularly prevalent in the pandemic context. In other respects, instructions were closely modelled on those of Sevincer and Oettingen (2013).

After stating each goal, participants rated their associated expectations of success ("How LIKELY do you think it is that you will realise this goal / resolve this concern?") and incentive value ("How IMPORTANT is it to you to realise this goal / resolve this concern?") on a 7-point Likert scale ranging from 1 (*Not at all*) to 7 (*Very much so*). A single-item measure of controllability ("To what extent do you feel you have CONTROL over realising this goal / resolving this concern?"), on the same 7-point scale, was included as a manipulation check.

Participants were then asked to elaborate by writing about any aspects of the stated goal that came to mind, with no time or word limit, as in the studies by Sevincer and Oettingen (2013). Finally, participants answered five 7-point Likert items to give a combined index of goal commitment. This included two negatively worded items ("How disappointed would you feel / how hard would it be for you if you did not realise this goal?") and three positively worded items ("How determined are you / how hard will you try / how energised do you feel to realise this goal?") taken from previous research (Oettingen, 2000; Sevincer & Oettingen, 2013).

4.2.3.2. Control measures

The second part of the survey asked participants about their daily news media exposure (estimated in hours and minutes; de Vreese & Neijens, 2016) and overall level of concern regarding the pandemic (10-point Likert, 1 = *Not at all concerned*, 10 = *Intensely concerned*; cf. Cox & Klinger, 2004). Finally, participants gave a binary response regarding clinical vulnerability ("Do you have any pre-existing medical conditions which might increase the risk posed to you by COVID-19?").

4.2.3.3. Coding of goal elaborations

Goal elaborations were first segmented into a number of statements (i.e., distinct syntactic units), which were then coded as either "desired future", "present reality" or "other" (examples given in Appendix III). The entire elaboration was then classified into one of five categories (mental

contrasting, reverse contrasting, indulging, dwelling, or other) according to the coding and order of the statements (i.e., mental contrasting = desired future followed by present reality, etc.; H. B. Kappes et al., 2011; Sevincer & Oettingen, 2013). The full data-set was coded in this way by an independent rater, blind to the two goal conditions, and a 25% random sample recoded by the author. Initial interrater agreement for category classification was 72% ($\kappa = .62$), with a further 26% agreed upon through subsequent discussion. The remaining 2% of elaborations were coded as "other". The first rater then reviewed their classifications for the remaining data to ensure consistency.

4.3. Results

4.3.1. Descriptive and preliminary analyses

Table 4.1 displays mean expectations, incentive value, controllability and commitment for both goal types (COVID-related, COVID-unrelated). Means for expectations and incentive value were above the midpoint in both cases, indicating that participants chose to describe goals they viewed as both realistic and important (in line with Sevincer & Oettingen, 2013). Comparisons between goal types revealed that expectations were significantly higher for COVID-unrelated goals ($p = .001$; Table 4.1); hence, participants viewed these as more achievable. Controllability ratings also differed, with COVID-related goals generally viewed as somewhat uncontrollable (mean = 3.43, below scale midpoint) while COVID-unrelated goals were rated as moderately controllable (mean = 4.79, above scale midpoint, $p < .001$; Table 4.1). Commitment ratings were high for both goal types.

Table 4.1. Mean (Standard Deviation) Expectations, Incentive Value, Controllability and Commitment for COVID-Related and COVID-Unrelated Goals.

Condition	Expectations (1–7)	Incentive Value (1–7)	Controllability (1–7)	Commitment (5–35)
COVID-Related	4.63 (1.60)	6.19 (1.15)	3.43 (1.92)	29.35 (5.26)[†]
COVID-Unrelated	5.05 (1.38)	6.07 (1.12)	4.79 (1.67)	28.78 (4.93)
Mean Difference	-.417**	.122	-1.36***	.521

Note. **$p < .01$, ***$p < .001$. [†] Two outliers (> 2.5 SD from mean) removed, i.e., $N = 286$.

Consistent with previous research (Oettingen, 2000; Sevincer & Oettingen, 2013), expectations were positively correlated with incentive value for both COVID-related goals ($r = .28$, $p < .001$) and COVID-unrelated goals ($r = .31$, $p < .001$).

After excluding 18 outliers with univariate scores further than 2.5 SD from the mean (remaining $N = 270$), participants generated an average of 6.16 statements for COVID-related goal elaborations (SD = 3.35) and 5.30 statements for COVID-unrelated elaborations (SD = 2.66); more statements were therefore generated for COVID-related goals ($t_{(269)} = 4.23$, $p < .001$).

Table 4.2 displays sample characteristics, including demographics (age, gender) and control measures (daily media exposure, overall concern regarding COVID-19, and medical vulnerability). Levels of overall concern were moderately high in the sample, with a mean value of 7.30 (above scale midpoint). The majority of participants (85.4%) reported that they did not have any specific medical vulnerability to COVID-19 (see Table 4.2).

Table 4.2. Participant Characteristics (Demographics and Control Measures).

	Age (Years)	Gender			Media Exposure (Mins/Day)	COVID Concern (1–10)	Vulnerability	
	Mean (SD)	F	M	Other	Mean (SD)	Mean (SD)	No	Yes
Raw Value	31.1 (11.4)	200	83	5	100.2 (113.5)	7.31 (1.84)	246	42
%	-	69.4	28.8	1.7	-	-	85.4	14.6

4.3.2. Goal type and self-regulatory thought mode

Table 4.3 shows the frequency of each self-regulatory thought (SRT) mode in the sample, for COVID-related and COVID-unrelated goals ("other" covers elaborations that did not fit into any other category). Dwelling was the most common thought mode for COVID-related goals (41%), followed by indulging (22.9%); this pattern was reversed for COVID-unrelated goals (indulging: 36.5%; dwelling: 26%). Moreover, 191 of 288 participants (66%) engaged different modes of thought when describing their COVID-related and COVID-unrelated goals. We therefore tested for an association between goal type (COVID-related, COVID-unrelated) and SRT category (dwelling, indulging, etc.). Such an association was evident ($\chi^2_{(4)} = 18.65$, $p = .001$). Examining standardised residuals (Sharpe, 2015) indicated that the relative frequencies of dwelling ($z = \pm 4.65$, $p < .001$) and indulging ($z = \pm 4.24$, $p < .001$) contributed significantly to this association, whereas the other modes did not ($zs < \pm 0.37$, *ns*).

Table 4.3. Frequency of Self-Regulatory Thought Modes for COVID-Related and COVID-Unrelated Goals.

SRT Mode	Dwelling		Indulging		Mental Contrasting		Reverse Contrasting		Other	
Condition	N	%	N	%	N	%	N	%	N	%
COVID-Related	118	41.0	66	22.9	49	17.0	40	13.9	15	5.2
Unrelated	75	26.0	105	36.5	49	17.0	42	14.6	17	5.9

Note. Total *N* for both goal types = 288.

Logistic regression performed in R (R Core Team, 2021; Field et al., 2012) further demonstrated that the odds of a dwelling response were higher for both COVID-related (*OR* = 2.12, $p < .001$) and *less* controllable goals (*OR* = .516, $p < .001$; see Table 4.4). Conversely, the odds of an indulging response were higher for COVID-unrelated (*OR* = .483, $p < .001$) and *more* controllable goals (*OR* = 1.592, $p < .001$; see Table 4.5). The two predictors did not interact in either model (*p*s > .3, *ns*).

Table 4.4. Hierarchical Logistic Regression Model Predicting Incidence of Dwelling SRT.

Model					*95% CI for odds ratio*		
	Included	B(SE)	*z*	*p*	*Lower*	*Point*	*Upper*
1	Constant	-1.044 (.134)	-7.774	< .001			
	Relatedness	.679 (.180)	3.771	< .001	1.388	1.972	2.813
2	Constant	-1.141 (.146)	-7.837	< .001			
	Relatedness	.752 (.191)	3.936	< .001	1.464	2.121	3.098
	Controllability	-.662 (.140)	-4.716	< .001	.389	.516	.676
	Relatedness × Controllability	.173 (.190)	.909	.364	.819	1.189	1.730

Note. Deviance criterion used to assess model fit improvement (Field et al., 2012); $\chi^2_{(2)} = 39.2$, $p < .0001$.

Table 4.5. Hierarchical Logistic Regression Model Predicting Incidence of Indulging SRT.

Model					*95% CI for odds ratio*		
	Included	B(SE)	*z*	*p*	*Lower*	*Point*	*Upper*
1	Constant	-.555 (.122)	-4.538	< .001			
	Relatedness	-.656 (.186)	-3.532	< .001	.450	.519	.728
2	Constant	-.587 (.127)	-4.635	< .001			
	Relatedness	-.727 (.198)	-3.672	< .001	.326	.483	.710
	Controllability	.465 (.134)	3.467	< .001	1.231	1.592	2.086
	Relatedness × Controllability	.156 (.199)	.787	.431	.791	1.169	1.730

Note. Deviance criterion used to assess model fit improvement (Field et al., 2012); $\chi^2_{(2)} = 32.0$, $p < .0001$.

When "other" elaborations were excluded and dwelling, indulging and reverse contrasting combined (producing a dichotomous measure; Sevincer & Oettingen, 2013), mental contrasting was equally frequent for both goal types (17%; $\chi^2_{(1)} = .002$, $p = .97$). The association between goal type and SRT mode therefore reflects differences in the prevalence of dwelling and indulging, rather than mental contrasting.

No associations were found between dichotomous SRT mode and survey block order ($\chi^2_{(1)} < .15$, $p > .70$), or medical vulnerability ($\chi^2_{(1)} < 2.31$, $p > .13$), for either goal type. However, an association was evident between SRT mode and gender, specifically for COVID-related goals ($\chi^2_{(1)} = 4.99$, $p = .026$). Here, 22% of females mentally contrasted, versus only 10% of males (five individuals reporting other genders were not included here due to small cell counts). For COVID-unrelated goals, this pattern was absent ($\chi^2_{(1)} = .49$, $p = .48$).

In sum, analysis of SRT mode frequencies suggests that while mental contrasting occurred with equal frequency for both goal types, dwelling occurred more frequently for COVID-related (and less controllable) goals and indulging occurred more frequently for unrelated (and more controllable) goals. There may also be gender differences in the tendency to naturally engage mental contrasting in certain circumstances (i.e., pandemic context / low perceived control).

4.3.3. Predicting commitment for COVID-related and COVID-unrelated goals

4.3.3.1. Bivariate analysis

Bivariate analyses revealed positive relationships between expectations and commitment for both COVID-related ($r = .31$, $p < .001$) and COVID-unrelated goals ($r = .29$, $p < .001$), in line with previous research (Oettingen, 2000; Sevincer & Oettingen, 2013). Overall concern regarding COVID-19 was also positively related to commitment for both COVID-related goals ($r = .15$, $p = .011$) and COVID-unrelated goals ($r = .18$, $p = .002$). For COVID-related goals alone, controllability was positively related to commitment ($r = .14$, $p = .017$), as was daily media exposure (square root transformation; $r = .12$, $p = .046$). These measures were therefore included as predictors in subsequent regression models.

Commitment scores were not related to participants' age for either goal type (rs < .06, ps > .33); nor to the number of statements generated (rs < .10, ps > .12). Furthermore, no reliable differences in commitment were found by dichotomous gender (ts < 1.70, ps > .09) or vulnerability (ts < 1.73, ps > .09). These measures are hereafter disregarded.

4.3.3.2. Hierarchical multiple regression

The first hierarchical regression model (Table 4.6) predicted commitment scores for COVID-related goals. In the first step, control predictors (identified above) were entered; of these, controllability ($b = .460$, $p = .005$) and overall concern ($b = .524$, $p = .003$) contributed significantly to the model ($R^2 = .065$, $p < .001$). In the second step, dichotomous SRT mode (dummy coded; 0 = mental contrasting, 1 = other modes) and expectations (mean-centred; Aiken & West, 1991) were entered as additional predictors. Only expectations contributed significantly to the model ($b = 1.057$, R^2 change = .081, $p < .001$). In the final step, the interaction of SRT mode and expectations was added (Sevincer & Oettingen, 2013), explaining no additional variance ($b = -.023$, R^2 change < .001, $p = .965$). The final model explained 14.5% of variance in commitment scores for COVID-related goals.

The second model (Table 4.7) predicted commitment scores for COVID-unrelated goals. In Step 1, overall concern was entered as a single control predictor, producing a significant model (R^2 = .026, p = .007). In Step 2, dichotomous SRT mode and expectations were added to the model; only expectations contributed significantly (b = 1.043, R^2 change = .093, p < .001). In the third step, the interaction of SRT mode and expectations was added, in this case explaining significant additional variance (b = -1.104, R^2 change = .014, p = .040). This indicates an expectancy-dependent effect of mental contrasting in line with previous research (Sevincer & Oettingen, 2013). The final model explained 13.3% of variance in commitment scores for COVID-unrelated goals.

Table 4.6. Hierarchical Regression Model Predicting Commitment for COVID-Related Goals.

Model Step	R^2	R^2 change	*p*	Predictor	B	SE(B)	β	*p*
1	**.065**	**.065**	**< .001**	**Controllability**	**.460**	**.164**	**.168**	**.005**
				Media exposure†	.113	.088	.079	.196
				Overall concern	**.524**	**.176**	**.182**	**.003**
2	**.145**	**.081**	**< .001**	Controllability	.046	.178	.017	.797
				Media exposure†	.117	.084	.082	.164
				Overall concern	**.571**	**.169**	**.198**	**.001**
				SRT Mode	.502	.784	.037	.522
				Expectations	**1.057**	**.213**	**.321**	**< .001**
3	.145	< .001	.965	Controllability	.046	.178	.017	.797
				Media exposure†	.118	.084	.082	.165
				Overall concern	**.570**	**.171**	**.198**	**.001**
				SRT Mode	.501	.786	.037	.524
				Expectations	**1.076**	**.481**	**.327**	**.026**
				SRT Mode × Expectations	-.023	.516	-.006	.965

Note. Included $N = 270$. Significant regression steps and predictors highlighted in **bold**. † Square root transformed prior to regression.

Table 4.7. Hierarchical Regression Model Predicting Commitment for COVID-Unrelated Goals.

Model Step	R^2	R^2 change	*p*	Predictor	B	SE(B)	β	*p*
1	**.026**	**.026**	**.007**	**Overall concern**	**.429**	**.159**	**.162**	**.007**
2	**.119**	**.093**	**< .001**	**Overall concern**	**.441**	**.153**	**.167**	**.004**
				SRT Mode	-1.043	.729	-.083	.154
				Expectations	**1.043**	**.201**	**.299**	**< .001**
3	**.133**	**.014**	**.040**	**Overall concern**	**.458**	**.153**	**.173**	**.003**
				SRT Mode	-1.221	.729	-.097	.095
				Expectations	**1.963**	**.489**	**.562**	**< .001**
				SRT Mode × Expectations	**-1.104**	**.536**	**-.288**	**.040**

Note. Included $N = 271$. Significant regression steps and predictors highlighted in **bold**.

To summarise, the expectancy-dependent effect of mental contrasting in predicting goal commitment (Oettingen, 2000, 2012; Sevincer & Oettingen, 2013; Sevincer et al., 2017) was only evident in this sample when analysing goals *unrelated* to the COVID-19 pandemic. This pattern is presented graphically in Figures 1 and 2. For COVID-related goals (Figure 4.1), the positive expectation-commitment relationship differs minimally across SRT modes (except for reverse contrasting). For COVID-unrelated goals (Figure 4.2), mental contrasting demonstrates the steepest positive slope of all four thought modes.

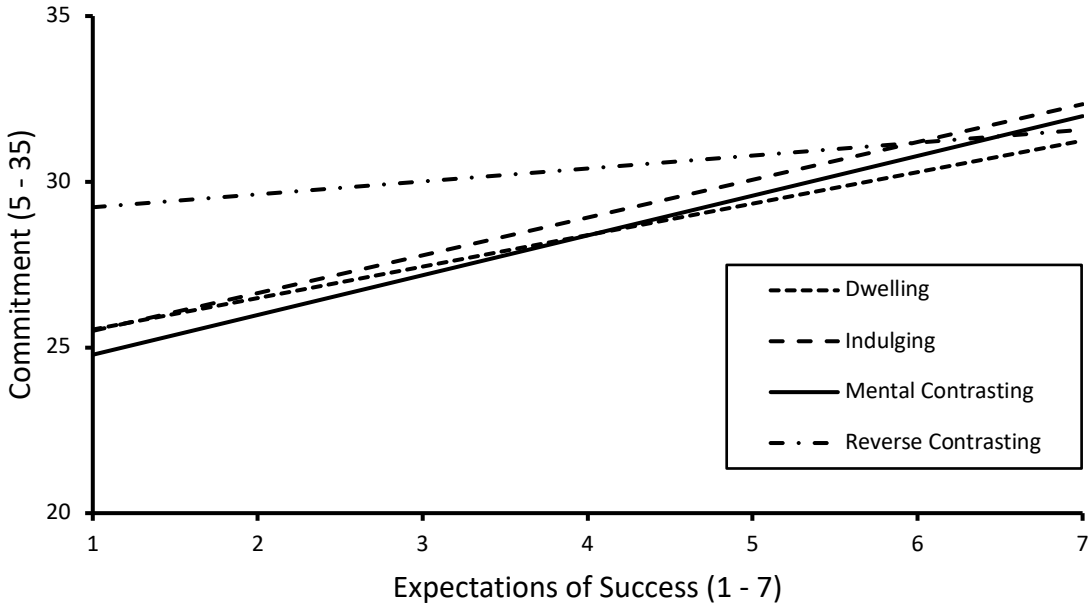


Figure 4.1. Regression Lines of Commitment on Expectations by SRT Mode (COVID-*Related* Goals)

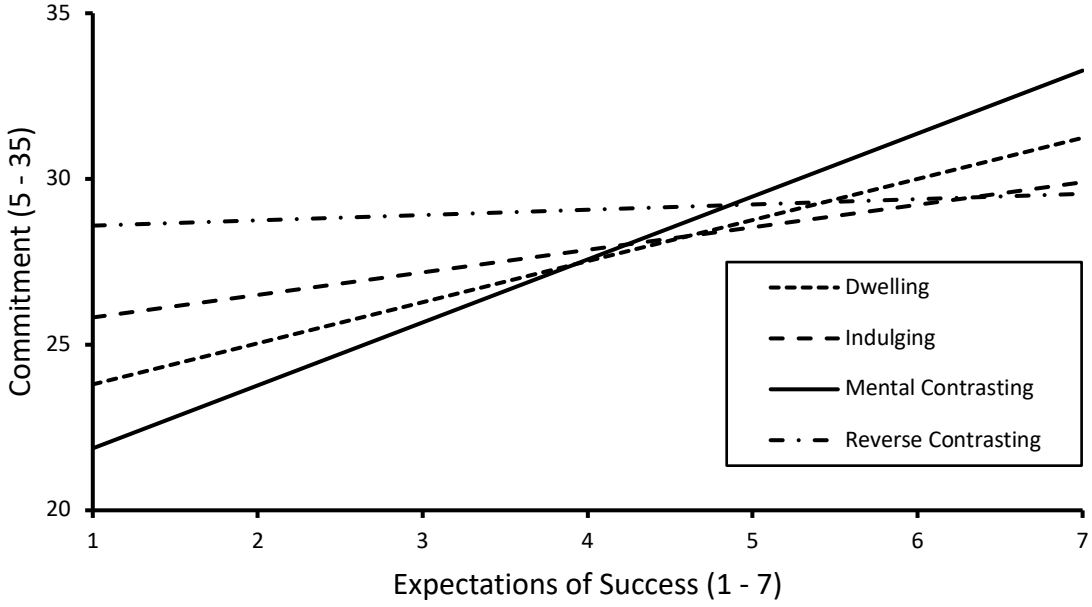


Figure 4.2. Regression Lines of Commitment on Expectations by SRT Mode (COVID-*Unrelated* Goals)

4.4. Discussion

4.4.1. Summary of key results

The present study investigated unprompted self-regulatory thought and goal pursuit during the COVID-19 pandemic. For the purposes of the thesis, an important aim was to test the potential utility of this paradigm in evaluating the role of goal-directed *spontaneous* thought in behavioural performance (see Chapter 5). In so doing, it has also illustrated the idiographic richness that can be gained from examining participants' goals in detail, distinct from their momentary goal-directed thoughts (Emmons, 1996; Moskowitz & Grant, 2009). In its own right, the study also served to illustrate differences in everyday goal pursuit in a set of novel and psychologically adverse circumstances (Pappas et al., 2009; Ritchie et al., 2021; Kokkoris & Stavrova, 2021).

A well-powered sample of UK-resident adults completed an online survey, reporting information on their single most important COVID-related and COVID-unrelated personal goals. Since COVID-related goals would often concern negative possibilities (e.g., the threat of catching the virus; Bacon & Corr, 2020; Zacher & Rudolph, 2021) that fall outside one's personal control (Park et al., 2021; Russell, 1982; Thurber & Weisz, 1997), a higher-than-usual rate of dwelling responses was expected when participants described these goals. Secondly, mental contrasting should have an attenuated effect on the expectation-commitment relation (Oettingen, 2000) for COVID-related goals.

The data provided some support for both hypotheses. Firstly, while mental contrasting occurred with equal frequency across goal types (17% of responses, comparable to Sevincer & Oettingen, 2013), differences emerged in the prevalence of the other modes, with dwelling predominating for COVID-related goals (41% of responses) and indulging, for unrelated goals (36.5%). This equates to a more-than-doubling of the odds of dwelling in the former case, and a similar increase in indulging in the latter. Moreover, perceived controllability influenced the odds of both dwelling (negatively) and indulging (positively), regardless of goal type. These additive effects imply that our manipulation successfully captured differences in perceived control, albeit not

absolutely, enabling us to identify two distinct self-regulatory patterns occurring simultaneously for goals of different types.

Secondly, the typical motivational effect of mental contrasting (Oettingen, 2000, 2012) was not consistently replicated in our study. After controlling for the independent effect of expectations, the anticipated interaction was absent when predicting commitment for COVID-related goals (β = -.006, $p > .05$), but evident for COVID-unrelated goals (β = -.288, $p < .05$). These results result support the proposition that self-regulatory thought may function differently in cases where perceived control is unusually low (cf. Cross & Sheffield, 2019; Oettingen, 2012).

By examining goals related and unrelated to an unfolding societal crisis, our study has identified real-time differences in cognitive and motivational aspects of goal pursuit (Gollwitzer & Oettingen, 2012; Milyavska & Werner, 2018) between domains where individuals feel differing levels of control over the respective outcomes. We now seek to explain and evaluate these differences, drawing on previous literature on self-regulation, coping, and the psychological effects of COVID-19.

4.4.2. Self-regulatory differences during COVID-19: A question of control

Analysis of controllability ratings for the two goal types confirmed the anticipated difference, with COVID-unrelated goals rated as much more controllable (cf. Sheldon & Elliot, 1998). COVID-related goals garnered a mean rating below the scale midpoint, indicating that participants felt a low absolute level of control over these outcomes (e.g., "I want my family to stay healthy… My children don't live with me, so I can't influence it directly"). This may partially reflect a general disparity in perceived control over health-related versus non-health-related events (Lau & Ware, 1981; Wallston, 1992), besides the specific psychological challenges of the pandemic (Pappas et al., 2009; Panayiotou et al., 2021).

Logistic regression further revealed that controllability influenced the form of a person's thoughts about their goals over and above the effect of goal type. The odds of dwelling almost halved for every point increase in controllability (1–7 Likert), while the odds of indulging increased by over 50%. Hence, though goal type may not represent a "pure" manipulation, this provides converging

evidence by showing a direct link between perceived control and patterns of unprompted SRT (cf. H. B. Kappes et al., 2011; Sevincer et al., 2017). In other words, controllability predicts the cognitive processing of goals in the absence of specific instructions; and our manipulation captures a broad, within-subjects difference on this characteristic. Moreover, the results are novel in that they highlight the application of other SRT modes, which are often thrown together or overlooked in a literature focussed around mental contrasting (Oettingen, 2012; Sevincer & Oettingen, 2013; Sevincer et al., 2017). With this in mind, the next section considers how links between SRT mode and goal commitment may depend upon controllability.

4.4.3. Goal commitment under conditions of limited control

Divergent commitment results for the two goal types may be attributable to the difference in controllability identified above. Expectations predicted commitment for both goal types as anticipated (Oettingen, 2000; Sevincer & Oettingen, 2013), yet when mental contrasting was engaged without an accompanying feeling of personal control (i.e., for COVID-related goals), its usual expectancy-dependent effect was absent. This may reflect suppression of the cognitive mechanisms of mental contrasting (Kappes et al., 2013; Kappes & Oettingen, 2014) and / or enhanced motivational effects of the other SRT modes, under conditions of limited control.

Considering the first possibility, mental contrasting entails the relational processing of a desired future and a present reality (Oettingen et al., 2001). Where expectations are high, associative links are formed such that aspects of the present situation become drivers for goal-directed action (Kappes et al., 2013; Kappes & Oettingen, 2014), increasing goal commitment. However, the present results show that COVID-related goals were viewed as fundamentally less controllable than COVID-unrelated goals (cf. earlier studies of subjective control; Russell, 1982; Thurber & Weisz, 1997). Thus, despite an equal prevalence of "mental contrasting" responses, low perceived control might have disrupted the relational processing of desired future and present reality, reducing its expectancy-dependent effect.

The expectation-commitment relationship under mental contrasting was significant for both goal types, yet this corresponded to a conventional large effect (Cohen, 1988) for COVID-unrelated goals ($r_{(49)} = .50$, $p < .001$) and only a medium effect for COVID-related goals ($r_{(49)} = .36$, $p = .013$). Since the subgroups were small and partially overlapping, these effects were not directly compared. Nonetheless, it is plausible that participants struggled to see uncontrollable, COVID-related outcomes as contingent upon their present actions, even when both aspects (desired future and present obstacles) were considered in the requisite order (cf. Oettingen et al., 2001) – thereby weakening the motivational effect of mental contrasting.

A second, compatible possibility is that the other SRT modes operated differently for COVID-related goals. For instance, some participants might have found solace in mentally "accentuating the positive" after realising that pandemic-related events were outside their direct control – hence receiving the label of indulging in the present methodology (e.g., fantasising about a rapid return to social interaction). This could be construed as an application of *secondary control* (Rothbaum et al., 1982; Thurber & Weisz, 1997) – moderating one's response to uncontrollable external events – which is an important aspect of coping (Armor & Taylor, 1998; Baumeister et al., 2016).

The expectation-commitment relationship was significant for those indulging about their COVID-related goals ($r_{(66)} = .35$, $p = .004$), but not for indulging about COVID-unrelated goals ($r_{(105)} = .16$, $p = .10$, *ns*), despite its popularity in the latter case. This pattern would be expected if such a mechanism were at play. Conversely, for dwelling, the expectation-commitment effect was estimated to be small for COVID-related ($r_{(118)} = .27$, $p = .004$) and medium for unrelated goals ($r_{(75)} = .42$, $p < .001$), suggesting that a more pessimistic outlook may have been unhelpful to motivation (cf. Baumeister et al., 2016).

Collectively, our results on SRT modes and commitment effects present a nuanced picture of the influence of subjective control on cognitive and motivational aspects of goal pursuit. COVID-related goals were typically less controllable and hence more likely to evoke pessimistic, dwelling responses (Park et al., 2021; Zacher & Rudolph, 2021); yet those that were relatively more

controllable often evoked other modes, such as indulging and mental contrasting, despite the negative circumstances (Rothbaum et al., 1982; Baumeister et al., 2016). Furthermore, different downstream motivational patterns were found for the two goal types, with the usual benefit of unprompted mental contrasting notably absent for COVID-related (uncontrollable) goals. These findings present a novel contribution to the literature (Oettingen, 2012; Sevincer & Oettingen, 2013; Sevincer et al., 2017) and highlight the need to update existing theoretical models to account for the influence of controllability.

4.4.4. Implications for theories of goal pursuit

Our findings concerning unprompted SRT mode occurrence highlight controllability as an important environmental determinant of self-regulatory thought, distinct from internal variables such as mood or personality traits (H. B. Kappes et al., 2011; Sevincer et al., 2017; Bacon & Corr, 2020; Kokkoris & Stavrova, 2021). Moreover, our commitment results challenge the assumption that mental contrasting is always a superior motivational strategy (Oettingen, 2012). Confirmatory analyses demonstrated the typical advantage only for pandemic-unrelated goals (which were perceived as more controllable). Hence, investigating goal pursuit during COVID-19 not only poses a contextually specific exception to fantasy realisation theory (Oettingen, 1996, 2000, 2012), but also highlights a wider theoretical limitation: The theory struggles to explain motivation in cases where individuals feel they have little direct control over important outcomes.

For instance, health outcomes like a prognosis or the success of a medical intervention are often beyond one's control (Lau & Ware, 1981; Wallston, 1992). The desired future, in this context, might be a positive health outcome. However, if one knows one's present actions cannot change the outcome, no amount of mental contrasting (nor any other motivational strategy) will illuminate a path to success. Consider the following case: "I hope I don't have cancer, but I've got a suspicious lump". Here, an ideal future is juxtaposed with an inconducive present reality, as per the theory (Oettingen, 2000, 2012); yet one cannot mentally circumvent the lump and thereby ensure the absence of cancer. Arguably, an uncontrollable threat to one's desired future can only be acknowledged and accepted.

How might one take a positive approach in a fundamentally uncontrollable context? In such cases, different forms of self-regulatory thought might be more adaptive (Baumeister et al., 2016; Sheppes et al., 2014). For example, one might adopt a "bracing" approach before hearing from a medical consultant, thereby employing secondary control to moderate one's reaction to an uncontrollable possible negative outcome (Shepperd et al., 2000; K. M. Taylor & Shepperd, 1998). This would entail focussing on outcomes and one's anticipated reactions to them (i.e., *affective forecasting*; Wilson & Gilbert, 2005), rather than forging links with the present as in mental contrasting (Kappes & Oettingen, 2014). Similarly, indulging in positive fantasies – typically unhelpful to goal pursuit (Oettingen et al., 2001) – could be beneficial to motivation in this context (in line with Panayiotou et al., 2021, who showed a benefit of short-term denial on quality of life in Cypriot students during COVID-19). When one desired outcome is uncontrollable, the pleasurable impact of positive fantasy (Gilbert & Wilson, 2007) might have a positive knock-on effect on one's progress towards other goals (Carver, 2003; Wrosch et al., 2003).

Crucially, to the author's knowledge, mental contrasting research has so far omitted to measure the subjective controllability of goals. Instead, it is often assumed that perceptions of control are a facet of expectations (Gollwitzer & Oettingen, 2012; Oettingen et al., 2001). By contrast, the present study made an operational distinction between the two. Furthermore, the within-subjects comparison reaffirms that an individual can adopt *contrasting approaches in different self-regulatory domains* (Armor & Taylor, 1998; Baumeister et al., 2016; Sheppes et al., 2014) – enabling flexible, adaptive responses in difficult circumstances such as the pandemic (Panayiotou et al., 2021; Mascret, 2020). Finally, plausible mechanisms have been articulated by which low subjective control might moderate the motivational effects of different SRT modes.

These novel developments call for a change of emphasis in the goal pursuit literature (Milyavskaya & Werner, 2018). Fantasy realisation theory (Oettingen, 1996, 2000, 2012) currently provides a useful framework for explaining the effects of SRT for highly controllable goals. However, it falls short when trying to explain how the same modes of thought operate for less controllable goals. In our view, a useful next step would be to integrate this theory with insights from the coping

literature, which specifies how different forms of prospective thought can be adaptive when responding to unavoidable stressors (Taylor & Schneider, 1989; Armor & Taylor, 1998; Folkman & Moskowitz, 2000; Benight & Bandura, 2004). New theoretical developments should also address individual differences like trait self-regulation (Kokkoris & Stavrova, 2021; Sevincer et al., 2017) and regulatory focus (Higgins, 1998), and how these might interact with controllability (subjective and objective; Armitage & Conner, 1999, 2000; Sheeran et al., 2003) in determining self-regulatory outcomes.

4.4.5. Implications for spontaneous future thought research

As outlined in section 4.1.1, much future thinking research is subject to the criticism that goals are treated as secondary to the patterns of thought that reflect or embody them (Baird et al., 2011; Cole & Berntsen, 2016; D'Argembeau & Mathy, 2011; Lehner & D'Argembeau, 2016). Spontaneous thought research, though sometimes placing more emphasis on goals (see review by Klinger et al., 2018), is nonetheless primarily concerned with the proximal mechanisms by which thought contents arise rather than the longer-term dynamics of how particular goals may influence thought and behaviour. In contrast to this, Study 4 focussed squarely on the ways in which particular goals are formulated and the consequences of perceived controllability and SRT mode for ongoing goal pursuit (captured through the proxy of self-reported commitment; Locke & Latham, 1990).

Divergent self-regulatory patterns, such as those observed here between goal types and SRT modes, might have implications for the types of spontaneous goal-related thought that individuals are likely to experience. For instance, it has been proposed that SRT modes such as mental contrasting should manifest in the stream of consciousness during mind-wandering (Oettingen & Schwörer, 2013). Thus, individuals who tend to adopt mental contrasting when freely describing their goals (Sevincer et al., 2017) might also experience spontaneous thoughts reflecting this goal formulation during everyday life (Oettingen & Schwörer, 2013). Study 4 did not address such possibilities directly as it did not capture spontaneous thoughts in real time (cf. Studies 1–3); this leaves room for an innovative approach to be pursued in Chapter 5, combining both methodological approaches.

In light of substantial differences between subjectively controllable (COVID-related) and uncontrollable (COVID-unrelated) goals, one may further speculate on the role of perceived control in the form and function of goal-related spontaneous thoughts. Recent research has shown clear parallels between psychological responses to COVID-19 (e.g., Huang & Zhao, 2020; Park et al., 2021; Shamblaw et al., 2021; Wang et al., 2020) and the typical effects of depression, in terms of a tendency to dwell on obstacles rather than adaptively negotiate them (Ruehlman, 1985; Roepke & Seligman, 2016). Might uncontrollable goals mirror this tendency, not only in terms of ultimate outcomes (e.g., disengagement or avoidance) but also in the types of spontaneous thought they promote? For instance, uncontrollable, yet salient, concerns might trigger thoughts akin to worry or rumination (Nolen-Hoeksema et al., 2008; Watkins, 2008); while subjectively controllable goals might lead the same individual's thoughts in a more functional direction (Klinger et al., 2018; Smallwood & Andrews-Hanna, 2013). Chapter 5 will expand upon this by examining the notion of self-efficacy (Bandura, 1982, 1997; Pintrich & De Groot, 1990) alongside measures of self-regulatory thought and spontaneous mind-wandering.

4.4.6. Limitations and future directions

One limitation of the present study is the use of self-reported commitment as an index of goal pursuit. Although standard practice in the literature (Oettingen, 2012; Sevincer & Oettingen, 2013), such subjective measures may be weakly aligned with actual behaviour (Armitage & Conner, 2001; Prestwich et al., 2008). It is hence acknowledged that these results, while reflecting a rich variety of goal-related experience, do not tell us whether each goal was ultimately achieved (cf. prospective memory research; Mason & Reinholtz, 2015; Neroni et al., 2014). Thus, one cannot be certain that any differences in commitment scores would translate to observable differences in behaviour. We therefore recommend that future research implement prospective designs to investigate objective performance outcomes while varying perceived control (see Sheeran et al., 2003). This would also enable researchers to gauge how far controllability effects generalise beyond the present (pandemic) context.

Secondly, mental contrasting for COVID-related goals was more prevalent in women (22%) than men (10%); this unexpected finding warrants further investigation. Research from 2020 shows that women were more optimistic than men in their expectations of how the pandemic would progress (Asimakopoulou et al., 2020; Sobol et al., 2020), and also more compliant with public health regulations (Sobol et al., 2020). This evidence is consistent with established understanding of the role of gender norms in health behaviours (Fleming & Agnew-Brune, 2015) and may help to explain our finding of a gender difference in SRT mode prevalence. However, since SRT mode had no moderating influence on commitment for COVID-related goals, our interpretations have not focussed on this aspect. It will therefore be important for future research to explore possible gender differences in unprompted SRT, as well as continuing to examine effects of gender on the psychological impact of the pandemic.

4.4.7. Conclusions

As predicted, COVID-related personal goals were perceived as significantly less controllable than COVID-unrelated goals in our sample of UK adults. Furthermore, different SRT modes predominated when participants described their COVID-related and unrelated goals: Dwelling responses were more than twice as likely for COVID-related than for unrelated goals; the opposite was true for indulging responses. Thought mode incidence also depended on controllability ratings, with less controllable goals being more prone to evoke dwelling regardless of goal type. When examining motivational consequences, expectations strongly predicted goal commitment for both goal types, yet the expectancy-dependent benefit of mental contrasting was non-significant for COVID-related goals.

Fundamentally, goals like keeping one's family safe throughout the pandemic seemed largely outside one's personal control – promoting threat-focussed, dwelling responses but also altering the motivational consequences of SRT. Specifically, the relational processing by which mental contrasting usually takes effect may have been disrupted, undermining its motivational effect; while indulging in positive fantasies appeared more favourable for uncontrollable goals. The study hence challenges the assumption that contrasting a desired future with present obstacles is always a superior

motivational strategy, prompting greater attentiveness to controllability as a contributing factor in self-regulation and goal pursuit.

Results also emphasise the value in adopting a more idiographic approach to studying personal goals: Everyday (COVID-unrelated) goals, many of which revolved around themes of education, career and self-improvement (cf. Gamble et al., 2021), yielded different motivational outcomes depending on the self-regulatory thought mode adopted. Chapter 5, while focussing on a context in which all participants share a common goal (i.e., to perform well in an upcoming exam), incorporated the unprompted SRT paradigm introduced in this chapter to more precisely discriminate between students' individual goal formulations. Hence, our attempt to quantify the effects of *spontaneous* thought on academic performance (Study 6) was able to account for the impact of *self-regulatory* thought (as in Study 4), and the possible interaction between these two constructs, in determining real-life outcomes.

Chapter 5. Contributions of Spontaneous Thought to Performance in Higher Education

5.1. Introduction

5.1.1. The pursuit of academic goals

An underlying premise of this thesis is that simply being motivated toward a particular goal is not sufficient to ensure successful goal pursuit. Rather, it is assumed that cognitive factors relating to how a goal is conceived of, or brought to mind, will play a pivotal role in determining success (e.g. perceived attainability; Gamble et al., 2021). The preceding chapters have assembled evidence from numerous sources in support of this general view. Spontaneous future thought (SFT) emerges as a strong candidate for explaining the relationship between motivational factors, on the one hand, and behavioural fulfilment of goals on the other (see intention-behaviour gap; Orbell & Sheeran, 1998; Prestwich et al., 2008). Since the content of SFT reflects personal goals (Cole & Berntsen, 2016; Baird et al., 2011; Chapter 2), and its occurrence is sensitive to external goal-relevant information (Jordão et al., 2019; Stawarczyk et al., 2011; Chapter 2), it is highly plausible that such thoughts play a functional role in translating intention into action. The aim of the present chapter is to fill this gap, combining insights from cognitive, social and educational psychology to examine the determinants of successful goal pursuit in a naturalistic setting.

So far, this thesis has considered goal pursuit in various domains; the data and conclusions of Chapter 4, for example, reflect a diverse range of personal aspirations encompassing health, self-improvement, work and education. By contrast, the present chapter focusses primarily on a common academic goal faced by undergraduate university students: to succeed in a future assessment. This study context offers two key advantages for examining the relationship between spontaneous thought and goal pursuit. Firstly, the extensive literature on cognitive factors influencing learning and assessment can both inform study design and aid in contextualising results (Pintrich, 2000; Schunk, 2005; Panadero, 2017). Secondly, university assessments impose a pre-defined structure whereby

every individual's behaviour is sampled and evaluated in a standardised way, without need of experimenter intervention. Hence, a meaningful measure of goal attainment – each student's assessment score – is readily available without sacrificing ecological validity.

The following sections will introduce key literature on the determinants of student assessment performance, before considering the role(s) of spontaneous thought and mind-wandering in education and, finally, highlighting the rationale for the studies presented in this final empirical chapter.

5.1.2. What drives students' performance in assessments?

There has been a tremendous amount of literature on the personal, interpersonal and contextual determinants of student performance in standardised assessments (Pintrich, 2000; Schunk, 2005; Hattie et al., 1996; Honicke & Broadbent, 2016; Panadero, 2017). An important insight from this literature is that it is not simply prior performance or measures of ability which dictate outcomes; nor do measures of time spent studying or subjective effort consistently fill the explanatory gap (Zimmerman, 1989, 2000). Rather, it is essential when predicting attainment to obtain a grasp of the student's private thoughts and feelings around an assessment goal. Just as self-regulation in general entails an interplay of cognitive, emotional and motivational variables, the learning and assessment activities undertaken by university students require a high degree of autonomous self-regulation (hence the term *self-regulated learning*; e.g., Pintrich & Zusho, 2002). Hence, all three levels of psychological description (cognitive, emotional and motivational) are as much implicated in the classroom as they are in any goal pursuit context.

Pham and Taylor (1999) conducted a pioneering experimental study of midterm examination performance in US undergraduate students, measuring and manipulating a variety of contributing factors (touched upon in Chapter 1). Their paper has exerted a marked influence on the broader study of thought-behaviour relationships (e.g., Andrews-Hanna et al., 2013; Cole et al., 2021; D'Argembeau et al., 2011; Gamble et al., 2021; Jing et al., 2016) and is particularly instructive for investigating goal pursuit in an educational context. The impetus for Pham and Taylor's (1999) study came from the theoretical proposal by Taylor and Schneider (1989) that mental simulation (e.g., the simulation of

"likely future events"; cf. Morewedge et al., 2005; Newby-Clark & Ross, 2003) serves important functions in goal pursuit, such as promoting problem-solving and enhancing emotional regulation (Jing et al., 2016; Poerio et al., 2016). Critically, the authors made a distinction between *outcome* and *process* simulation, which they operationalised by asking students to visualise either the outcome of achieving a high exam grade, the process of studying towards that end, or both (*combined simulation condition*). All three groups, plus a control group, then monitored their study behaviour over a five-to-seven-day interval before sitting the exam. Those in the simulation conditions were asked to repeat their visualisation exercise for five minutes every day.

Different predictions were made regarding the effects of outcome versus process simulation; the former, though potentially boosting self-efficacy by making a goal appear more attainable (Bandura, 1986; Locke & Latham, 1990), was expected not to benefit performance. Process simulation, on the other hand, should benefit achievement both through emphasising the steps necessary for success (i.e., a cognitive effect, promoting planning; cf. implementation intentions; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006) and by evoking emotional states conducive to taking the relevant actions (i.e., an emotional-motivational effect). Pham and Taylor (1999) also accounted for several additional, interlinked factors which might influence performance, measuring these at two time points before the exam (self-efficacy; outcome expectancy and value; intentions and action identification; Vallacher & Wegner, 1987).

As predicted, Pham and Taylor (1999) found an increase in exam grades and the number of hours spent studying for students engaging in process simulation. In other words, repeatedly visualising the sequence of steps towards successful exam preparation aided in making this a reality. On average, the process-only group outperformed the outcome-only group by eight percentage points (i.e., almost an entire grade category in standard assessment systems). Average grades for outcome-only students were in fact numerically lower than for controls, and further analysis showed that across the four groups, engaging in outcome simulation negatively predicted students' grade aspirations on the day before the exam, tending to hinder performance. Mediation analyses confirmed the authors' hypotheses regarding the underlying mechanisms of these effects: Process-only students showed

lower levels of anxiety about the exam and elevated levels of planning, both of which subsequently improved performance (the latter indirectly, by boosting grade aspirations).

Pham and Taylor's (1999) study provides an illuminating starting point in considering the effects of different forms of prospective thought (see Szpunar et al., 2014) on academic performance. For instance, it emphasises the value of accounting for "hot" motivational-emotional variables such as self-efficacy and anxiety in addition to "cold" cognitive components such as the form or frequency of mental simulations. If a student is highly anxious about the prospect of taking an exam (i.e., test anxiety; Wine, 1971; Pintrich & De Groot, 1990; Elliot & McGregor, 1999; C. Huang, 2011; Lüftenegger et al., 2016), this will manifest in different patterns of thought compared to a student who is feeling calm and confident (cf. MacLeod et al., 1997; Marsh et al., 2019). Of course, such relations may be bi-directional – with certain thought patterns *driving* heightened anxiety (Andrews-Hanna et al., 2013; Kambara et al., 2019; Philippot et al., 2010; Watkins, 2008). Even a randomised intervention study like that of Pham and Taylor (1999) cannot entirely circumvent unpredictable individual variation in relevant variables (e.g., background anxious tendencies or emotional regulation styles; del Palacio-Gonzalez & Berntsen, 2018; Seli, Beaty, et al., 2018). The present chapter aims to address such issues directly by embracing a more idiographic approach, eliciting individual-level information on motivation and thought patterns through open-ended questions (cf. Emmons, 1986, 1996; Klinger & Cox, 2004; Andrews-Hanna et al., 2013; Gamble et al., 2021).

In Chapter 4, a link was made between the process-outcome dichotomy and the fantasy realisation theory (FRT) model of self-regulation (Oettingen, 2000, 2012). FRT specifies four self-regulatory thought (SRT) modes – mental contrasting, dwelling, indulging and reverse contrasting – offering a ready-made tool for categorising individuals' goal aspirations as they naturally occur (see COVID-related and unrelated goals, Chapter 4). Although FRT has been presented as a theory of "future thought" and its relationship to behaviour change (Oettingen, 2012; Oettingen & Sevincer, 2018), it is important to disambiguate this usage from the (more typical) definition of future thought used throughout this thesis – namely, the cognitive processing and representation of possible future

events (Szpunar, 2010; Cole & Kvavilashvili, 2021). The four SRT modes prescribed in FRT may be viewed rather as indicators of particular *states of motivation* with respect to a given goal.

An example will serve to reinforce the clarity and significance of this distinction: A participant who describes their goal in a manner indicative of, say, mental contrasting might in principle experience a diverse range of future thoughts (voluntary and / or spontaneous; Cole & Kvavilashvili, 2021) about events connected with that goal. Some of these thoughts might align, in form, with the identified SRT mode (e.g., simulation of goal achievement combined with contemplation of present obstacles; see Oettingen & Schwörer, 2013), while others might not (an isolated worry about one's preparedness, for instance). The present chapter therefore makes an operational distinction between antecedent motivational factors (SRT mode, expectations, self-efficacy, etc.) and dynamic cognitive factors which might turn out to be independent from, but interact with, the former (e.g., frequency and content of spontaneous thoughts about a goal).

Panadero (2017) conducted a systematic review of research on self-regulated learning (SRL), an applied field encompassing motivational, volitional, cognitive and emotional aspects of how students manage (or struggle to manage) their own learning goals. The review critically contrasts prominent theoretical models and concludes that more integration is required, providing recommendations for future research. One of these is that "*more fine-grained studies* should be conducted to understand how the specifics of SRL work" (p. 24, emphasis added). From the present perspective, an obvious implication is that SRL research, with its focus upon motivational factors assessed statically through questionnaires (e.g., goal orientation; self-efficacy; Pintrich & de Groot, 1990; Pintrich et al., 1993), has often neglected the underlying cognitive dynamics involved in student learning and achievement[12]. This is not to say that the well-honed measures and models of SRL lack value in explaining how students learn; yet, echoing the point about ecological validity and realism sounded above (section 5.1.1), a student's academic fortunes might depend more heavily on the

[12] Boekaerts (2011) explicitly addresses *dynamic* aspects of SRL in her model, but this is to be understood in terms of the cyclical interactions between a learner and their educational environment across successive learning goals (Panadero, 2017, p.5). The criticism therefore remains that such models neglect more transient, everyday cognitive processes such as momentary thought contents.

thoughts that habitually or *naturally* come to mind regarding their studies than on motivational constructs that they might only consider when prompted.

Furthermore, motivational factors like self-efficacy or goal commitment might *interact* with the dynamic properties of conscious thought in determining goal pursuit outcomes. This would cohere with the emphasis in the recent mind-wandering literature on the function of spontaneous thoughts being moderated by context (Smallwood & Andrews-Hanna, 2013; Robison & Unsworth, 2018; Linz et al., 2019). As with the archetypal anxious student, a person experiencing involuntary thoughts about an upcoming goal in a motivational context of anxiety and self-doubt (i.e. low self-efficacy) is not likely to derive the same benefit from – or attribute the same meaning to – these thoughts as a person who experiences them while feeling confident (i.e. high self-efficacy) and optimistic.

Several of the theories reviewed by Panadero (2017) assign a role to automatic thought processes (cf. Moors & De Houwer, 2006) that might for instance activate goal representations (Boekaerts, 2011; cf. Chapter 2) or activate prior subject knowledge relevant to performing well (Pintrich, 2000). Yet these underlying cognitive mechanisms are not a priority for empirical work in the area, potentially due to the much longer timescales involved in typical SRL research compared to automatic thought studies (e.g., Morsella et al., 2010; Bargh et al., 2001). A notable irony is that, if automatic cognitive processes such as the triggering of a goal representation by environmental information (Bargh et al., 2001) must be considered short-term and transient, goals in themselves are chronic and enduring and are known to exert a pervasive influence over thought and behaviour (Zeigarnik, 1927; Fishbach & Ferguson, 2007; Klinger, 1975, 2013). It therefore appears that, with the appropriate theoretical and methodological tools at hand, a more complete account could be constructed of how students achieve their goals – incorporating a role for transient, automatic cognitive processes. The next section reviews evidence on one such class of processes – those involved in mind-wandering (Schooler et al., 2011; Smallwood & Schooler, 2015).

5.1.3. Mind-wandering in education: A double-edged sword?

The existing literature has rarely been flattering about the effects of mind-wandering in an educational setting. In part owing to a particular characterisation of mind-wandering in terms of *executive failure* (McVay & Kane, 2010), which gained traction while experimental research on the phenomenon was in its infancy, investigators have explicitly set out to demonstrate its "costs" for student engagement, knowledge retention and ultimately academic performance (Kane et al., 2021; Seli, Wammes, et al., 2016; Smallwood, Fishman, et al., 2007; Szpunar, Moulton, et al., 2013). In addition, this literature has tended to assess MW *during* educational activities such as lectures or private study, rather than outside the academic context (but see Unsworth & McMillan, 2017, for an exception using a daily diary method). While there are undoubted disadvantages to students frequently "tuning out" (see Smallwood et al., 2008) in class, from an educator's point of view as well as their own (Szpunar, Moulton, et al., 2013), this bias risks oversimplifying our understanding of the consequences of task-unrelated thought and encourages an unwarranted hostility to the possibility of mind-wandering in education as a force for good.

Some studies, notably those by Seli, Wammes, et al. (2016) and Unsworth and McMillan (2017), have posed more sophisticated hypotheses about the relationship between MW and educational outcomes. Seli, Wammes, et al. (2016) had participants view a video-recorded history lecture punctuated by unpredictable thought probes (cf. vigilance task probes), before demonstrating their retention of the material in a multiple-choice test and subsequently rating their motivation to perform well. The authors constructed three models to examine the mediating effects of different forms of mind-wandering (overall, unintentional, intentional) on the relation between motivation and test performance. Extending upon previous findings (Szpunar, Moulton, et al., 2013; Unsworth & McMillan, 2013), Seli and colleagues (2016) found that overall MW during learning partially mediated the effect of motivation on test performance, and when taking intentionality into account, both unintentional and intentional MW *fully* mediated this effect. From a practical point of view, these findings suggest novel strategies that could be used to optimise student performance – focussing on

disincentivising deliberate tuning out, as well as adjusting course delivery to mitigate against unintentional MW (Seli, Wammes, et al., 2016).

Such results are promising, in guarding against an overly simplistic view of MW as a construct; but ultimately, this work is still grounded in the assumption that the *effects* of MW on educational outcomes will be adverse. Accordingly, MW is captured during educational activities (e.g., throughout a video lecture), when it is understandably viewed as a disruption, thereby reducing the chances of observing beneficial effects. Conversely, when using a daily diary method, mind-wandering frequency has been shown to have no discernible effect on academic performance (Unsworth & McMillan, 2017).

Outside the educational sphere, mind-wandering research has proceeded more neutrally, seeking to distinguish functional from dysfunctional patterns of off-task thought and examine their relations with personal and contextual variables (Robison & Unsworth, 2018; Linz et al., 2019; Konu et al., 2021). Some key theorists have endorsed the possibility that MW during routine everyday activities – when cognitive resources exceed task demands – might in fact benefit goal pursuit (including of educational goals) by reorienting one's attention to meaningful long-term goals (Schooler, 2011; Smallwood & Andrews-Hanna, 2013). Thus, the student stacking shelves in the local supermarket mentally disengages ("decouples") from the present to pursue more profitable trains of thought, for instance contemplating how they will prepare for an imminent university assessment.

An important study by Pereira et al. (2020) confirmed that the relationship between MW and academic performance may be moderated by person-level variables. Measuring a range of temperamental traits (Evans & Rothbart, 2007), they found that although MW frequency (assessed with the MWQ; Mrazek et al., 2013) was highest in those displaying low effortful control and extraversion combined with high negative affect, the relationship between MW scores and retrospective academic grades was moderated by effortful control. Specifically, grades were negatively related to MW propensity for those with low, but positively related for those with high, levels of effortful control. These findings imply that individuals with superior attentional control abilities (as indexed by the effortful control scale; Evans & Rothbart, 2007) might enjoy greater

flexibility in their experience of mind-wandering, adjusting its frequency and content to suit the present task context. This coheres closely with the aforementioned work on contextual determinants of MW functionality (Smallwood & Andrews-Hanna, 2013; Robison & Unsworth, 2018; Linz et al., 2019) and provides a link with real-world academic performance (albeit retrospectively), underlining the plausibility of context-dependent positive effects of MW in education.

5.1.4. Spontaneous thought as a causal factor in goal achievement

It is well-known that spontaneous thoughts often include the contemplation of uncompleted personal goals (Klinger, 1975, 2013; Baird et al., 2011; Morsella et al., 2010; Cole & Berntsen, 2016). Yet currently, there is a dearth of evidence going beyond this statement to test the *causal potency* of spontaneous thoughts (cf. Laukkonen et al., 2022). Do they functionally contribute to the tangible process of progress with, and ultimately achieving, one's goals? It is true that spontaneous mental contents may be elusive, fleeting, and multifactorial in origin (Konu et al., 2021; Schooler & Schreiber, 2004; Seli, Kane, Smallwood, et al., 2018); yet this does not preclude their playing a robust causal role in goal-directed behaviour, functional and dysfunctional (Klinger et al., 2018; Gamble et al., 2021).

One illuminating source of evidence comes from the traditionally distinct field of prospective memory, where investigators are concerned with the factors that determine a person's likelihood of fulfilling a delayed intention encoded at some previous point (Einstein et al., 2005). Unlike the goals literature, prospective memory research typically focusses on relatively trivial, experimenter-generated intentions – for instance, to press a different response button on the computer when a stimulus appears bearing some specified characteristic (R. L. Marsh & Hicks, 1998; Smith, 2003). However, outside of the lab, prospective memory targets often take the form of personal goals (R. L. Marsh et al., 1998; Freeman & Ellis, 2003). Moreover, as the name suggests, this literature typically uses prospective research designs that include some behavioural outcome measure (e.g., how many reported intentions a participant actually fulfils). Examining key findings from this literature can therefore provide valuable insights for considering how prospective thought (of which intention is one subtype; Szpunar et al., 2014) might more generally influence goal achievement.

Mason and Reinholtz (2015) conducted a prospective memory experiment in which participants formed the delayed intention to send a text message to the researcher, either two or four days later, within a narrow (one-hour) time window (study 1). Over the following week, they were instructed to go about their daily lives and press a button within a simple smartphone app every time the delayed intention came to mind. Intention-related thoughts could then be examined through time from the moment the participant left the lab, past the point of intention enactment (sending or failing to send the text), up until the end of the week. Intention-related thoughts were found to be far more frequent before than after the enactment window across all participants (d = .98). Furthermore, the frequency of prospective intention-related thoughts (i.e. those occurring beforehand) significantly predicted the odds of successfully sending the text when examined using logistic regression. For every standard deviation increase in (log-transformed) thought frequency, participants were approximately 40% more likely to fulfil the intention[13]. The proposed function of such thoughts as self-generated prompts to enact a delayed intention at an appropriate future moment (termed "self-remindings" by Mason & Reinholtz, 2015) was therefore confirmed.

These findings are consistent with those of Anna-Lisa Cohen (A. L. Cohen et al., 2008; A. L. Cohen, 2013) using a laboratory approach. Cohen (2013) found in a dual-task lab paradigm that spontaneous thoughts of a delayed intention occurring during an intervening task (cf. task-unrelated thoughts; Stawarczyk et al., 2011; Smallwood & Schooler, 2015) can, under certain conditions, function as reminders to fulfil the intention at the relevant future moment. Accepting the premise that prospective memory is partly coextensive with the more recently proposed construct of SFT (Cole & Kvavilashvili, 2021; Kvavilashvili & Rummel, 2020), such prospective memory studies (Mason & Reinholtz, 2015; A. L. Cohen, 2013) stand as preliminary evidence of spontaneous future thoughts promoting successful performance at fulfilling a subsequent goal.

There is one important distinction to acknowledge between prospective memory goals and the goals addressed in this chapter – namely, to perform well in academic assessments. In the former case,

[13] This figure was calculated by the present author from a standardised logistic regression parameter, $\beta = .33$, reported by Mason and Reinholtz (2015, p. 7). Odds ratio for SD unit increase in log(thoughts) = $e^{\beta} = e^{(0.33)} = 1.39$.

one must only take a simple action (e.g., pressing a button, sending a message) for the intention to be fulfilled. If the intention is retrieved in the correct context, then success is absolute (but see R. L. Marsh et al., 1998, discussing more complex, everyday PM fulfilment). In the case of academic assessments, however, the picture is necessarily more complex: A student must do more than remember *to take* the exam in order to perform well. This is a familiar problem in the broader goal pursuit literature, where even the "simplest" self-regulatory strategies (e.g., Gollwitzer, 1999) involve identifying and enacting intermediate steps, rather than taking a single, discrete action that absolutely ensures goal attainment. Consequently, the relationship between spontaneous thoughts about, and subsequent fulfilment of, a real-life academic goal is likely to be more complicated than the straightforward predictive relationship between frequent spontaneous "remindings" and enactment of a PM intention.

5.1.5. Chapter aims and objectives

Synthesising the various theoretical and methodological frameworks drawn upon in the thesis, this chapter aims to build upon suggestive evidence from mental simulation, mind-wandering and prospective memory research that certain forms of spontaneous thought, in particular motivational contexts, can benefit goal pursuit. For reasons of applied interest and practical convenience, this aim was pursued in a university setting (cf. Seli, Wammes, et al., 2016; Kane et al., 2021; Pereira et al., 2020). The main objective was to construct and evaluate a predictive model of how self-regulation (as in the theory of Oettingen, 2012; Oettingen & Sevincer, 2018) and spontaneous thought (Klinger et al., 2018; Cole & Kvavilashvili, 2021) interact to determine student assessment performance. In brief, it was hypothesised that the influence of spontaneous goal-related thought on performance would be moderated by SRT mode (further elaborated in Study 6 Aims / section 5.3.1).

To examine this hypothesis, two preliminary objectives must first be addressed. Firstly, it was necessary to establish the plausibility of predictive relationships between spontaneous anticipatory thought and objective performance in a simple knowledge test (Study 5). This was accomplished by recruiting a sample of students intending to obtain a driving licence who had not yet passed the

prerequisite driving theory test, and for whom this therefore constituted an authentic achievement goal. These students completed a vigilance task with experimenter-imposed thought probes (Chapter 3; cf. Plimpton et al., 2015; Vannucci et al., 2015, 2017; Mazzoni, 2019), followed by a shortened "mock" version of the UK driving theory test (see https://www.gov.uk/take-practice-theory-test), plus control measures, within a single experimental session.

The second preliminary objective was to validate a brief questionnaire measure which could be used to approximate individuals' propensity to experience spontaneous thoughts relating to their current goals. This was done in a separate online sample (detailed in Study 6 Methods / section 5.3.2), using a self-caught version of the vigilance task (to maximise thought accessibility; Barzykowski & Staugaard, 2018) along with validated mind-wandering questionnaires and a novel version adapted specifically to capture goal-related MW. The rationale for this is further detailed in section 5.3.1.1.

5.2. Study 5: Do Lab-Elicited SFTs Drive Mock Theory Test Performance?

5.2.1. Aims and hypotheses

The aim of this exploratory study was to examine possible links between spontaneous thoughts, captured in real time, and performance on a simple knowledge test (mock driving theory test). Identifying any such links in advance would help to direct the focus of the subsequent study on exam performance (Study 6). For instance, spontaneous thoughts might exhibit a planning or preparatory function relevant to goal attainment, including theory test performance (Smallwood & Andrews-Hanna, 2013; Klinger et al., 2018). On a more fine-grained level, the content of individual thought reports might reveal explicit rehearsal of information relating to the test (cf. Morsella et al., 2010). As such, not just frequency, but also mode of occurrence (spontaneous vs. voluntary; Cole & Kvavilashvili, 2021; Seli, Risko, et al., 2016) and thought content were captured and analysed in relation to performance data.

The emotional content of task-unrelated thoughts was also considered, in view of prior research on test anxiety (Wine, 1971; Elliot & McGregor, 1999; Lüftenegger et al., 2016). It was theorised that the present paradigm might distinguish functional test-related thoughts from less functional, potentially intrusive "worries" about the test (cf. Watkins, 2008; Kambara et al., 2019; Philippot et al., 2010). Emotional valence ratings were captured for each reported thought so that this potential factor could be examined.

An important concern for the present study was ensuring that participants remained unaware of the true function of the thought capturing procedure (i.e., examining spontaneous thoughts with a view to predicting test performance). A cover story was therefore devised whereby participants had ostensibly been assigned to one of two study groups (receiving different revision materials). The focus of the "experiment" – from a participant's point of view – was therefore to examine differences between these two groups. In reality, there was no group manipulation and all participants were given the same revision materials (see below).

5.2.2. Methods

5.2.2.1. Participants

The sample consisted of 31 psychology students recruited via physical advertisements and online forum posts at York St John University. Participants were compensated with credit towards their research participation module. Key inclusion criteria were (1) individuals currently seeking to obtain a UK driving licence, who (2) had not yet passed the prerequisite driving theory test. The sample had a mean age of 19.8 years (SD = 1.7) and comprised 28 females and 3 males. No formal power analysis was undertaken for this exploratory study.

5.2.2.2. Design

The study used a prospective correlational design to examine relationships between thought data from a probe-caught version of the vigilance task (as used in Chapter 3) and performance on a mock driving theory test, together with other potential predictors. The study was approved by a University Ethics Committee.

5.2.2.3. Materials

Pre-test measures

The first questionnaire elicited demographics (gender and age) and categorical measures of daily revision time in the two-day period preceding the session (*Not at all, Up to 15 minutes, More than 15 minutes*) and total time preparing for the driving theory test (*Not at all, Less than a month, Less than a year, More than one year*). Participants also reported the number of GCSEs (high school qualifications) attained at grades A* to C (reflecting a "good pass"; Department for Education, 2017) to control for general test ability.

Spontaneous thought task

As in Study 3 (Chapter 3), the primary vigilance task consisted of 600 trials, each of 1.5 s duration, displaying either horizontal (n = 589) or vertical line arrays (n = 11). Participants were instructed to detect the vertical target stimuli and respond by pressing the spacebar. They were also

informed that the task would occasionally be paused and interrupted by "concentration probes" to monitor their concentration and other aspects of their experience in the preceding moments. Twelve such probes were presented at fixed pseudorandom intervals on an iPad running Qualtrics survey software. Participants were asked to rate their concentration on a 1–5 Likert scale (1 = *Not concentrating at all*; 5 = *Fully concentrating*) and then give a brief thought description and ratings of temporal orientation (past, present, future, other), spontaneity (binary spontaneous / voluntary, unlike Studies 2 and 3) and emotional valence (1–5 Likert, 1 = *Extremely negative*; 3 = *Neutral*; 5 = *Extremely positive*).

As before, cue phrases were embedded within the line arrays on 120 out of 600 trials (i.e. 20%), to act as triggers for spontaneous thoughts. These were the same as those used in the standard cue condition of Studies 1 and 2 (see also Cole et al., 2016; Schlagman & Kvavilashvili, 2008) and comprised 50% positive phrases such as "Feeling happy" and 50% negative phrases such as "Lack of energy". Cues were presented in a fixed order for all participants, with intervals of two to eight trials between successive cues.

Mock driving theory test

The mock theory test consisted of 20 multiple choice questions, each with four possible answers labelled A to D (the official test comprises 50 questions). Questions were sampled from freely available online revision resources and correct answers were jittered between options A–D to avoid predictability. Two "picture questions" were included, which require the candidate to interpret the meaning of common UK road signs. Participants completed the test on paper under invigilated conditions.

Post-test measures

First, self-efficacy was assessed using a domain-general 10-item measure (*Generalized Self-Efficacy Scale*; Schwarzer & Jerusalem, 1995). Each item was answered on a scale of 1 (*Not at all true*) to 4 (*Exactly true*) and responses summed to produce a total score in the range 10 to 40. The PHQ-9 (Kroenke et al., 2001) was used to assess depressive symptoms, consisting of nine items asking about the frequency of certain feelings and experiences in the last two weeks on a scale of 0

(*Not at all*) to 3 (*Nearly every day*). Total scores ranged between 0 and 27. This was followed by the state anxiety subscale of the state-trait anxiety inventory (Spielberger et al., 1983), assessing present-moment anxiety symptoms using 20 items on a scale of 0 (*Not at all*) to 3 (*Very much so*) and resulting in a total score between 0 and 60.

5.2.2.4. Procedure

The study was advertised as an investigation of the merits of two revision strategies for test performance, "spacing" and "cramming". In reality, there was no assignment to separate study conditions as all participants were given the "spacing" instructions previously shown to improve performance and decrease stress and anxiety levels (Cepeda et al., 2006). Two days before the timetabled lab session, participants were provided with tailored study materials relating to the 20-question mock driving theory test they would later complete. They were asked to revise from these materials for at least 15 minutes on both days preceding the test.

Participants were tested in small groups of two to six in a teaching lab equipped with desktop PCs and an electronic whiteboard. After obtaining their informed consent, the researcher gave a short presentation recapping the previously circulated information about revision strategies and briefing participants on the structure of the session. Participants then filled out the initial questionnaire covering demographics, two-day revision time, total theory test preparation time and number of GCSEs at grades A* to C. They then completed the spontaneous thought task, in which they were required to maintain concentration and ignore the "irrelevant phrases" appearing onscreen, followed by the mock theory test. This was conducted in silence and with a 20-minute time limit to minimise distractions and ensure fairness. Participants were separated by at least one empty desk to minimise the potential for cheating. Those who finished early were instructed to sit quietly until the whole group had finished, at which point the post-test questionnaire was administered, combining measures of self-efficacy, depression and anxiety symptoms.

5.2.3. Results

5.2.3.1. Descriptive statistics

Pre-test measures: Preparation and prior test performance

For the two-day revision time variable, ≤ 15 mins was the modal category (n = 22); for total theory test preparation time, the modal category was *Not at all* (n = 14; see Table 5.1). Hence, while all included participants intended to obtain a driving licence, and most had spent some time revising from the material provided before coming to the lab, many had not been actively pursuing the goal prior to signing up for the study. Due to small cell counts, these categorical variables were recoded in binary format for subsequent analysis (i.e., 0 = no revision / preparation; 1 = some revision / preparation).

The average reported number of GCSEs at grades A*-C (Table 5.1) was 9.34 (SD = 2.61). This is presumably at or above the national average given that average total GCSE *entries* in England was 9.2–9.4 per pupil in the relevant period (2015–17, Department for Education, 2017).

Table 5.1. Descriptive Statistics for Pre-Test Measures.

Two-Day Revision Time			Total Theory Test Prep Time				Number of GCSEs
Not at all	≤ 15 mins	> 15 mins	Not at all	< 1 month	< 1 year	> 1 year	Mean (SD)
3	22	5	14	10	5	1	9.34 (2.61)

Note. n = 30 due to missing data for one participant (PC technical error).

Spontaneous thought task measures

Due to a computer error, data for target detection in the vigilance task (accuracy and RTs) were lost. Concentration ratings were, on average, close to the midpoint of the 1–5 Likert scale (M = 3.21, SD = 0.88).

Across the 12 probes, participants reported task-unrelated thoughts an average of 5.13 times (SD = 3.06; Table 5.2). Of these, an average of 3.45 (SD = 2.50) thoughts were spontaneous, and average emotional valence ratings were close to the midpoint of the 1–5 Likert scale (M = 3.12, SD = 0.68). Table 5.2 also breaks down spontaneous thoughts by temporal orientation (past, present, future,

other). A nonparametric comparison (due to positively skewed data) confirmed that present and future thoughts outnumbered past and other thoughts (Wilcoxon's $T = 53.0$, SE = 39.0, $p = .002$).

Finally, two proportional variables were computed (see Table 5.2): average proportion of thought reports rated as spontaneous (by participants) and average proportion coded as test-related (by two raters; $\kappa = .90$). As in Studies 1, 2 and 3, the use of proportional measures enabled the properties of participants' task-unrelated thoughts to be compared independently of overall reporting frequency (cf. Cole & Berntsen, 2016).

Table 5.2. Descriptive Statistics for Spontaneous Thought Measures.

Thought Reports:			Spontaneous Thoughts:				Proportion Spontaneous	Proportion Test-Related
Total	Spontaneous	Avg. Valence	Past	Present	Future	Other		
5.13 (3.06)	3.45 (2.50)	3.12 (0.68)	0.77 (1.15)	1.19 (1.14)	1.32 (1.60)	0.16 (0.45)	0.70 (0.34)	0.07 (0.11)

Note. Standard deviations in parentheses.

Mock theory test performance and post-test measures

On average, participants scored just under 15 out of 20 marks on the mock theory test (M = 14.94, SD = 2.28; Table 5.3). This equates to average performance of 74.7% correct. Self-efficacy scores were, on average, below the scale midpoint of 25 (M = 19.42, SD = 3.62), while levels of depressive symptoms were generally low (M = 6.77, SD = 4.48; scale range 0–27). State anxiety scores were close to the midpoint of 30 (M = 30.90, SD = 6.25).

Table 5.3. Descriptive Statistics for Mock Theory Test and Post-Test Measures.

Avg. Theory Test Score [1–20]	Self-efficacy [10–40]	Depression [0–27]	State Anxiety [0–60]
14.94 (2.28)	19.42 (3.62)	6.77 (4.48)	30.90 (6.25)

Note. Standard deviations in parentheses.

5.2.3.2. Identifying predictors of test score

Correlational analysis

Pearson's correlations were computed between the primary thought variables (proportion spontaneous, proportion test-related), continuous control measures (GCSEs, self-efficacy, depression, anxiety), and participants' test scores. The only significant result was a positive correlation of $r_{(30)}$ = .47 (p = .009) between proportion spontaneous and test score. However, in view of the limited sample size, it was decided that correlations of absolute magnitude $|r| > .25$ would be retained for inclusion in the subsequent predictive model, regardless of significance. Two such correlations were identified: a marginally significant positive relationship between self-efficacy and test score ($r_{(31)}$ = .33, p = .07) and a sizeable though non-significant positive relationship between proportion test-related and test score ($r_{(30)}$ = .29, p = .12).

Categorical variables

For two-day revision, participants who revised (n = 28) attained higher average test scores than those who did not (n = 3; M_{diff} = 2.14), although this difference was not statistically reliable due to unbalanced groups ($t_{(29)}$ = -1.59, p = .124, *ns*). For total theory test preparation, those who had been preparing beforehand (n = 17) attained higher average test scores than those who had not (n = 14; M_{diff} = 1.32), although this difference was again non-significant ($t_{(29)}$ = -1.64, p = .111, *ns*). Hence, these variables were not included in the subsequent predictive model.

5.2.3.3. Predicting test score as a function of thought variables

A hierarchical multiple linear regression model was computed, with self-efficacy as the sole predictor in step 1, and the two relevant thought variables, proportion spontaneous and proportion test-related, added in step 2. This enabled the unique contributions of the latter to be examined while controlling for the possible effect of self-efficacy identified above (r = .33, p = .07). Model parameters are summarised in Table 5.4.

Table 5.4. Multiple Linear Regression Model Predicting Theory Test Score.

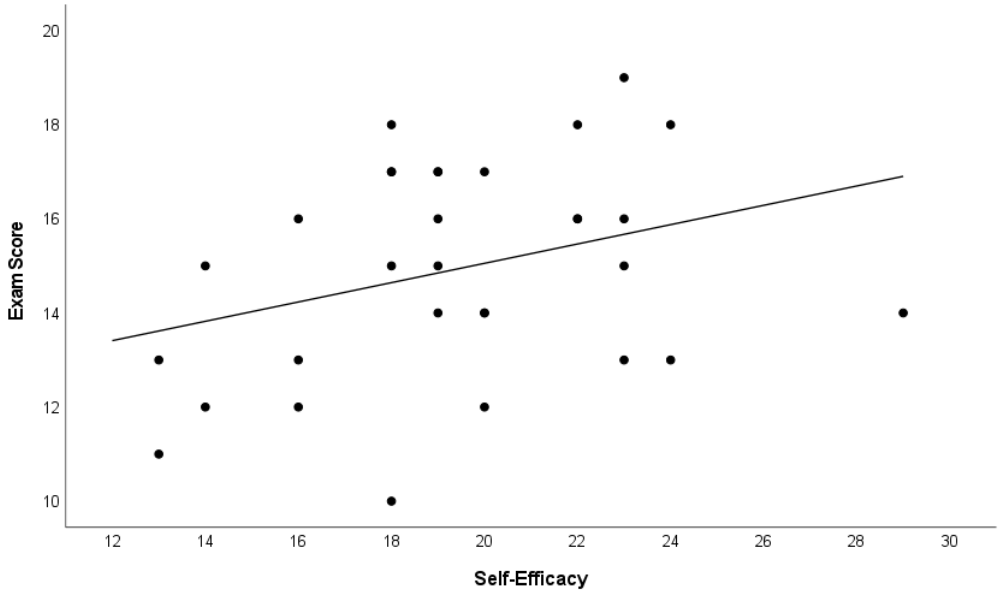
	Predictor	*b* [95% CI]	β	*t*	*p(t)*	R^2	ΔR^2	$p(\Delta R^2)$
Step 1	Self-efficacy	.19 [-.05, .44]	.29	1.63	.114	.087	-	-
Step 2	Self-efficacy	.22 [.00, .44]	.34	2.03	.053			
	Proportion (Spontaneous)	2.60 [.41, 4.78]	.39	2.44	.022			
	Proportion (Test-Related)	7.70 [.41, 14.98]	.35	2.17	.039	.382	.295	.006

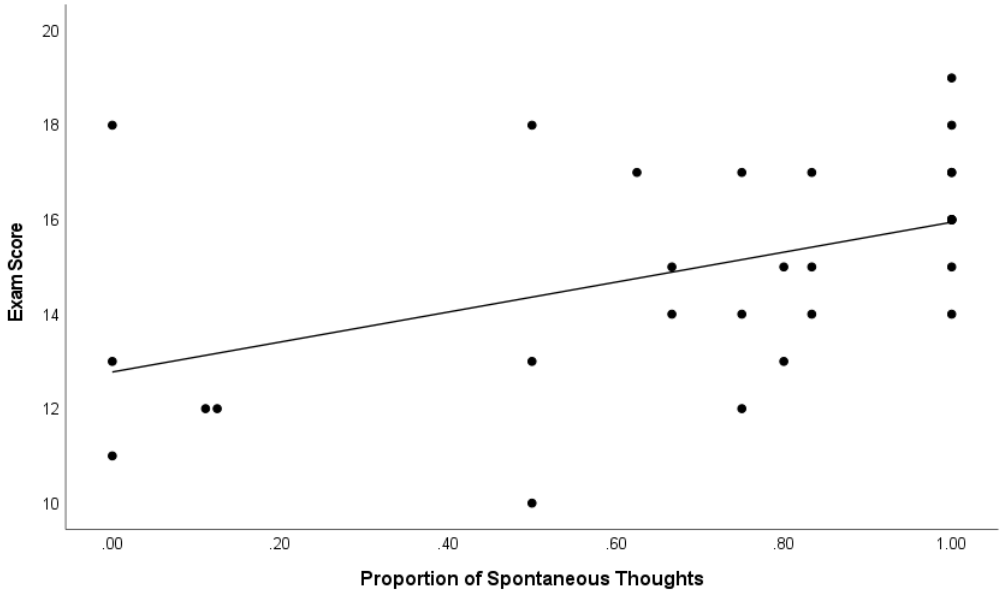
Note. $n = 30$ due to one participant with zero thoughts (hence proportional values incalculable). Significant predictors in bold.

In step 1, self-efficacy did not significantly predict test score (β = .29, $t = 1.63$, $p = .114$, *ns*). The total variance explained (R^2) for this step was 8.7% (see Table 5.4). However, the addition of proportion spontaneous (β = .39, $t = 2.44$, $p = .022$) and proportion test-related thoughts (β = .35, $t = 2.17$, $p = .039$) in step 2 significantly improved the model, explaining an additional 29.5% of variance ($\Delta R^2 = .295$, $p = .006$; Table 5.4). Figure 5.1 illustrates the positive relationships between each predictor and the outcome variable, test score.

Due to the low incidence of spontaneous, test-related thoughts (avg. proportion = .05, SD = .09), this factor was not included as a linear regression predictor. However, an exploratory comparison was conducted between students who reported zero such thoughts ($n = 22$) and those who reported at least one ($n = 9$; maximum = 2). The relevant means and standard errors are presented in Figure 5.2. Although non-significant ($t_{(29)} = -1.15$, $p = .26$, *ns*), the direction of the difference is consistent with regression results: Those who experienced spontaneous, test-related thoughts tended to achieve higher theory test scores.

Figure 5.1. Relationships Between Regression Predictor Variables and Test Scores.





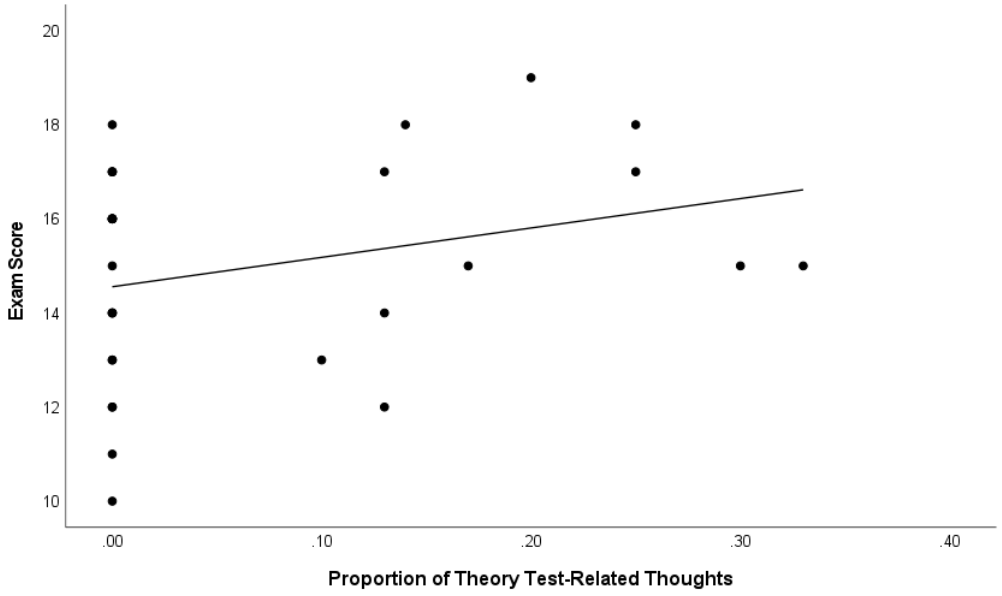
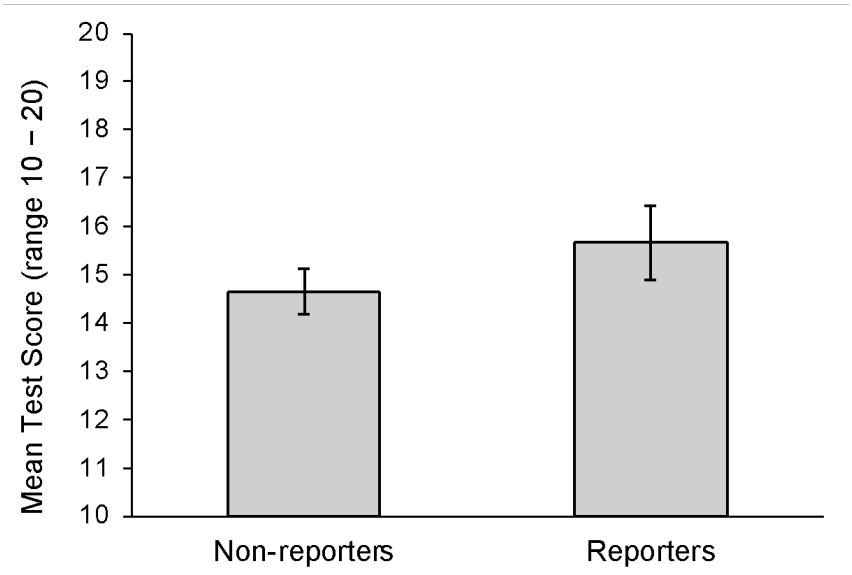


Figure 5.2. Mean Scores for Reporters and Non-Reporters of Spontaneous, Test-Related Thoughts



5.2.4. Discussion

This exploratory study aimed to identify possible predictive relationships between aspects of spontaneous anticipatory thought and objective test performance (on a mock driving theory test). A sample of undergraduates were recruited who all shared an aspiration to pass the official UK driving theory test. These students received tailored revision materials two days before an experimental session in which they A) completed a vigilance task interspersed by unpredictable thought probes (to assess spontaneous thoughts in real time); B) took the mock theory test in exam conditions; and C) completed several additional questionnaire measures.

Tentative expectations about the relationship between spontaneous thoughts and mock theory test performance were formed at the outset. It was anticipated that thoughts relating to the test may function as "self-remindings" (Mason & Reinholtz, 2015), promoting mental preparation during an undemanding prior task (Morsella et al., 2010; Smallwood & Andrews-Hanna, 2013). In addition, as discussed in section 5.1, particular thought contents – as well as an individual's current psychological state – may be pivotal in determining the behavioural effects of spontaneous thought (Smallwood & Andrews-Hanna, 2013; Andrews-Hanna et al., 2013; Poerio et al., 2013; Pereira et al., 2020). Open-ended thought descriptions were therefore elicited and systematically coded for relevance to the goal of succeeding in the test. Participants' motivational-affective state was assessed by measuring self-efficacy and feelings of depression and anxiety at the end of the experimental session. A regression model was then constructed to predict theory test scores based on self-efficacy and two indices derived from anticipatory thought sampling data (proportion of spontaneous thoughts, proportion of test-related thoughts).

Results suggest, firstly, that the greater a participant's tendency to experience spontaneous thoughts during an irrelevant prior task, the better they perform at a subsequent goal-relevant activity. This can be interpreted at differing levels of specificity: Does spontaneous thought as a global tendency or trait (Carriere et al., 2013; Mrazek et al., 2013) predict goal achievement in general, or do certain types of spontaneous thoughts occurring shortly before a performance opportunity (cf. Morsella et al., 2010; Mason & Reinholtz, 2015; A. L. Cohen, 2013) yield domain-specific benefits

for performance? The regression results also highlighted the importance of *test-related* thoughts, arguing in favour of a domain-specific explanation.

Those experiencing a higher proportion of test-related thoughts showed superior test performance, with the regression parameter (b = 7.70) indicating that a participant reporting exclusively test-related thoughts (i.e., proportion = 1) should attain a score almost eight points higher than one reporting no such thoughts (i.e., proportion = 0). Given the overall thought frequencies observed (Table 5.2), experiencing one additional test-related thought would generally correspond to a meaningful increase in the resulting test score (i.e., ≥ 1 point). Hence, it appears that it is not spontaneity alone, but also goal-relevant content, which carries the beneficial effect of off-task thoughts for subsequent test performance. The exploratory comparison of reporters and non-reporters of at least one *spontaneous, test-related* thought, though statistically inconclusive, fits with this general interpretation.

The present findings are novel and highly illuminating regarding the relationship between spontaneous thought and goal attainment. They provide direct support for the notion that it is not merely the occurrence, but also the content, of anticipatory thoughts that determines functional outcomes (Andrews-Hanna et al., 2013; Linz et al., 2019; Poerio et al., 2013; Pereira et al., 2020). The combination of a prospective design and an objective performance measure enabled us to identify clear links between the presence of certain thought characteristics and quantifiable degrees of success in subsequent goal pursuit. Oettingen and Schwörer (2013) speculate that the content of ongoing thought could reflect the spontaneous application of SRT modes such as dwelling or mental contrasting – known to predict objective goal pursuit outcomes (Oettingen, 2000, 2012). This link has yet to be verified directly (but see Baumeister et al., 2020, for evidence of "pragmatic" everyday thoughts combining present and future). However, applying it to the present study, it is conceivable that the most successful participants not only thought about the impending test but consciously linked their goal with the remaining hurdles that must be overcome (e.g., maintaining concentration, regulating anxiety; Huang, 2011; Philippot et al., 2010). This would resemble the *outcome plus process* condition of Pham and Taylor (1999), which yielded the best assessment performance. Study

6 follows up on this by explicitly considering the interactive effect of SRT mode and the tendency to think spontaneously about an upcoming performance opportunity.

Notably, the effects of spontaneous and test-related thinking were present after controlling for self-efficacy, which did not significantly predict test score in itself. This suggests that the benefits of certain anticipatory thought patterns may be accessible even for individuals whose general confidence in their abilities is relatively low. This paints a somewhat different picture to studies that have emphasised stable, trait variables as moderators of thought-behaviour relationships (e.g., Pereira et al., 2020; Sevincer et al., 2017). It is also consistent with the conclusion drawn by Pham and Taylor (1999) that repeatedly engaging in pragmatic, goal-directed thought yields specific performance benefits independently of traits or personality (since students in their study were randomly allocated to the conditions). It should be borne in mind that since Study 5 used a domain-general scale to measure self-efficacy, scores likely do not reflect specific feelings of confidence / readiness to take the theory test, but a more generic motivational trait or attitude (Schwarzer & Jerusalem, 1995; Bandura, 1982, 2006). It may transpire that a more specific measure, anchored to the pursuit of a particular goal, is superior in predicting performance (Bandura, 2006); this consideration informed the choice of measures in Study 6.

5.2.4.1. Limitations

Firstly, the present study sample was small (n = 31). Thus, even a regression model with only three predictors and no interactions must be interpreted cautiously, with the caveat of limited statistical power in mind (Field, 2013; Button et al., 2013). Furthermore, a series of bivariate correlations were assessed to determine the inclusion of predictors; hence, the model itself was dependent on inferences subject to increased Type I and Type II error rates (Button et al., 2013). Thus, conclusions drawn from these findings should remain tentative. Nonetheless, the study was able to fulfil the intended objective of scoping out *plausible* predictive relationships between anticipatory thought and test performance.

A second limitation is that deriving predictors from filtered thought report data can lead to heavily reduced numbers of observations. Participants reported around five thoughts each; not all of these were spontaneous, and the vast majority were unrelated to the driving theory test (see section 5.2.3.1). This places severe constraints on our ability to discern the effect of *spontaneous, test-related thoughts* (see binary comparison of reporters and non-reporters; section 5.2.3.3). Study 6 therefore substituted real-time thought capture with a questionnaire measure to ensure every participant contributed a continuous data point reflecting their *general tendency* to experience spontaneous, goal-related thoughts.

Finally, the timescale in the present study is rather short: two days of revision before the test, with spontaneous thoughts only assessed in the preceding half hour. Thus, inferences about longer-term, "real-world" patterns of goal pursuit are necessarily limited (cf. Pham & Taylor, 1999; Gamble et al., 2021; Kane et al., 2021). This reinforces the motivation for switching to a questionnaire-based thought measure in Study 6.

5.2.4.2. Summary and conclusions

Study 5 combined sensitive, real-time thought capture (vigilance task) with an objective measure of test performance (driving theory test) in a domain of specific importance to the sample demographic (would-be drivers). Results showed that participants who experienced a higher rate of spontaneous, and / or test-relevant, thoughts during an unrelated prior task achieved superior theory test scores. Additionally, domain-general self-efficacy (i.e., perception of one's ability to cope and manage life's challenges) showed a marginally significant positive relationship with test score when accounting for the thought variables. These novel results support the proposition that task-unrelated thoughts occurring during periods of low cognitive demand can directly benefit subsequent behavioural outcomes, dependent on their form and content (Smallwood & Andrews-Hanna, 2013; Andrews-Hanna et al., 2013). More specifically, they highlight the viability of predicting *academic* outcomes (e.g., performance on multiple choice tests) based on a combination of antecedent factors including the parameters of spontaneous anticipatory thought (cf. Pereira et al., 2020; Kane et al., 2021).

Study 6 aimed to expand on the foregoing results in the context of an authentic university assessment. Instead of treating cognitive and motivational factors as independent of one another, it also addressed the possibility that the two might interact (for instance, certain self-regulatory tendencies might moderate the benefit of mind-wandering about one's goals; Oettingen & Schwörer, 2013). A full rationale, including considerations involved in adapting the study design, is presented in the following section.

5.3. Study 6: Student Examination Grades as a Function of Self-Regulation and Goal-Directed Spontaneous Thought

5.3.1. Aims and hypotheses

It was hypothesised in the Introduction to this chapter that an individual's motivational state with respect to a goal might moderate (i.e., interact with) the effect of goal-related spontaneous thoughts on performance (Oettingen & Schwörer, 2013; Klinger et al., 2018). In other words, spontaneous thought cannot simply be viewed as a help or a hindrance to academic performance, but rather its impact is critically dependent upon the motivational context in which it occurs (Poerio et al., 2013, 2016; Linz et al., 2019; Pereira et al., 2020). The aim of Study 6 was to test this hypothesis in the context of an authentic university assessment (online exam), building upon the evidence from Study 5 of positive relationships between particular aspects of anticipatory thought and performance on a multiple-choice knowledge test.

The initial impetus for Study 6 was to build upon the results of Pham and Taylor (1999) by allowing a role for spontaneous thought (or spontaneous mind-wandering) in explaining the relationship between students' motivation and performance (cf. Pereira et al., 2020; Panadero, 2017). However, ethical restrictions precluded direct experimental manipulation of goal processing (i.e., outcome versus process simulation; Pham & Taylor, 1999; Conroy et al., 2015; Cole et al., 2021). It was therefore necessary to devise a correlational study which could discriminate between different motivational styles *as they naturally occur*. Sevincer and Oettingen's (2013) method of coding self-regulatory thought (SRT) mode from free-text goal elaborations offered a practicable solution; hence, it was adopted in the present study (see also proposed link between SRT modes and mind-wandering; Oettingen & Schwörer, 2013).

The results of Study 5 highlighted the potential performance benefits of spontaneous thoughts related to an assessment goal. However, issues of small sample size and infrequent overall thought reporting limited the conclusions that could be drawn. It was decided that in Study 6, which would

also be subject to certain sampling constraints[14], a continuous questionnaire measure of spontaneous goal-related thought would be used to maximise the value of the available data while facilitating the running of the study (by heavily reducing the time commitment). Further details on this process are given in the next section.

5.3.1.1. Rationale for online validation of novel MW scale

As the fine-grained vigilance task used in Studies 1, 2, 3 and 5 (Cole et al., 2016; Schlagman & Kvavilashvili, 2008) was unfeasible here due to time and data collection constraints (see section 5.3.2), it was necessary to develop a brief proxy measure of individual variation in spontaneous goal-related thought (Klinger et al., 2018).

Several existing scales designed to assess spontaneous mental time travel, daydreaming and / or mind-wandering were considered (Berntsen et al., 2015; Carriere et al., 2013; L. M. Giambra, 1980; Mrazek et al., 2013). The author then selected the spontaneous and deliberate mind-wandering (MW-S and MW-D) scales devised by Carriere et al. (2013), for several reasons including brevity and extensive prior validation (Seli, Risko, et al., 2016; Thomson et al., 2015). Scale items were adapted so as to elicit responses on an appropriate level of specificity (i.e., exam-related thoughts only).

5.3.1.2. Hypotheses

Two hypotheses were formulated based on the literature summarised in the Introduction and insights gained from Chapter 4:

1. In a group of students preparing for an online exam, varying SRT modes would occur naturally when students were prompted to describe their academic goal (as when individuals freely describe goals in various life domains; Sevincer & Oettingen, 2013; Sevincer et al., 2017).

[14] Study 5 required participants from within the York St John psychology subject pool (approx. N = 250) who also intended to pass their driving test; Study 6 required that participants be enrolled on certain course modules and was therefore somewhat less restrictive (see section 5.3.2.1).

2. The effect of spontaneous thoughts about one's academic goal – operationalised in terms of *exam-related mind-wandering* (EMW) – would be moderated by SRT mode, with mentally contrasting students showing the greatest performance benefit (cf. *type* of simulation; Pham & Taylor, 1999; Oettingen & Schwörer, 2013).

5.3.2. Methods

5.3.2.1. Participants

The study was advertised to two undergraduate cohorts sitting online exams in cognitive psychology at York St John University. Total enrolment numbers for these modules were 142 and 98 respectively; of these, 30 students (21%) from Year 1 and 28 students (29%) from Year 2 volunteered to participate. All students were given access to detailed study information beforehand, which emphasised the optional nature of the study. Although it was mentioned that the chance to reflect on the upcoming exam might benefit performance through the engagement of metacognitive processes (Schraw et al., 2006; Tanner, 2012), there was no further incentive for participation. Students choosing to take part were asked to complete a 10-minute Qualtrics survey either during or shortly after a timetabled one-hour revision session.

The combined sample of 58 participants had a mean age of 20.9 years (SD = 5.3) and comprised 55 females, 2 males and one individual reporting a non-binary identity. No formal power analysis was conducted due to the inherently restricted sampling context, although it is acknowledged that this sample is still small for the purposes of multiple regression (Field, 2013; Tabachnick & Fidell, 2018). Results are therefore interpreted with this caveat in mind.

5.3.2.2. Design

The study used a prospective correlational design to examine relationships between self-regulatory thought (SRT), exam-related mind-wandering (EMW) and exam performance. On the basis of prior validation (see Appendix IV), the novel questionnaire measure of EMW was taken to be a valid proxy for spontaneous thoughts of the upcoming exam. SRT mode was established through content coding of free-text responses (see *Materials*, section 5.3.2.3), as in previous research on unprompted mental contrasting (Sevincer & Oettingen, 2013; Sevincer et al., 2017). Finally, exam grades were obtained in pre-standardised format (0-100%), enabling Year 1 and Year 2 samples to be combined without further data transformation. Formal letters of consent were obtained from the

academic staff responsible for the modules, and the study was approved by the relevant University Ethics Committee.

5.3.2.3. Materials and Procedure

Online survey

The survey consisted of a self-regulatory thought (SRT) task followed by a series of short questionnaires, all accessed via a single Qualtrics link. The SRT task required participants to describe their thoughts and feelings around their academic goal – to succeed, by their own standards, in the upcoming online exam. This is termed goal elaboration (Sevincer & Oettingen, 2013). Answers were typed in a large, open-text entry field, with a minimum length of 50 characters imposed to encourage genuine responses. The exact instructions, modelled on the "unprompted" goal elaboration condition in Sevincer and Oettingen (2013), were as follows:

> A key goal of this module is to perform well in the exam that will be held in January. First, we would like you to think in detail about this goal. You are free to write about whatever aspects come to mind that are related to succeeding in the exam. Let the mental images pass by in your thoughts and do not hesitate to give your thoughts and images free rein. Take as much space as you need to describe your thoughts.

This was followed by ratings of expectation ("Indicate how likely you are to succeed at the level you would like"; 1 = *Not at all likely*, 7 = *Very likely*) and commitment (five-item composite measure taken from Locke & Latham, 1990; Oettingen, 2012, including items such as "How hard will you try to realise this goal?"; 1 = *Not at all*, 7 = *Very*). These were the same measures used in the larger study, on COVID-related and unrelated goals, reported in Chapter 4. However, in this case the expectation measure was presented *after* the goal elaboration question, since it was considered redundant to ask participants to state their goal (as in Sevincer & Oettingen, 2013) when all were describing success in an exam which must be passed to secure academic progression. Thus, by first elaborating the goal, participants provided themselves with an anchor for the subsequent ratings, as would normally be provided through an initial "goal statement" question (Sevincer & Oettingen, 2013). Specific grade predictions were not elicited, in line with the standard tendency to focus on

degrees of expectation of a single outcome, rather than degrees of success (Sevincer & Oettingen, 2013; Oettingen, 2012).

The second section of the survey comprised an adapted version of the MW-S scale (Carriere et al., 2013) in which instructions and item wordings were again adjusted, this time to elicit responses based on spontaneous mind-wandering about the exam goal in particular (henceforth *exam-related mind-wandering*, EMW). For instance, "When my mind wanders, my thoughts tend to be pulled from topic to topic" was reworded as "When my mind wanders, my thoughts *revolve around the upcoming exam*" (italics added). Online validation in a separate sample (n = 34) showed EMW to have good internal consistency (α = .80) and to correlate with the frequency of spontaneous goal-related thoughts reported in an online vigilance task ($r_{(34)}$ = .44, p = .009)[15]. All scale items are provided in Appendix IV, along with further details on the validation process.

Thirdly, the survey included eight items measuring self-efficacy (e.g., "I'm confident I can do an excellent job on the upcoming exam") and four measuring test anxiety (e.g. "I worry a great deal about tests"), taken from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich & DeGroot, 1990; Pintrich et al., 1993). All MSLQ items were answered on a 7-point Likert (1 = *Not at all true of me*; 7 = *Very true of me*) and presented in an intermixed order. Finally, the two standard mind-wandering scales, MW-S and MW-D (Carriere et al., 2013), were included to assess discriminant validity with respect to the adapted EMW measure (as in online validation; see Appendix IV). The entire survey took approximately 10 minutes to complete.

[15] Correlational analysis was performed after square root transformation of SFT frequency data due to positive skew. EMW scores were approximately normally distributed and hence were not transformed.

Exam performance

Exams for both cohorts were conducted online, several weeks after the sessions in which the survey link was distributed. Inevitably, pre-existing assessment schedules made it impossible to standardise this time lag. For the Year 1 subsample, the survey was completed between 9th and 19th December 2020 and the exam closed on 12th February 2021 (i.e., approximate time lag of 8-9 weeks); for Year 2, the survey ran from 26th February to 4th March 2021 and the exam closed on 12th March (i.e., approximate time lag of 1-2 weeks). Both cohorts had a one-week window in which to complete the exam via the Moodle VLE site, subject to a two-hour time limit.

Final exam grades, once confirmed, were obtained through an academic administrator in pseudonymised form (using pre-existing student numbers). These were then matched to the student numbers provided by survey participants when collating data for analysis. Only one survey response could not be associated with an exam grade (presumably due to a student number error in the survey), resulting in a missing case for this variable.

5.3.3. Results

5.3.3.1. Descriptive statistics

Table 5.5 displays descriptive statistics for the main measures of interest, broken down by academic cohort (Year 1 vs. Year 2) and for the total sample. Table 5.6 summarises control variables on the same basis. Although average exam grade differed between the two student cohorts (Year 2 > Year 1, $t_{(55)} = -4.89$, $p < .001$), inspection of the distributions (Figure 5.3) indicated that the combined sample featured a more normally distributed spread of scores, with the peak frequency density remaining between 75 and 80 (combined mean = 76.8; Table 5.5). Subsequent analyses were therefore performed on the pooled total sample of $n = 58$ students ($n = 57$ for exam score due to one missing case; see section 5.3.2.3).

Table 5.5. Mean (SD) Expectations, Exam-Related Mind-Wandering (EMW), Commitment and Exam Grade by Cohort.

Cohort	*n*	Expectations (1–7)	EMW (4–28)	Commitment (5–35)	Exam Grade (0–100)*
Year 1	30	4.73 (1.05)	13.50 (6.40)	27.50 (4.93)	69.69 (11.41)
Year 2	28	5.25 (1.01)	14.18 (5.91)	28.04 (4.76)	84.14 (10.91)
Total	58	4.98 (1.05)	13.83 (6.13)	27.76 (4.81)	76.79 (13.25)

Note. *Year 1 / total values are for $n = 57$ due to unidentifiable case (see section 5.3.2.3).

Table 5.6. Summary of Control Measures (Age, Gender, MW-S, MW-D, Self-Efficacy, Test Anxiety) by Cohort.

	Age (Years)	Gender			MW-S (4–28)	MW-D (4–28)	Self-Efficacy (8–56)	Test Anxiety (4–28)
	Mean (SD)	F	M	Other	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Year 1	21.33 (7.13)	29	0	1	20.30 (4.07)	17.57 (4.49)	37.40 (8.44)	19.87 (6.31)
Year 2	20.46 (2.27)	26	2	0	19.07 (4.19)	14.61 (5.75)	37.00 (8.26)	18.29 (6.37)
Total	20.91 (5.34)	55	2	1	19.71 (4.14)	16.14 (5.30)	37.21 (8.28)	19.10 (6.33)

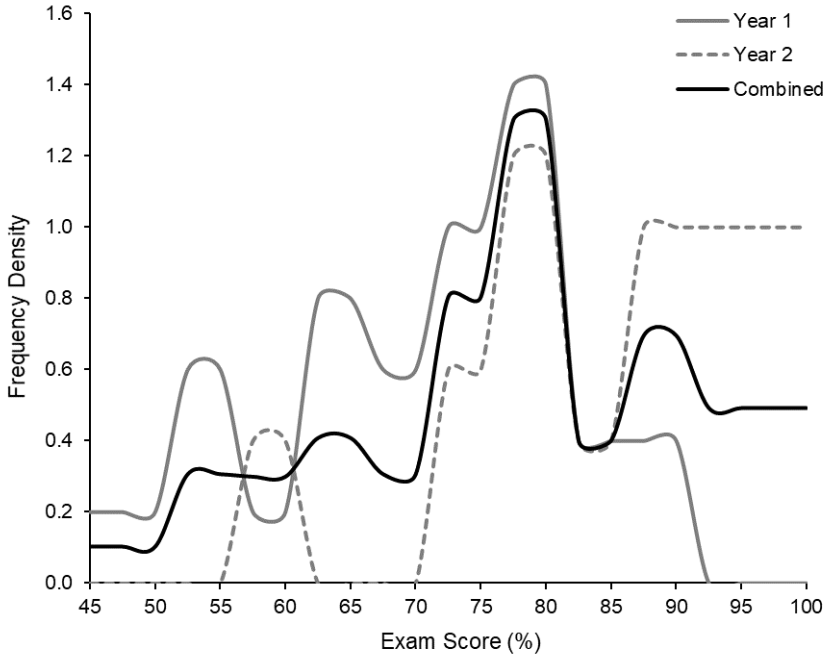


Figure 5.3. Exam Score Distribution by Year Group and for Combined Sample.

5.3.3.2. Preliminary analysis

Assessing continuous predictors

Pearson's correlations were computed between the key predictors (EMW, expectations and commitment); motivational control variables (self-efficacy, test anxiety); and the outcome measure of exam grade. Results are summarised in Table 5.7[16]. The only measure showing a significant relationship with exam grade was expectations ($r_{(57)} = .329$, $p = .013$). Self-efficacy and test anxiety, despite being strongly anti-correlated ($r_{(58)} = -.501$, $p < .001$) and displaying several relationships with other predictors, did not show reliable relationships with objective performance (rs < .2, ps > .13, *ns*). Likewise, although commitment was strongly correlated with expectations ($r_{(58)} = .364$, $p = .005$), it showed a non-significant positive relationship with exam grade ($r = .11$, $p = .44$, *ns*). Finally, EMW showed a non-significant negative relationship with exam grade ($r = -.15$, $p = .25$, *ns*).

Table 5.7. Pearson's Correlations Between Primary Measures.

	1	2	3	4	5
1. EMW	-				
2. Expectations	-.235	-			
3. Commitment	.178	**.364****	-		
4. Self-Efficacy	**-.296***	**.522*****	**.397****	-	
5. Test Anxiety	**.570*****	**-.395****	-.015	**-.501*****	-
6. Exam Grade	-.154	**.329***	.105	.157	-.199

$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

[16] Intercorrelations between the three MW measures (EMW, MW-S and MW-D) were also assessed; the two published measures were positively intercorrelated (MW-S, MW-D; $r_{(58)} = .44$, $p < .001$), yet neither was related to EMW (rs < .2, ps > .18, *ns*). This is taken as further evidence that EMW successfully taps a distinct construct (see also section 5.3.2.3 and Appendix IV).

Assessing categorical predictors

A one-way ANOVA was computed with exam grade as the dependent measure and SRT mode (mental contrasting, dwelling, indulging, reverse contrasting, other) as the factor. This did not indicate a significant difference ($F_{(4, 52)} = .62$, $p > .5$, *ns*). However, group size was very variable (range 2 – 28), limiting the reliability of this test. The data were hence submitted to an independent samples t-test with binary coded SRT mode (mental contrasting vs. all others) as the grouping variable. Again, no significant difference was found ($t_{(55)} = -.36$, $p > .5$, *ns*).

From these analyses, it can be concluded that SRT mode *per se* is not relevant to predicting exam grades. This is consistent with previous research emphasising the *moderating* effect of mental contrasting on performance, in combination with other variables (e.g., expectations; Oettingen, 2000, 2012).

5.3.3.3. Predicting exam grades as a function of motivation and EMW

A hierarchical linear regression model was computed to assess the combined effect of motivational variables and EMW in predicting exam performance. In light of preliminary analyses, only expectation was included in step 1 of the model. Although null relationships were identified between EMW / SRT mode and exam grade, the main theoretical prediction outlined above is that they would interact (Hypothesis 2; section 5.3.1.2). Hence, mean-centred EMW values (Aiken & West, 1991) and binary SRT mode (0 = mental contrasting; 1 = others) were added to the model in step 2, and crossed to produce an interaction term which was added in step 3 (cf. Sevincer & Oettingen, 2013; interaction of expectation and SRT mode). Model parameters, variance explained figures and associated significance tests are presented below in Table 5.8.

Table 5.8. Multiple Linear Regression Model Predicting Exam Grade.

	Predictor	*b* [95% CI]	β	*t*	*p(t)*	R^2	ΔR^2	Model *p*
Step 1	**Expectations**	**4.07 [.91, 7.24]**	**.33**	**2.58**	**.013**	**.106**	-	**.013**
Step 2	**Expectations**	**3.82 [.49, 7.16]**	**.31**	**2.30**	**.025**			
	SRT Mode	.17 [-7.40, 7.73]	.01	.04	.965			
	EMW	-.18 [-.74, .39]	-.08	-.62	.537	.113	.006	.089
Step 3	**Expectations**	**3.34 [.02, 6.66]**	**.27**	**2.02**	**.049**			
	SRT Mode	.63 [-6.82, 8.07]	.02	.17	.867			
	EMW	.82 [-.45, 2.08]	.38	1.30	.200			
	EMW * SRT Mode	-1.24 [-2.66, .18]	-.52	-1.76	.085	.161	.049	**.050**

Note. $n = 58$ (mean substitution for missing case). Significant predictors in bold.

In step 1, the model was significant, explaining 10.6% of variance in exam grades with expectations as the sole predictor. In step 2, as anticipated, the simple effects of SRT mode and EMW did not explain significant additional variance ($\Delta R^2 < 1\%$, *ns*). In step 3, however, adding the interaction term explained marginally significant additional variance ($\Delta R^2 = 4.9\%$, $p = .085$), improving the model to the point of borderline significance (model $p = .050$). Notably, the estimated effect of expectations declined from $\beta = .33$ ($p = .013$) to $\beta = .27$ ($p = .049$) as further parameters were added, suggesting that the true effect of prior expectations on academic performance is less robust when accounting for the combined effect of SRT mode and exam-related mind-wandering.

The anticipated interaction effect, which was negative in line with predictions (i.e., adopting mental contrasting resulted in a more *positive* slope; see Figure 5.4), nonetheless failed to reach conventional significance in this model ($p = .085$). Given the limited sample size, this result may be unsurprising and must be interpreted with caution. It is however worth noting that in a simpler, two-step model omitting expectations, this effect was estimated as $b = -1.48$ ($p = .046$, 95% CI [-2.93, -.03]). There are therefore some grounds for supposing that, in a larger (and more homogenous) sample, a reliable effect might be detected when controlling for expectations.

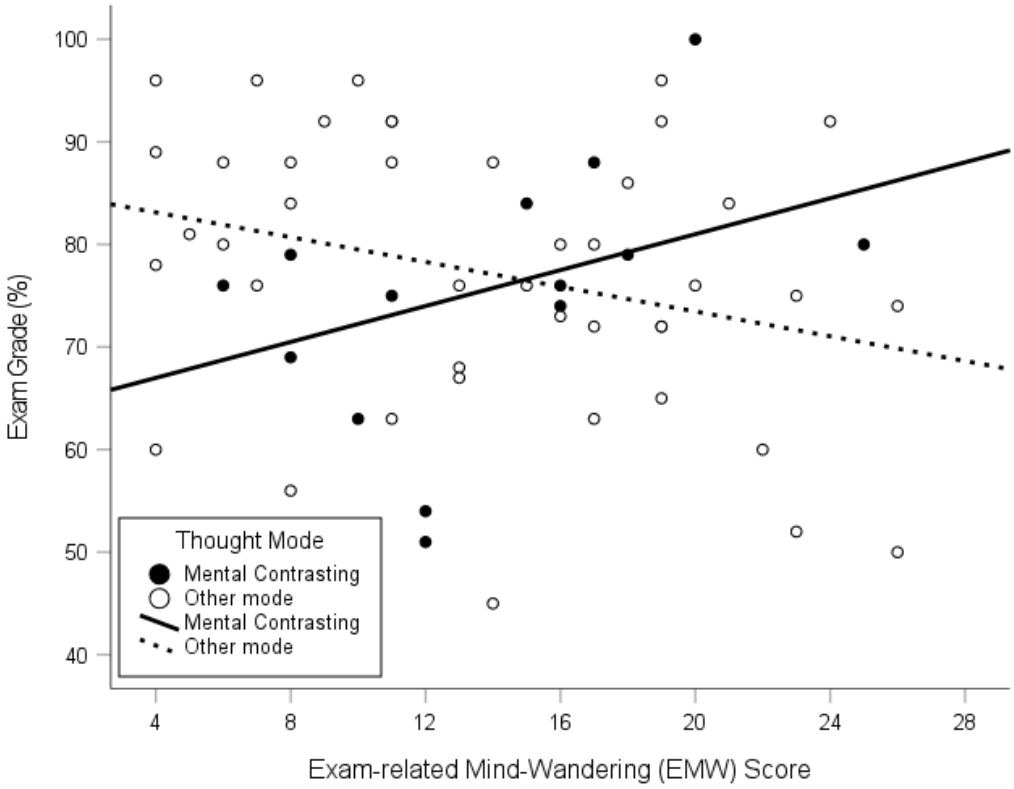


Figure 5.4. Relationships Between Exam Grade and EMW According to Binary SRT Mode.

Furthermore, using a median split to divide lower- and higher-EMW participants (median = 13.0, range 4–26), those who mentally contrasted achieved significantly higher grades if they mind-wandered relatively often about the exam (M_{diff} = 11.8%; one-tailed $t_{(14)} = 2.03$, $p = .032$, $d = 1.02$). The pattern was reversed, though non-significant, when comparing those using other SRT modes between high and low EMW groups (M_{diff} = -6.8%; $t_{(39)} = -1.65$, $p = .054$, $d = .51$). A corresponding 2 × 2 ANOVA showed no main effects of SRT (MC, other) or EMW group (low, high; Fs < 1, ps > .5) but a significant interaction ($F_{(1, 53)} = 6.00$, $p = .018$, $\eta^2_p = .102$). This pattern is displayed in Figure 5.5, corroborating the crossover in regression lines seen in Figure 5.4.

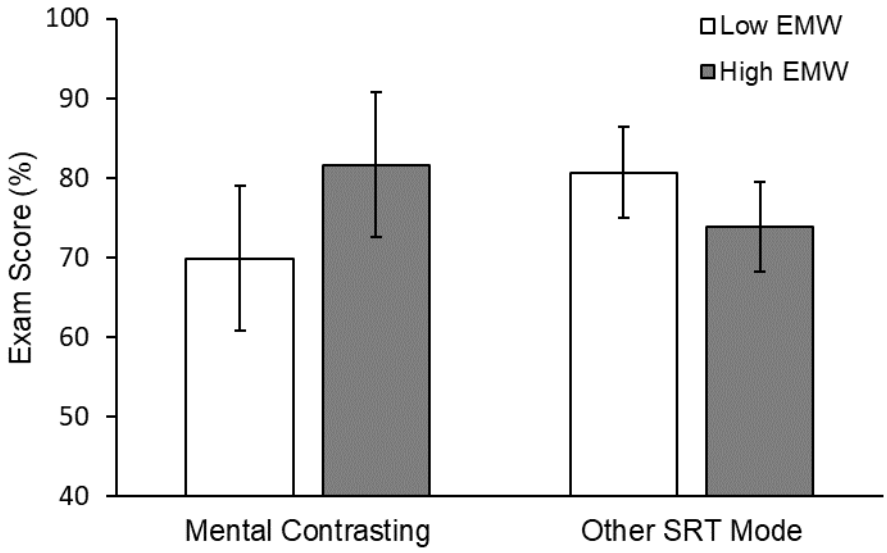


Figure 5.5. Mean Exam Score by Binary SRT Mode and EMW Group.

5.4. General Discussion

This chapter has synthesised evidence from mental simulation, mind-wandering and prospective memory research that certain forms of spontaneous thought can benefit goal pursuit, dependent on individual and contextual factors. The ultimate aim was to explore this possibility in an applied educational setting, examining performance on an authentic university assessment in relation to background patterns of thought and motivation (cf. Seli, Wammes, et al., 2016; Kane et al., 2021; Pereira et al., 2020). We sought to construct and evaluate a predictive model of how self-regulation (as in the theory of Oettingen, 2012; Oettingen & Sevincer, 2018) and spontaneous thought (Klinger et al., 2018; Cole & Kvavilashvili, 2021) might interact to determine performance in this context. It was hypothesised that the influence of spontaneous goal-related thought on exam performance would be moderated by SRT mode: Students adopting the adaptive strategy of mental contrasting (Sevincer & Oettingen, 2013) when describing their exam goal would derive particular benefit from the tendency to think spontaneously about the upcoming exam (see Oettingen & Schwörer, 2013).

Study 5, conducted in a sample of students seeking to obtain their driving licence, demonstrated that the tendency to experience spontaneous, goal-related thoughts during an irrelevant task can predict subsequent performance in a goal-relevant activity (in this case, a mock driving theory test). These findings raise further questions about the power of spontaneous anticipatory thought (cf. Laukkonen, 2022): Is simply *bringing to mind* an outstanding goal, at repeated intervals, enough to derive performance benefits? The literature on mental simulation and self-regulation, summarised early in this chapter, would suggest otherwise (e.g., outcome / process distinction; Pham & Taylor, 1999; Cole et al., 2021). This literature (see also Oettingen & Schwörer, 2013; Smallwood & Andrews-Hanna, 2013) generated the hypothesis, in Study 6, that the effect of goal-related spontaneous thoughts upon academic achievement (in an online exam some weeks afterward) would be moderated by self-regulatory thought (i.e., the way in which one views the goal). Specifically, mental contrasting, which entails consideration of both a desired outcome (e.g., achieving a grade over 70%) and prior obstacles (the challenges inherent in studying and managing one's emotions;

Pham & Taylor, 1999), should yield the greatest performance benefit of the four self-regulatory thought modes described by Oettingen (2000, 2012; Sevincer & Oettingen, 2013).

In preparation for this final study, a novel four-item measure was validated to capture individuals' propensity to experience spontaneous goal-related thoughts (based on the MW-S; Carriere et al., 2013). An online sample (n = 34) exhibited substantial positive correlations between scores on the new scale and real-time reporting of spontaneous, goal-related thoughts (see Appendix IV). This alone represents a potentially valuable contribution to the spontaneous thought literature, as the currently available scales focus on the occurrence (e.g., Carriere et al., 2013; Mrazek et al., 2013) and / or phenomenology (IAMI; Berntsen et al., 2015) of such experiences, rather than their potential functional value (see Duffy & Cole, 2020; Cole & Kvavilashvili, 2021).

5.4.1. Interpreting the findings of Study 6

In Study 6, all four SRT modes were represented to varying extents in students' descriptions ("elaborations") of their exam goals, consistent with Hypothesis 1 (section 5.3.1.2). In the combined sample (n = 57) of Year 1 and Year 2 students sitting comparable, percentile-graded online exams, 16 participants (i.e., 28%) exhibited mental contrasting. This proportion is in line with, or slightly in excess of, those reported in other studies that have elicited goal elaborations without providing specific instructions to adopt certain SRT modes (Sevincer & Oettingen, 2013; H. B. Kappes et al., 2011; Sevincer et al., 2017; Chapter 4). It was therefore possible to conduct a meaningful comparison of the motivational consequences of exam-related mind-wandering for mental contrasters (MC) versus those adopting other thought modes (Other), addressing Hypothesis 2 and this chapter's overarching objective (section 5.1.5).

As is typical in studies of goal pursuit (Deci & Ryan, 2000; Oettingen, 2012; Milyavskaya & Werner, 2018), expectations of success were the strongest predictor of exam attainment among the variables measured here. Nonetheless, a combined model including SRT mode (MC vs. Other) and exam-related mind-wandering (EMW) yielded suggestive evidence of an interaction between these two factors (p = .085). Furthermore, visualising the data in a scatter plot (Figure 5.4) indicated a

possible crossover, with the effect of EMW reversing direction depending on whether MC was adopted. When aggregating EMW scores into a dichotomous measure around the sample median, participants who used mental contrasting in describing their goal were at a clear advantage if their EMW score fell in the upper half of responses (mean grade = 81.6%) compared to the lower half (mean grade = 69.9%; difference = 11.8%). This was not the case for those using other thought modes (mean difference = -6.8%)[17]. In summary, despite similar sampling and power constraints to those in Study 5, results produced tentative evidence in support of Hypothesis 2: The functional benefit (or drawback) of frequently mind-wandering about an exam appears to vary as a function of one's automatic response when called to reflect upon it (Sevincer & Oettingen, 2013). We now discuss this key result in light of relevant literature, before proposing a theoretical model that distinguishes between *static* and *dynamic* aspects of anticipatory thought.

On a superficial level, the present results mirror those published by Pham and Taylor more than 20 years ago (Pham & Taylor, 1999), in that they emphasise how different ways of thinking about an academic goal are relevant to predicting achievement (Zimmerman, 2000; Lüftenegger et al., 2016; Oettingen et al., 2018). Pham and Taylor (1999) showed differences in student assessment performance as a function of the type of mental simulation employed, with process simulation (visualising the steps to success) yielding the highest grades. Furthermore, the intricate study design enabled them to identify causal pathways from mental simulation through to assessment performance (i.e., interim anxiety and planning measures acted as mediators). Yet, beyond assessing simulation frequency to check participants' compliance with instructions, the authors did not consider the role of ongoing cognitive dynamics over the intervening days in helping or hindering performance.

More recent literature has suggested that patterns of ongoing thought (for instance, the content of mind-wandering) might influence subsequent goal achievement in a positive direction (e.g., Smallwood & Andrews-Hanna, 2013). In a higher education context, Pereira et al. (2020) showed

[17] The latter test failed to reach significance despite the larger number of observations (n = 41 vs. n = 16), suggesting that the *positive* effect associated with mental contrasting may be more relevant to explaining the emerging interaction. Alternatively, it could simply reflect the greater heterogeneity of a group exhibiting three, rather than one, distinct SRT modes.

links between mind-wandering and retrospective assessment performance, with the direction depending on trait variables including executive control. Hence, rather than look at the mechanisms of performance benefits where they do occur (e.g., benefits of process simulation; Pham and Taylor, 1999), the present aim was to identify *boundary conditions* to the possible benefit of mind-wandering about an exam (see Hayes, 2015) using a complementary prospective design. Following up on Oettingen and Schwörer's (2013) suggestion that distinct self-regulatory thought (SRT) modes might manifest in the content of mind-wandering, thereby modulating its effect on goal pursuit, the investigation was framed around these two measures. The results, while tentative, therefore illuminate a different aspect of the relationship between anticipatory thought and academic performance than that examined by Pham and Taylor (1999).

As predicted, SRT mode alone did not influence exam grades in our study; instead, it appeared to *moderate* the influence of exam-related mind-wandering on subsequent performance (cf. Pereira et al., 2020). Among individuals adopting the mental contrasting formulation (Oettingen, 2000, 2012), mind-wandering exerted a positive impact; yet this relationship was reversed for those adopting other thought modes (see Figure 5.4). Hence, subject to further confirmation, results support the view that mind-wandering is not simply a help or a hindrance to academic achievement; its impact, as in other life domains, depends on underlying motivational factors (Smallwood & Andrews-Hanna, 2013; Poerio et al., 2013). In our design, SRT mode acted as a convenient classifier and proxy for what may in reality correspond to a range of antecedent factors. For instance, H. B. Kappes et al. (2011) showed that inducing negative mood increased the chances of unprompted mental contrasting through triggering a *problem-focussed* mindset. Though it is not certain that the same would hold true for students sitting an exam, mood is just one possible source of variation in goal setting / elaboration which might ultimately explain differential effects of mind-wandering across groups of individuals. Other underlying factors (e.g., trait variables; see Pereira et al., 2020) might also conceivably act as moderators; these can be collectively referred to as *antecedent states*. A distinction between such states, on the one hand, and the dynamic patterns of thought that follow in their wake, is inherent in

the design and results of Study 6 and forms the basis of the theoretical model introduced in the following section.

5.4.2. A static-dynamic model of spontaneous thought and goal pursuit

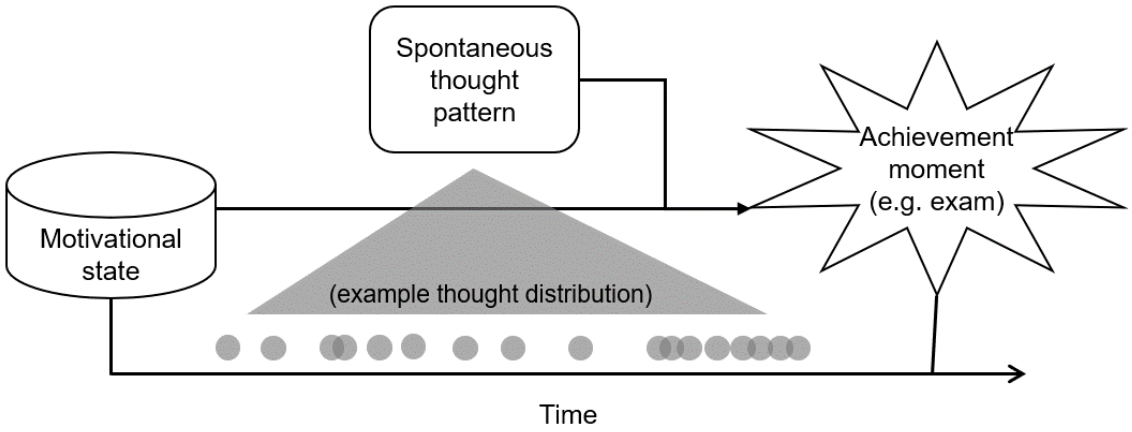


Figure 5.6. Proposed model with motivation and spontaneous thought co-predicting goal performance

Figure 5.6 displays the basic outline of a model connecting antecedent states ("motivational state"), ensuing patterns of spontaneous thought, and subsequent behaviour relative to a performance opportunity ("achievement moment"). The results of Study 5 lend direct empirical support to the dynamic (i.e., spontaneous thought) aspect of the model as they reflect the beneficial action of specific test-related thoughts captured in the window of time before a performance opportunity. Meanwhile, results from Study 6 provide evidence for the proposed interaction between antecedent states (e.g., mental contrasting) and ongoing thought (approximated with a self-report measure). The model is not concerned, at present, with the question of whether antecedent motivational states operate wholly or partly *through* the mechanisms of spontaneous thought (although the existence of such mediation effects is not ruled out); the intention is rather to illustrate the *joint influence* of motivational states and dynamic mental contents upon tangible goal performance, bearing out the empirical findings of this chapter.

To further validate the model, subsequent research should seek to sample spontaneous thoughts directly over a longer interval (e.g., through remote experience sampling; Hurlburt & Akhter,

2006; Ottaviani & Couyoumdjian, 2013; Laughland & Kvavilashvili, 2018). For example, a longitudinal design capturing students' assessment-related thoughts from the beginning to the end of a course module would be advantageous as it would represent the full extent of the time axis shown in Figure 5.6.

As in many cases where high-level psychological phenomena are under investigation, a complete account would probably entail the co-presence of moderation and mediation (i.e., *moderated mediation*; Hayes, 2015). This was considered at the planning stage of Study 6, but it was deemed unfeasible to run a study large enough for meaningful tests of such complex effects. Indeed, with the benefit of hindsight, it was challenging enough within the scope of a PhD project – constrained by remote learning and limited student attendance – to assemble a large enough sample for Study 6 in its current form (assessing moderation only).

Another aspect which the present model does not address is the influence of external factors on the occurrence of spontaneous thought. While the foregoing chapters have shown mixed support for the assumption that spontaneous future thoughts are largely cue-dependent, it is clearly not the case that such thoughts occur in a completely unpredictable fashion. For instance, goals are known to drive and constrain SFT (Cole & Berntsen, 2016; Klinger, 2013; Chapter 2). Similarly, contextual factors such as attentional demands and mood will likely affect its occurrence (Linz et al., 2019; Mazzoni, 2019; Robison & Unsworth, 2018). The central point of this model is that, whatever the extent, nature and precipitating factors of spontaneous anticipatory thought, their behavioural function with respect to achieving a given goal will be moderated by one's underlying outlook (captured in Study 6 by classifying SRT modes).

5.4.3. Implications for educators

As hinted in the introduction, this chapter set out from a position of scepticism regarding the negative view of spontaneous thought present in much of the mind-wandering literature. Accounts like Smallwood, Fishman, et al. (2007), Szpunar, Moulton et al. (2013) and Seli, Wammes, et al. (2016) warn of the potentially disruptive value of task-unrelated thoughts to processes of learning and

academic achievement; yet they all focus on cases where mind-wandering is measured during educational activities (e.g., lectures). Studies 5 and 6 reversed this focus by capturing (directly or indirectly) those instances of mind-wandering that occur outside the teaching and learning context. Thus, the learner drivers in Study 5 were asked to report their thoughts during a monotonous attentional task with no obvious benefit to test preparation or performance. Similarly, students undertaking cognitive psychology exams in Study 6 were asked about exam-related thoughts *occurring in their everyday lives*. We anticipated that the existing weight of evidence might be biased as a result of focussing upon learning contexts, and that our contrasting approach might therefore yield results supporting a more positive characterisation of mind-wandering in education.

The results were broadly consistent with our predictions, which justifies making the case that educators should view the possibility of student mind-wandering from a more balanced perspective than has thus far been endorsed in the literature. Of course, students voluntarily "tuning out" in lectures are an understandable source of frustration for those who teach them; yet the possibility that *spontaneous* thoughts might carry specific benefit for the pursuit of academic goals should not be overlooked. Mind-wandering has also been associated with creativity (Baird et al., 2012) and problem solving (Poerio et al., 2016; Smallwood et al., 2013) – so it might be advantageous for educators to incorporate periods of low-demand activity (such as structured lecture breaks) into their teaching sessions in order to capitalise on these potential positive effects. There is an argument that, given the ubiquity of mind-wandering (Killingsworth & Gilbert, 2010; Smallwood & Schooler, 2015), it is bound to occur to some degree in any large group of students ostensibly engaged in a learning activity. Perhaps educators should embrace this by creating conditions for functional mind-wandering, rather than viewing it as a uniformly negative phenomenon and seeking to reduce or eliminate it (cf. Szpunar, Moulton, et al., 2013).

The results of Study 6 more specifically implicate underlying self-regulatory factors, such as contrasting future success with present obstacles, in determining the help or hindrance posed by frequent (exam-related) mind-wandering. This points to different educational recommendations more closely aligned with conventional self-regulated learning research (Pintrich, 2000; Panadero, 2017;

Schunk & DiBenedetto, 2018). For instance, explicitly discussing the benefits of mental contrasting (or of process simulation; Pham & Taylor, 1999) at the outset of an academic module might both empower students to engage in effective, self-regulated learning (Schunk & DiBenedetto, 2018) and increase the chances that their undirected thoughts throughout the module will be beneficial to performance.

On a more theoretical level, the study of mind-wandering was originally inspired by the observation that humans do not have a "one-track mind": Cognition features a noisy interplay of fluctuating attentional states (Antrobus, 1968; Schooler et al., 2011; Smallwood, 2013). This is arguably analogous to the heterogeneity of everyday life – with its cycles of sleep and wake, work and play, to which students are no exception. Those engaged in facilitating students' learning in higher education should therefore remain mindful that the more a student's daily life can be made conducive to performing well, the better their academic outcomes. For example, if a lecturer can set things up so that a student goes away still thinking about the topic of their teaching, this may have far-reaching benefits regardless of whether they tuned out for a few moments at the time.

5.4.4. Limitations and future directions

The problem of limited sample size has already been acknowledged in relation to Study 5, and also applies to Study 6. The intention in the latter case was to recruit around 100 students, which would perhaps have been feasible if recruitment had taken place during conventional, in-person teaching sessions with higher attendance rates. Furthermore, while some effort was made to justify the aggregation of separate (Year 1 and Year 2) samples, it is acknowledged that this is unconventional and the noted difference in exam grades might indicate that the groups should be treated separately. The author intends to conduct further studies, with larger samples, to replicate and consolidate the present, tentative findings – an undertaking more feasible in the role of a qualified academic.

A second key limitation relates to the measures used. Study 6 collapsed the dynamic aspect of spontaneous thought (per Figure 5.6) into a static scale, which despite its practical advantages is inevitably reductionistic. Hence, one cannot ascertain if students' ongoing spontaneous thoughts

continued to reflect the frequency estimates on the scale through the crucial subsequent period of exam preparation. Precipitating factors on the occurrence of such thoughts, as discussed in section 5.4.2, also remain opaque. Nonetheless, the broad agreement between Studies 5 and 6 – that certain types of anticipatory thought benefit subsequent test performance – mitigates against the severity of this limitation. As mentioned above, a study capable of capturing thought dynamics in a more comprehensive way (e.g., through longitudinal experience sampling) would be able to resolve some of these unanswered questions. It would also be particularly helpful to ascertain the effect of different thought patterns upon behavioural preparation (e.g., studying), for instance by collecting a second, retrospective set of self-report data shortly before the performance opportunity (as per Pham & Taylor, 1999).

Finally, relying on observation (as opposed to experimentation) has the unfortunate consequence that one cannot draw strong causal conclusions about the relationships between the observed variables. The use of prospective designs enables us to rule out certain possibilities: It is implausible, for example, that test performance exerted a causal effect on thoughts occurring (weeks) earlier in time. Yet the variables treated as predictors in both studies – assumed to "influence" outcomes – might in reality only be correlated, carrying no causal potency (see Laukkonen et al., 2022). Like the issue of sample size, these studies were designed in full view of the limitations of such an approach; alternatives involving random allocation to experimental groups were considered unethical in that our actions might unfairly prejudice life outcomes such as learning to drive (Study 5) and official university assessments (Study 6). Subsequent investigations in this area – like extant studies of self-regulatory interventions (Duckworth et al., 2011; Hagger et al., 2016) – would have to persuade the relevant parties that the potential value of a strong causal test outweighed such drawbacks. One possible strategy would be to devise a design whereby participants in the potentially disadvantaged group(s) could later be compensated, for instance with course credit or through access to additional support on a subsequent assessment.

5.4.5. Summary and conclusions

This chapter examined the possibility that spontaneous thought might benefit goal pursuit in an educational context, through two complementary empirical studies. Study 5 captured task-unrelated thoughts in real time shortly before a quantifiable performance opportunity relevant to the goal of learning to drive (mock driving theory test). Participants who experienced frequent spontaneous and / or test-relevant thoughts outperformed others on the test, supporting the proposition that certain forms of anticipatory thought can benefit subsequent achievement (Smallwood & Andrews-Hanna, 2013; Andrews-Hanna et al., 2013).

Study 6 expanded on these findings in the context of an authentic university assessment, testing the hypothesis that students' self-regulatory outlook should moderate the effects of spontaneous thought (Oettingen & Schwörer, 2013; Pereira et al., 2020). As anticipated, students who mentally contrasted success in an upcoming exam with the obstacles that must be overcome tended to benefit from frequent exam-related thoughts, whereas others did not (although regression analyses were subject to power constraints and therefore inconclusive). The findings of both studies have been synthesised in support of a new theoretical model which begins to formalise relationships between antecedent states, dynamic patterns of anticipatory thought, and goal achievement. Results also support certain recommendations for higher education professionals, pushing against the generalised assumption that mind-wandering is detrimental to student learning (Szpunar, Moulton, et al., 2013; Seli, Wammes, et al., 2016; Kane et al., 2021).

Chapter 6. General Discussion and Summary of Contributions

6.1. Preliminary summary of empirical chapters

This section summarises the key findings and conclusions of Chapters 2–5, clarifying the relevance of each empirical study to understanding SFT. This provides a starting point for the subsequent discussion of theoretical implications and future research directions (sections 6.2–6.4). Table 6.1 complements this by giving a condensed overview of research questions addressed; answers provided by the presented data; and further implications / future research directions raised in each chapter.

Table 6.1. Summary of Research Questions, Answers and Future Directions from the Present Thesis

Chapter Title	Main Research Questions	Answers Provided	Further Implications / Future Directions
Chapter 2: What's in a cue? Influences of cue type on the occurrence and characteristics of SFTs	1. How does changing verbal cue content impact the occurrence and characteristics of SFTs? 2. What can this tell us about the underlying mechanisms of SFT?	1. Mixed results regarding occurrence; goal-cued thoughts show flattened temporal distribution and more negative valence (Study 1) 2. Environmental cues may take effect through cumulative priming / chaining, in addition to direct associative triggering	• Future work (include applied studies) should assume that SFTs will occur both with and without cues; and cues are unlikely to operate independently, in a one-to-one manner. • Dual-task thought sampling may be difficult to replicate online due to discrepant attentional dynamics (but see online validation study; Appendix IV).
Chapter 3: The genesis and reoccurrence of spontaneous future thoughts: An experimental test of the 'memories of the future' hypothesis	1. Are voluntary future event constructions spontaneously re-accessed in a subsequent task? 2. How do the findings relate to Cole & Kvavilashvili's (2021) dual process model?	1. Yes: Future constructions more often spontaneously re-accessed than controls, but not cue-specific 2. Findings provide direct support for the dual process model, confirming V → S temporal link	• Future work could replicate voluntary-spontaneous paradigm with variations on event encoding, e.g., tailoring cues to personal goals (cf. McVay & Kane, 2013) or using different event components (Levine et al., 2002; Dijkstra & Misirlisoy, 2006)
Chapter 4: Self-regulatory thought and goal pursuit: Insights from a naturalistic study during COVID-19	1. Do self-regulatory thought (SRT) mechanisms operate differently for uncontrollable goals? 2. Can the unprompted SRT paradigm be applied to understanding the functional value of SFT?	1. Yes: Different SRT modes emerge (e.g., low subjective control promotes dwelling) and mental contrasting appears ineffective in context of low control 2. Yes, provided target goals are selected which exhibit sufficient (subjective) control	• Self-regulation research should address goal controllability (e.g., in the case of continuous coping goals; Armor & Taylor, 1998; Folkman & Moskowitz, 2000). • Objective performance is preferable to proxy measures (e.g., commitment) in seeking to show functional effects of SFT.
Chapter 5: Contributions of spontaneous thought to performance in higher education	1. Does the frequency / content of SFTs predict performance in an upcoming knowledge test? 2. How does a novel measure of *goal-directed spontaneous thought* relate to performance on a subsequent online exam?	1. Yes, tentatively: Frequent spontaneous thoughts / test-related thoughts are beneficial but direct evidence of *SFTs* lacking (Study 5) 2. Exam-related spontaneous thoughts, in context of unprompted mental contrasting, are beneficial (Study 6)	• These studies open the door to more concerted research efforts looking at the predictive value of SFT in education. • Some nuanced recommendations for educators were made regarding how mind-wandering should be viewed in a higher education setting.

6.1.1. Chapter 2: What's in a cue?

Chapter 2 presented two experiments (Studies 1 and 2) investigating the mechanisms by which SFTs enter consciousness (i.e., what might be termed the "how" question). Manipulating cue content in a commonly used laboratory vigilance task (Schlagman & Kvavilashvili, 2008; Cole et al., 2016; Plimpton et al., 2015; Vannucci et al., 2017), these studies aimed to establish whether cues specifically targeting future autobiographical representations would increase SFT frequency and / or the prevalence of *goal-related* SFTs. Study 1, conducted in conventional lab conditions, found partial support for these hypotheses: Life-goal cues referencing aspirations like obtaining a secure career (Weinstein, 1980) yielded more SFTs than standard cues, balanced for valence (Schlagman & Kvavilashvili, 2008). However, this effect was equivalent for cue-triggered thoughts and those with no external trigger, prompting reconsideration of the basic mechanism(s) by which environmental cues are assumed to operate (Berntsen et al., 2013; Berntsen, 2019). It was theorised that repeated exposure to a set of cues may produce *cumulative long-term priming* (Mace et al., 2019; Mace & Unlu, 2020) or *chaining* effects (Demblon & D'Argembeau, 2014; Mace, 2009). Moreover, changing cue content did not affect the extent to which SFTs reflected participants' current goals, despite the expectation that goal cues would selectively activate future autobiographical representations (Markus & Nurius, 1986; Conway et al., 2019).

Study 2 attempted to replicate findings in a more highly powered sample, using a simplified online design. A contrasting pattern of results was found here (no overall increase in SFTs; tentative evidence of an increase in goal-related SFTs). Analysis of SFT data in relation to primary task performance (i.e., at detecting attentional targets) suggested that well-known limitations of conducting cognitive research online (e.g., poor participant engagement; Chmielewski & Kucker, 2020) might have been particularly detrimental to Study 2. This relates to the dual-task nature of the paradigm, which requires the division of attentional resources even when conducted under highly controlled conditions (Rummel et al., 2017; Rummel & Boywitt, 2014). In spite of the differences between lab and online results, Chapter 2 produced some useful insights – particularly in the implication that they might not be triggered according to the same associative principles known to operate for involuntary

memory (Berntsen et al., 2013; see Chapter 2, section 2.1). This aspect receives particular attention in the following synthesis of empirical findings relating to the cognitive mechanisms of SFT (section 6.2).

6.1.2. Chapter 3: Spontaneous memories of the future

Chapter 3 combined the methods of voluntary episodic construction (Addis et al., 2007; Schacter et al., 2012) and involuntary / spontaneous thought (Cole et al., 2016; Cole & Kvavilashvili, 2021) to test a theoretically motivated question that was present yet unanswered in the literature: the plausibility of "memories of the future" (MoFs). MoFs may be defined as pre-existing mnemonic representations of future events which are retrieved at a later point (Jeunehomme & D'Argembeau, 2017; Szpunar, Addis, et al., 2013); spontaneous MoFs are those that are retrieved without intention. Results confirmed that spontaneous thoughts captured in a (probe-caught) vigilance task are more likely to bear thematic relations with previously imagined *future* events than those which are neither personal nor future-oriented in nature, consistent with the notion that voluntary future thoughts remain highly accessible to subsequent retrieval (i.e., memories of the future *do exist*). These findings, like the hybrid paradigm from which they emerged, are highly novel and provide direct support for Cole and Kvavilashvili's (2021) theory. In particular, they clearly demonstrate the existence of a temporal link between voluntary and spontaneous forms of future thought – occurring in real time between the two phases of the experiment.

Contrary to our exact predictions, reoccurring future events were detected for both familiar cues (e.g., "Bus stop", around which a future event had been constructed) and unfamiliar cues (e.g., "Museum", unseen in the construction task). This suggests that pre-encoded future event representations are liable to return to consciousness irrespective of the presence of specific environmental cues, revealing common ground with the results of Studies 1 and 2 and motivating broader theoretical conclusions on the cognitive mechanisms of SFT occurrence (section 6.2).

6.1.3. Chapter 4: Self-regulation and subjective control

In Chapter 4, the thesis shifted from laboratory-based scrutiny of cognitive mechanisms towards considering the wider self-regulatory context in which SFT is enmeshed (Kvavilashvili & Rummel, 2020; Duffy & Cole, 2020). Before attempting to demonstrate the functional benefits of SFT (Chapter 5), an enterprise which must inevitably address this broader, naturalistic context, Study 4 adopted the contrasting perspective and methods of *unprompted self-regulatory thought* (Sevincer & Oettingen, 2013; Sevincer et al., 2017). This paradigm offered the scope to look in detail at the idiographic goal representations (cf. Emmons, 1986, 1996) which must, in principle, underlie future thinking as it is naturally manifested (see D'Argembeau, 2020; Kvavilashvili & Rummel, 2020). Cognitive research, largely focussing on the mechanisms through which individual future thoughts are produced, has rarely addressed this aspect (but see e.g., Ernst et al., 2018).

Study 4 employed a pseudo-experimental design to elicit detailed information on goals *related* and *unrelated* to the current COVID-19 pandemic. The pandemic was expected to have a pronounced influence on people's goal pursuits, creating new challenges like managing isolation as well as hampering the pursuit of existing goals (Kokkoris & Stavrova, 2021; Ritchie et al., 2021). Furthermore, COVID-related goals were expected to exhibit lower ratings of controllability – which should influence both the form and function of self-regulatory thought within individuals. These hypotheses were supported in analyses showing that A) COVID-related (and less controllable) goals were more likely to produce present-focussed, dwelling responses, and unrelated (more controllable) goals, future-focussed, indulging responses; and B) mental contrasting of desired future with present reality only yielded a motivational benefit for COVID-unrelated goals (cf. Oettingen, 2012; Sevincer & Oettingen, 2013). Findings were interpreted in relation to the fundamental difference in controllability observed between goal types, highlighting subjective control as an important but often overlooked factor in self-regulation research (Rothbaum et al., 1982; Thurber & Weisz, 1997).

Chapter 4 not only provided a helpful link to a field until now largely unconnected with cognitive research on future thinking (see section 4.1.1); it also helped to shape the applied investigation of spontaneous thought patterns undertaken in Chapter 5. Studies seeking to quantify the

effects of anticipatory thought on goal achievement (relative to underlying motivational factors) are most likely to meet with success where they can identify a target goal that is sufficiently controllable for self-regulatory strategies to be effective in the first place (e.g., Pham & Taylor, 1999).

6.1.4. Chapter 5: Spontaneous thought and academic performance

Chapter 5 built upon the theoretical and methodological foundations of the earlier chapters to arrive at a three-step plan for assessing the potential value of SFT to students sitting a university exam (i.e., a context exhibiting a predefined interval leading up to a performance opportunity; see Figure 5.6). The first step was to determine if predictive relationships could be observed between thought parameters captured in the vigilance task (as in Chapters 2 and 3) and subsequent performance on a simple knowledge test; this objective was fulfilled in a small sample of students holding the current goal to pass the UK driving theory test. Results showed positive effects both of spontaneous thinking in general, and the rate of test-related thoughts, during the interval immediately before the test was taken. These findings are consistent both with existing evidence of automatic mental preparation before a performance opportunity (Morsella et al., 2010) and with the theoretical proposition that mind-wandering (which typically shows a prospective bias, or focus on the future; Baird et al., 2011) can aid in goal pursuit by facilitating the creation and rehearsal of plans (Smallwood & Andrews-Hanna, 2013).

Having thus laid the ground for a more ecologically meaningful study examining university assessment performance as an outcome measure, the critical second step was to evidence the validity of a novel questionnaire measure approximating real-time goal-related SFT frequency. This objective was fulfilled by conducting a separate online study (see Appendix IV), which found the new scale to have strong internal consistency ($\alpha = .80$) and exhibit a robust positive correlation with real-time reporting of goal-related spontaneous thoughts (in the vigilance task; $r = .44$). The new measure was then used in Study 6 to mitigate against the problem of high variability in thought sampling data (Spronken et al., 2016; Zanesco et al., 2020), while also reducing participant burden.

The final design of Study 6 combined insights from Chapter 4 and from the driving theory test data (Study 5). A predictive model was constructed to examine whether spontaneous thought would hold benefits for exam performance (cf. Pham & Taylor, 1999; Pereira et al., 2020) contingent upon the motivational context in which it occurred (Oettingen & Schwörer, 2013; Poerio et al., 2013; Smallwood & Andrews-Hanna, 2013; Welz et al., 2018). While multivariate results were inconclusive (the anticipated effect being numerically present but failing to reach significance), simpler factorial analysis provided basic support for the notion that high exam-related mind-wandering precedes high performance only under specific conditions: Participants who viewed their achievement goal through the lens of mental contrasting (i.e., reflecting on both the desired outcome and present obstacles; Oettingen, 2000, 2012) displayed a benefit of frequent anticipatory thoughts of the exam, whereas others did not (and, numerically, achieved *lower* grades as tendency towards exam-related mind-wandering increased). Subject to replication in a larger sample, Study 6 promises to make an important contribution to the applied literature on mind-wandering in educational contexts (e.g., Seli et al., 2016; Szpunar, Moulton, et al., 2013; Unsworth & McMillan, 2017) because it emphasises that goal-related spontaneous thoughts occurring during students' everyday experience can, under certain motivational conditions, benefit their subsequent level of attainment (cf. Pereira et al., 2020; Smallwood & Andrews-Hanna, 2013; Welz et al., 2018).

Having summarised in turn the key findings and potential contributions of each chapter, the full range of evidence will now be examined more synoptically in view of the two foundational elements of the thesis' title: cognitive mechanisms and goal-directed functions.

6.2. Strand one: Cognitive mechanisms of SFT

Berntsen (2019) published a review of literature from different fields and approaches (involuntary autobiographical thought; mind-wandering; intrusive thought), drawing conclusions about spontaneous future cognition as a general concept and making suggestions for future research. Berntsen's (2019) theoretical assumptions and arguments hence represent current understanding of SFT at the point when the research in this thesis was initiated (i.e., 2018–19). Perhaps unsurprisingly,

as a leading light in the study of involuntary autobiographical memory (Berntsen, 1996, 1998; Berntsen & Hall, 2004), her key arguments coalesce around the idea of spontaneous future thoughts as a future-oriented analogue of IAM. For instance, Berntsen (2019) affirms that SFTs, like IAMs of past events, "…typically have cues in the ongoing situation" (p. 12[18]), citing an example in which the content of a (diary-method) thought report and the situation in which it was recorded show clear thematic similarity (i.e., *associative overlap*; Berntsen, 2010; Berntsen et al., 2013). In characterising representational *differences* between SFTs and IAMs, she asserts that SFTs "…have not yet been encountered and encoded…" (Berntsen, 2019, p. 18), amounting to a strong claim about the ultimately non-mnemonic nature of future thinking (cf. Perrin, 2016). The paper hence presents a pertinent reference point against which to evaluate the general pattern of findings from Studies 1–3 of the present thesis.

6.2.1. Cue specificity and continuity between past and future representations

Fundamentally, Chapter 2 set out to address the question of cue specificity with respect to SFT: *How important is the content of the cue?* As summarised above (section 6.1.1), Studies 1 and 2 produced mixed results in this regard, while Study 3 found a clear null result for the effect of a different cue manipulation. The overall pattern of these results ultimately favours the view that SFTs do not exhibit cue specificity in the same sense, or to the same degree, as involuntary memories (Berntsen et al., 2013). To be clear, the question is not whether such mental experiences are sensitive to cues altogether; SFTs, like IAMs, have repeatedly been shown to occur with and without external triggers (e.g., Berntsen & Jacobsen, 2008; Cole et al., 2016; Plimpton et al., 2015). It is rather a question of the *specificity* aspect: Whereas one can reasonably claim that the occurrence of IAMs is favoured by (if not always dependent on) the presence of triggers bearing semantic overlap with memory contents (Berntsen, 1996; Mace, 2004; Berntsen et al., 2013), the present data do not readily support this claim in relation to SFT.

[18] N.B. Page references from Berntsen (2019) are based on the openly available version of the paper accessible via Aarhus University's institutional repository at: https://pure.au.dk/ws/files/142702439/Spontaneous_future_cognitions_Accepted_manuscript_2018.pdf.

Study 3 confirmed that voluntarily constructed future events can readily be accessed without intention at a subsequent time (hence, in principle at least, SFTs might be *encoded and stored* like autobiographical memories, *contra* Berntsen, 2019). Yet the results also indicated that future scenarios were re-accessed just as frequently in response to cues which were *not* intrinsically linked with scenario content (i.e., an unseen location cue, as opposed to the location around which the scenario was constructed). If these representations are indeed encoded and stored in the same manner as veridical life experiences (i.e., the raw material of autobiographical memories; Mace, 2019), how can this be reconciled with their apparent insensitivity to specific associative cues (cf. Mace, 2004; Berntsen, 2010; Berntsen et al., 2013)?

A resolution may be found in the debate surrounding continuity between past- and future-oriented mental time travel (e.g., Tulving, 1985; Suddendorf, 2010; Klein, 2016; Perrin, 2016; Michaelian, 2016; Addis, 2018). While the evidence of psychological and neurocognitive similarities abounds between these two classes of mental experience (Schacter & Addis, 2007; Addis et al., 2007; Schacter et al., 2012), philosophers advocating the *discontinuist* position have made penetrating arguments that they should still be treated as distinct phenomena (e.g., Perrin, 2016)[19]. Such arguments rest on the epistemological claim that the future is, by definition, undetermined at any given point in time; hence one cannot know it in the same sense as knowing of veridical past events. A pre-constructed SFT might "feel" like an IAM in the sense of possessing similar phenomenological qualities (e.g., sense of autonoesis; Tulving, 1985; Johnson et al., 1988; see also differences reported by Cole et al., 2016); yet one is nonetheless aware that it reflects a *possible* future event rather than a *veridical* past one[20]. Invoking this argument therefore helps to clarify the findings of Studies 1–3 – that the cueing mechanisms governing the retrieval of IAMs do not straightforwardly apply to SFTs despite the latter exhibiting key mnemonic properties (Roediger et al., 2007).

[19] Importantly, this type of argument does not preclude the involvement of mnemonic processes like encoding, consolidation and forgetting (see Roediger et al., 2007) in future event representation. Indeed, Perrin (2016) acknowledges and discusses the wealth of evidence for neurocognitive processes common to past and future thinking (Schacter et al., 2012), while reinforcing the *ontological* dissimilarity between the two.

[20] We acknowledge that this requires the assumption that the temporal information associated with an event representation will adhere to it and hence be retrieved if and when the event is later retrieved (cf. Rubin & Umanath, 2015; Rubin, 2019).

6.2.2. Alternate explanations for the emergence of SFTs

How, then, might the cognitive mechanisms underlying SFT differ from those governing IAMs? Two recently developed concepts from the memory literature, touched upon in Chapter 2, can provide relevant insight here: Mace et al.'s *semantic-to-autobiographical priming* (Mace et al., 2019; Mace & Unlu, 2020) and Renoult et al.'s *personal semantics* (Renoult et al., 2012; S. Sheldon et al., 2020).

Firstly, Mace et al. (2019) showed that processing generic word stimuli (e.g., "summer") facilitated the occurrence of voluntary and also *involuntary* personal memories (i.e., IAMs) related to the primed concepts. On the basis of this evidence, Mace and Unlu (2020) presented a theory of long-term memory processes in which priming by different types of environmental information occurs ubiquitously during waking life, influencing autobiographical memory retrieval via both voluntary and involuntary mechanisms (Mace, 2004; Berntsen, 2010).

Importantly, this theory explains the occurrence of untriggered IAMs (Berntsen & Hall, 2004; Berntsen & Jacobsen, 2008), in that the continuous, low-level activation of autobiographical memories (i.e., *cumulative long-term priming*; Mace & Unlu, 2020) would result in some memories surpassing the awareness threshold and being reported in the absence of a single, identifiable trigger (cf. Tulving's concept of *synergistic ecphory*; Tulving, 1985). Given that untriggered SFTs are relatively more prevalent than untriggered IAMs (Cole et al., 2016; Plimpton et al., 2015), one might speculate that such continuous, low-level priming plays an even more significant role in the emergence of SFTs (as suggested in Chapter 2). The possible objection that priming could only operate on *stored long-term representations* – sometimes seen as contentious in the case of future events (see Berntsen, 2019) – is dismissed by the positive evidence of spontaneous memories of the future provided by Study 3.

A second relevant concept from the recent memory literature is the theory presented by Renoult et al. (2012). This account views long-term memory contents along on a continuum of abstraction – with concrete, episodically specific events (i.e., episodic memories; Tulving, 1972) at

one extreme; maximally abstract, semantic material at the other; and *hybrid* representations in the centre. Two experiments assessing retrieval speed of autobiographical memories after priming provided further support for this view (S. Sheldon et al., 2020). Sheldon and colleagues (2020) primed participants with "personal semantic facts" (non-episodic information personal to the individual, e.g., personal traits or repeated event descriptions) and found that bringing such information to mind facilitated voluntary recall of specific episodic memories, reducing retrieval time relative to a control task using generic semantic facts as primes. This is reminiscent of the facilitation occurring when participants process personal goals – which could be construed as future-oriented "personal semantic" representations – in voluntary and spontaneous future thinking (D'Argembeau & Mathy, 2011; Jordão et al., 2019; Lehner & D'Argembeau, 2016; Stawarczyk et al., 2011).

To the extent that future events are never fully determined, always uncertain and always hypothetical (Perrin, 2016), one might expect the connections between non-episodic information about the future (e.g., goals, self-images, future life periods; Conway et al., 2019; Markus & Nurius, 1986) and episodic representations of possible future events to be more flexible than those that exist for past events. In the involuntary mode, then, IAMs may be triggered through specific links from a cue to the intrinsic content of a past event (i.e., details bound together at the moment of encoding; Craik, 2007; Berntsen et al., 2013); while SFTs might be more generally sensitive to any stimulus bearing some minimal level of semantic association with the target event (see Mace et al., 2019). This would both explain the higher incidence of SFTs for which *no environmental trigger* is identified (Vannucci et al., 2017; Plimpton et al., 2015; Cole et al., 2016) and predict that SFTs should show a more *diffuse* susceptibility to environmental triggers – with looser specificity and distinctiveness constraints than those operating for IAMs (Berntsen et al., 2013; Mazzoni et al., 2014). Arguably, this is closely reflected in the results of the present Studies 1–3.

An example will serve to illustrate this greater flexibility proposed to operate in the environmental triggering of SFT. One might, for instance, spontaneously visualise an upcoming beach trip in response to hearing the word *jellyfish*, regardless of whether one really expects to encounter a jellyfish (an unlikely but possible occurrence on a British beach). Although the concept *jellyfish* was

not strongly associated with one's plan to visit the beach (or indeed, any pre-encoded event representations) beforehand, the open-ended nature of future events (Perrin, 2016; Baumeister et al., 2018), along with the semantic association of sea creatures with coastal locations, enables a *new associative link* to be made in the presence of the cue. On future occasions (repetition apparently being the norm for such thoughts; Cole et al., 2016; cf. Jeunehomme & D'Argembeau, 2016), one's vision of the beach may be susceptible to triggering by a wider (or simply an altered) range of stimuli. After experiencing the imagined event repeatedly in the presence of the *jellyfish* cue, the associative connection between *jellyfish* and an anticipated beach trip would be strengthened in the manner of classical conditioning (Pavlov, 1927; Rescorla & Wagner, 1972), thereby altering future responses to the same or similar cues and increasing the likelihood of SFT reoccurrence.

6.2.3. Viewing goals as primary

The preceding argument is reinforced by the observation that future-oriented representations are in general highly accessible to awareness (including those that are not necessarily episodic in form, e.g., intentions; Freeman & Ellis, 2003). In particular, Berntsen (2019) picks up Klinger's long-running contention that *goals*, while one is committed to them, are chronically accessible and exert a broad influence on both the contents of conscious thought and the focussing of attention (Klinger, 1975, 1977, 1999, 2013). Berntsen (2019) hints that this may be a point of dissimilarity between past and future involuntary thought, alluding to the possibility that "momentary cues… [might] *interact* with more prolonged current concerns and goals of the individual" in the production of SFTs (p. 30, emphasis added). In other words, alongside sensitivity to a wider range of potential cues as outlined above, the way in which given stimuli are attended to, processed and interpreted is likely to differ according to an individual's current goals (Vogt et al., 2011). This argues for a shift in emphasis, with the influence of environmental cues on SFT viewed as secondary to – and dependent upon – underlying goal representations (see Klinger et al., 2018; Kvavilashvili & Rummel, 2020).

Viewed in this light, Chapter 2 examined whether, through a change in cue content, one could achieve a better "fit" or "match" to people's underlying goal representations (Markus & Nurius, 1986; D'Argembeau, 2016; Conway et al., 2019), thereby triggering more SFTs in the wake of enhanced

goal activation. Yet the reality – for a cognitive system characterised by flexibility in the behavioural outcomes it appraises and pursues (Markman & Brendl, 2000) – is that goals vary dynamically and are susceptible to being updated by incoming information (e.g., fluctuating self-images collectively forming the "working self-concept"; Markus & Nurius, 1986; Oyserman et al., 2006). Thus, the experimental paradigm used in Studies 1 and 2 – rooted in a method designed to trigger IAMs using verbal cues (Schlagman & Kvavilashvili, 2008) – struggled to do justice to the central role of goals in determining and constraining the emergence of SFTs.

The foregoing discussion recommends a subtle change of approach in studying the phenomenon of SFT. Rather than structure our understanding primarily around the role of environmental cues in evoking particular mental representations (Berntsen, 2019), this thesis demonstrates that researchers should focus on particular, objectively verifiable goals to which an individual is committed as an anchor for studying related spontaneous thoughts. It is in this direction which we now turn: considering this thesis' contribution to elucidating SFT as a functional capacity.

6.3. Strand two: Goal-directed functions of SFT

As noted in section 6.1.3, Chapter 4 represents a turning point in the thesis – a shift from laboratory work on the cognitive mechanisms of SFT, towards applied work looking at its functions or consequences. Underlying this shift is the contention that research focussing only on the cognitive basis of SFT takes place in a vacuum, never able to observe or evaluate the referenced future events as they unfold (or fail to materialise). To determine whether, and under what circumstances, future thinking may be adaptive, researchers also need to look prospectively at processes of self-regulation and goal performance unfolding through time (cf. Pham & Taylor, 1999). Studies 5 and 6 arguably represent the greatest potential contribution to the literature of the studies in this thesis, as they have been able to examine SFT as a functional capacity in this way, with reference to concrete performance goals faced by a group of students.

6.3.1. Interplay of spontaneous and voluntary goal-related thinking

By taking this bold step away from the research tradition which originally identified SFT as an object of study (Cole & Berntsen, 2016; Cole & Kvavilashvili, 2019, 2021), Studies 4–6 were able to shed empirical light on what had previously been speculative links between spontaneous thought and goal pursuit (Smallwood & Andrews-Hanna, 2013; Cole & Berntsen, 2016; Klinger et al., 2018). More developed ideas around the role of (voluntary) future thinking in adaptive behaviour (Jing et al., 2016, 2017; McLelland et al., 2015) have thereby gained a counterpart in the present findings on thoughts experienced in the spontaneous mode (Cole & Kvavilashvili, 2021).

Indeed, the results of Study 3 presented the voluntary and spontaneous modes as two temporally and ontologically linked processes, whose differences and commonalities may be more effectively investigated in paradigms which allow for the occurrence of both (cf. Jeunehomme & D'Argembeau, 2016; Cole & Berntsen, 2016). Although the present findings do not directly endorse the view that involuntary and voluntary retrieval modes differ *only* in the degree of constructive / generative processing involved (Berntsen & Nielsen, 2021; Rubin, 2019), they are compatible with an account based on differences of degree (i.e., of effort, intention, meta-awareness; see Moors & De Houwer, 2006; Schooler et al., 2011). In any case, when investigating the *functions* of future thinking it seems prudent to expect that both the form of one's deliberate thoughts (cf. SRT modes; Oettingen, 2012) and the frequency / form of one's spontaneous thoughts (Oettingen & Schwörer, 2013; Smallwood & Andrews-Hanna, 2013) might be relevant for self-regulation and performance[21].

In this connection, the findings of Study 6 are compatible with the possibility that the content of ongoing thought might include *respondent segments* (Klinger, 1977)[22] that exhibit distinct self-

[21] For instance, Pham and Taylor (1999) showed that the assigned form of mental simulation (outcome, process, both, or control) influenced assessment outcomes through the action of two mediators (planning and management of anxiety). This thesis supports the view that spontaneous thoughts – their content moderated by the form of deliberate mental simulation – are likely to have played an undetected role in this causal chain.

[22] Klinger (1977) distinguishes between three types of "thought segment", or momentary mental content, occurring in the stream of consciousness (cf. James, 1890/1950): *operant* segments relate to the fulfilment of current task demands; *respondent* segments reflect disengagement from task processes and may hence include mind-wandering (cf. Schooler et al., 2011). Both are distinguished from *mind blanks*, where one has the subjective impression that no thoughts are present (Klinger, 1977).

regulatory modes such as those described by fantasy realisation theory (Oettingen, 2000, 2012). This, again, had previously been a speculative theoretical idea (Oettingen & Schwörer, 2013) receiving little attention from empirical research. The findings of Study 6, showing spontaneous mind-wandering (captured through a retrospective summary measure; Carriere et al., 2013; Seli et al., 2015) to be differentially related to performance depending on SRT mode, lent empirical support to this idea for the first time.

6.3.2. Towards a multi-faceted view of SFT

The logical next step – to directly identify self-regulatory mechanisms among real-time spontaneous thought data – could be achieved by re-examining the qualitative thought descriptions generated by Studies 1–3, Study 5 and the online validation study (Appendix IV) through the lens of Sevincer and Oettingen's (2013) coding scheme. Previous studies that have classified (or instructed participants themselves to classify; Mazzoni, 2019) spontaneous thought data converge on the conclusion that future representations can, at least, be divided into those resembling *plans* (i.e., referencing steps to achieving a goal) and those resembling mere *hypothetical scenarios* (Mazzoni, 2019; Plimpton et al., 2015; Warden et al., 2019). Furthermore, one recent study conducted by researchers in the field of self-regulation revealed that *planning* thoughts – that combine time frames (e.g., future and present) analogously to mental contrasting – occur regularly in the contents of everyday conscious thought (Baumeister et al., 2020). As acknowledged in Chapter 1, these authors did not elicit judgments of spontaneity *per se*; yet their results are suggestive regarding the importance of how goal-related future thoughts are *formulated*, as a potential predictor of functional outcomes.

The present chapter has thus far continued to follow the layout set forth in Chapter 1 – first addressing mechanisms, then addressing functions. An important implication of this thesis is that a strong theory of SFT must consider not just the questions of "when" and "how" it occurs (i.e., the focus of Chapters 2 and 3); it must also consider the "why" question, as to the ultimate significance and value of spontaneous future thought within human cognition (cf. Seligman et al., 2016). Moreover, the studies presented here have laid the ground for future studies to examine these different aspects of the phenomenon in concert, rather than in isolation.

In moving from considering SFT as a purely cognitive to a complex self-regulatory phenomenon, the present work paves the way for subsequent research to operate in reverse: Insights gleaned from Studies 4–6 can be "ploughed back" into basic research on the mechanisms and subjective experience of SFTs as they occur in real time. For instance, an experiment using the vigilance task to sample SFTs under controlled conditions could ask for ratings of goal controllability or anticipated completion time (expanding upon the simple assessment of goals in Studies 1 and 2), comparing the frequency and characteristics of SFTs related to goals of different types. Alternatively, one could explicitly assess participants' goal hierarchies (Austin & Vancouver, 1996) and examine the form and characteristics of SFTs relating to different hierarchical levels (cf. subordinate vs. superordinate goals; Klinger & Cox, 2011).

With such considerations in mind regarding the need to *integrate* the two major strands of this thesis, the following section introduces a conceptual model whose aim is to formalise and combine the key messages of Studies 1–6. Alongside the overview of questions answered and unanswered presented in Table 6.1, the intention here is to stimulate further research on spontaneous future thought as both a cognitive phenomenon and a functional, self-regulatory capacity.

6.4. Final conceptual model

Chapter 5 proposed a simple model connecting prior states (expressing the cognitive, motivational and emotional structure of goal commitments; Gollwitzer & Oettingen, 2012; Locke & Latham, 1990) with ongoing patterns of thought and goal achievement anchored to a specific performance opportunity. Rooted largely in the coarser-grained, survey-based methodology of Study 5, however, the model gave little consideration to the *cognitive basis* of the thoughts it sought to explain (i.e., the subject of Chapters 2 and 3). Hence, in order to draw general conclusions from the work as a whole, insights from Studies 1–3 – about the cognitive mechanisms through which SFTs arise – are integrated into a more elaborate model alongside insights from Chapters 4 and 5 about SFTs' goal-directed functions.

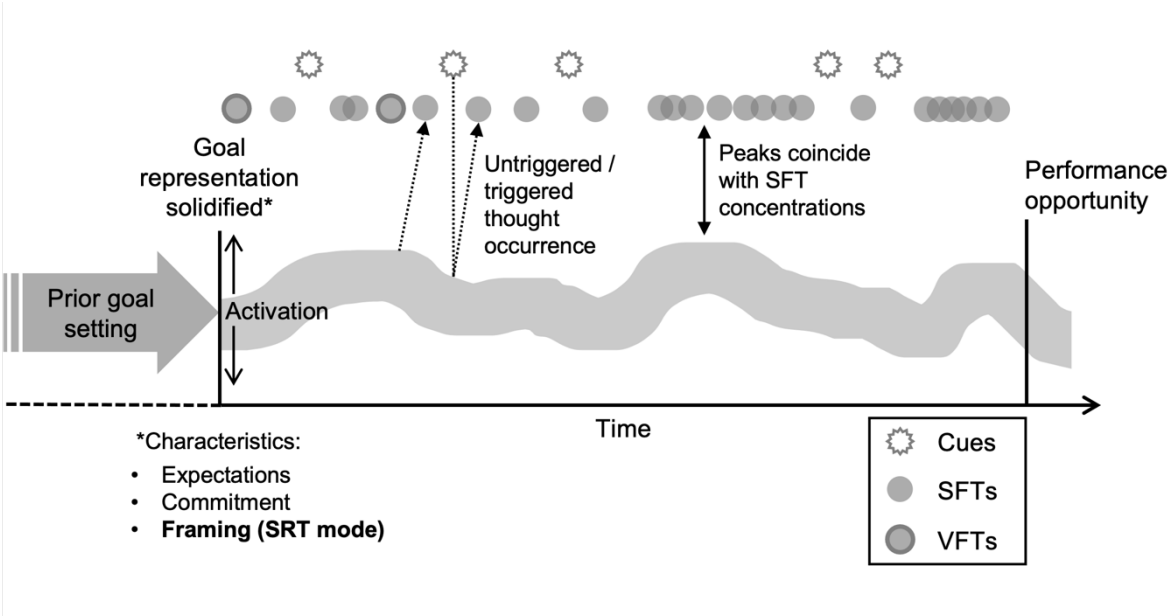


Figure 6.1. Schematic Model of SFT through Time, Bounded by Goal Setting and a Performance Opportunity

Note. Grey line represents underlying goal activation, shown to vary on vertical axis.

Figure 6.1 brings together insights from across the chapters of the thesis, illustrating a possible trajectory from the point where a goal representation is "solidified" (i.e., one becomes committed to a particular desired outcome)[23] to a relevant performance opportunity. The meandering grey line in the centre of the diagram represents fluctuating activation of the goal in long-term memory (Markus & Nurius, 1986; Mace & Unlu, 2020; Singer, 1975; Klinger, 2013). The occurrence of *goal-related* thoughts is represented through the distribution of grey dots along the time axis, with plain dots representing spontaneous thoughts of the goal and bounded dots, voluntary thoughts of the goal (the high relative frequency of spontaneous thoughts is for illustrative purposes only; see Cole et al., 2016; Finnbogadóttir & Berntsen, 2013). It is assumed that, once aspects of goal pursuit (such as desired outcomes and necessary steps) have been encoded voluntarily as future event representations, they will reoccur spontaneously in the manner demonstrated in Study 3 for experimentally induced future thoughts. For this reason, VFTs are illustrated as occurring early in the trajectory (although one may also think voluntarily of one's goal at a later stage).

[23] N.B. Commitment does not necessarily entail the formulation of a plan or sequence of actions; in the goal pursuit literature, the latter is often seen as subsequent to, and dependent on, the former (e.g., Baumeister et al., 2016, two-stage model of pragmatic prospection).

Concentrations of SFT occurrence are predicted in the model to coincide with points of peak activation of the relevant goal, following the argument in Chapter 2 about the underlying activation of future autobiographical concepts giving rise to SFTs (Markus & Nurius, 1986; Mace & Unlu, 2020; Conway et al., 2019). This is also consistent with the priming studies discussed in Chapters 1 and 2 (Jordão et al., 2019; Stawarczyk et al., 2011); a peak in goal activation could represent a boost following a period of explicit reflection upon one's goals, as effected in these studies[24]. Likewise, thoughts may occur as a result of associative triggering through cues (Berntsen et al., 2013; Berntsen, 2019), or in the absence of such a process (see dotted arrows) – reflecting the nuanced conclusions of Chapters 2 and 3. All other things being equal, spontaneous thoughts acting as reminders of what one should expect, or how one needs to perform, are predicted to occur with maximum frequency shortly before the relevant event (cf. "self-remindings" in prospective memory; A. L. Cohen, 2013; Mason & Reinholtz, 2015).

To give a concrete example, a student (let us call him 'Carl') might appraise his motivation towards an upcoming academic exam, establishing expectations of success and a "starting" level of commitment as per the standard goal pursuit literature (Gollwitzer & Oettingen, 2012; Locke & Latham, 1990)[25]. Carl might then (in a survey input box like in Study 6, or privately inside his head) consider desired outcomes, obstacles, steps, etc., in various formulations and varying amounts of detail. This would dictate the "framing" or antecedent self-regulatory state for Carl's goal (cf. Chapter 5, Figure 5.6). During this process of "setting his sights", Carl might, for example, construct an episodic event (Schacter & Addis, 2007) in which he visualises departing the exam room feeling relieved and accomplished. As he moves through time towards the anticipated exam date (i.e., from left to right along the time axis in Figure 6.1), repetitions of this event, or variations upon it, might re-emerge in consciousness (i.e., memories of the future; Cole & Berntsen, 2016; Jeunehomme &

[24] The opposite possibility, that SFT occurrence boosts goal activation, could be tested using an adapted paradigm in which one participant group completes a goal fluency task BEFORE thought sampling, the other AFTER. One might expect that: A) The BEFORE group should report more SFTs (replicating Jordão et al., 2019; Stawarczyk et al., 2011); B) in the AFTER group, those who registered more SFTs beforehand should show greater fluency when listing their goals.

[25] In Study 6, the point of survey completion acted as a surrogate for this moment, requiring students to appraise, or reappraise, their academic goal in terms of expectations, commitment, and a text-based elaboration (Sevincer & Oettingen, 2013).

D'Argembeau, 2016, 2021; Szpunar et al., 2013; Chapter 3). Additionally, spontaneous reflections upon other aspects of the goal or remaining achievement trajectory (e.g., ongoing study plans) might emerge at any time as Carl goes about his everyday life (Baumeister et al., 2020; Mazzoni, 2019; Plimpton et al., 2015; Smallwood & Andrews-Hanna, 2013).

Other goals can be envisaged with comparable trajectories that would lend themselves to description within this model – yet which vary widely in their constituent features (life domain, timescale, source of motivation), highlighting the model's potential breadth of application. For instance, one might be invited to a social event due to take place in one or two days, and on accepting the invitation, conceive the wish to make a good impression on the other people attending. In terms of domain, the goal to which one is committing here is one of social interaction rather than academic achievement (Gamble et al., 2021); likewise, its timescale is much shorter than that of the exam scenario, presenting a more limited window during which underlying goal activation (and any external cues) may give rise to goal-relevant spontaneous thoughts. And yet, just as in the exam case, one might reasonably expect that A) spontaneous thoughts of one's goal will enter consciousness, with or without external triggers; and B) any impact exerted by such thoughts upon subsequent behaviour will be moderated by the way in which one originally, or underlyingly, appraised the goal (referred to in Figure 6.1 as "framing"). While Chapters 4 and 5 equated such appraisal with goal elaboration and classification, as per fantasy realisation theory (Oettingen, 2000, 2012), the reality will of course be more complex (for instance, levels of expectation and commitment will vary dynamically in response to goal-relevant feedback; Oettingen et al., 2018). Yet, on a rudimentary level, the present model predicts that it is probably most helpful to the individual awaiting an important social occasion to consider both how they would like it to turn out *and* some of the ways in which it could go wrong (i.e., to adopt something like the mental contrasting formulation; Oettingen, 2012).

Still other cases exist which would not so straightforwardly lend themselves to description within the current model. For example, some of the COVID-related goals captured by Study 4 were focussed on coping with inevitable negative events on an ongoing basis (e.g., "My girlfriend is a

student in Paris and we are not currently able to see each other"; Appendix III). Goals of this type have been referred to as *continuous* (see Austin & Vancouver, 1996; Milyavskaya & Werner, 2018) as they motivate behaviour over an extended period of time, not demarcated by the attainment of particular discrete outcomes. One cannot rule out a functional role for SFT in such cases; on the contrary, this chapter's characterisation of SFT as a self-regulatory process predicts that it might have important benefits in coping, as well as striving for success (Armor & Taylor, 1998; Taylor & Schneider, 1989). Yet, the comparison serves to illustrate the special nature of goals possessing a definite end-point: a performance opportunity or other landmark event by which the anticipatory trajectory can be defined, and the potential effects of spontaneous thought readily quantified.

Another interesting implication of Study 4 is that, in contexts of low subjective control, self-regulatory states which would normally be expected to favour success (i.e., adopting mental contrasting) might be motivationally ineffective. To accommodate such cases, modifications to the current model would probably be required, since *ineffective* mental contrasting might have a different moderating effect (or none at all) on the functional value of spontaneous, goal-related thoughts.

Clearly, Figure 6.1 does not claim to present a comprehensive or universal theory of SFT, either as a cognitive phenomenon or a functional capacity. It simply serves as a starting point and organising framework for future research on both aspects – and particularly for the investigation of both aspects simultaneously. In this endeavour it is assisted by Table 6.1 which, alongside a summary of this thesis' main research questions (as in Table 1.1, Chapter 1) and preliminary answers generated by the present studies, lists a number of implications and directions for future research.

6.5. Summary and conclusion

As expressed in Chapter 1, this thesis' overarching aims were to A) refine understanding of the cognitive basis of SFT; B) examine the potential functional value of SFT in particular goal pursuit contexts; and C) test out specific theoretical proposals regarding both aspects (e.g., Cole & Kvavilashvili, 2021; Smallwood & Andrews-Hanna, 2013). These aims were addressed by conducting a series of empirical studies, documented in Chapters 2–5, whose individual findings and contributions have been outlined in this chapter (section 6.1 / Table 6.1). Foremost among these is the demonstration, for the first time, of spontaneous memories of the future reoccurring in real time, using a hybrid paradigm influenced by both voluntary and involuntary research traditions (Mace, 2006; Schacter & Addis, 2007; Schlagman & Kvavilashvili, 2008).

This final chapter also examined broader conceptual issues in light of the combined pattern of results; for instance, around the assumption of cue specificity inherited from the involuntary memory literature (Berntsen & Jacobsen, 2008; Berntsen, 2019) and the implications of pre-encoded future event representations for theory and research (Berntsen, 2019; Cole & Kvavilashvili, 2021). The discussion also emphasised the need to *integrate* the two strands reflected in the present series of studies – research on SFT's cognitive mechanisms and on its goal-directed functions.

In addition to reviewing the thesis' empirical findings, both in relation to its specific research questions and more generally, this chapter has been able to synthesise the resulting insights in a flexible conceptual model (Figure 6.1). The hope is that this will serve to stimulate future research on SFT and, in turn, be modified and refined in light of future findings. In this respect, the present thesis represents a new milestone in progressing, and further delineating, the emerging field of spontaneous future thought (Cole & Kvavilashvili, 2019, 2021).

Appendix I. Cue Lists Used in Study 1 (Chapter 2)

Goal-Related Cues	Future-Related Cues	Standard Cues	Scrambled Cues
Public affairs	When we get there	Grandmother's cooking	Ganoerrdmth's ockigon
Being off sick	Presently	Armed robbery	Ermad roeybbr
Moving abroad	Round the corner	Favourite artist	Favoiurte traist
Broken friendship	Looking ahead	Heavy bags	Ehyva bgas
Heart attack	Fast forward	Prison sentence	Pisrno tseennec
Failed marriage	In the medium term	Seasick	Sesaick
Management	Ready to go	Open-minded	Pneo-eiddmn
Low self-esteem	Things to come	Having no money	Aivhng no emony
Serious illness	Imminently	Losing a race	Silgon a raec
Physical health	Maybe one day	Giving money to charity	Viiggn nomey to chatriy
Cramped office	On the horizon	Big mistake	Gbi imstake
High-flying career	Next opportunity	Perfect day	Pferect ady
New experiences	Going boldly	Family heirloom	Mfaily liohrmoe
Gum problems	Near future	Car crash	Rca rachs
Early divorce	Not likely	Bumpy road	Pmyub orad
Supporting the arts	End of the month	Sandy beach	Sandy cbeha
Contracting an STI	Forevermore	Being ill	Bgeni lil
Sports success	Next week	New Year's Eve	Enw Eayr's Eve
Raising a family	Cliff hanger	Nice thoughts	Inec uttgohhs
Missed payments	Too early to say	Lost keys	Slot keys
Ethnic harmony	In eternity	Buying a new hi-fi	Ybguni a enw hi-fi
Purpose in life	Coming soon	Cosy room	Syco oorm
Getting burgled	Far off in time	Family feud	Mfaily efud
Meaningful work	Unexpected twist	First holiday	Frist olihdya
Personal philosophy	It'll be fine	Friendly waiter	Efrnidly aierwt
Accomplishment	Going forward	Landscape gardens	Lanascdpe graesnd
Developing cancer	Looking forward	Sore feet	Seor feet
Expert in the field	Sometime soon	Bright sunshine	Ribhgt seunsihn
Earning enough	First time	Villa in France	Ivlla ni Efracn
Public service	Until further notice	Helpful comments	Hellupf cmnomtes
Bereavement	In several months	Feeling paranoid	Feelign aaprndio
Great Wealth	Next year	Holiday romance	Lydioha ramonce
Death in the family	Getting closer	Feeling afraid	Iefenlg ariadf
Original work	As it transpires	Healthy glow	Haeltyh lgow
Happy family	Later in life	Favourite teacher	Afvuoeirt cetaehr
Auto breakdown	Not far off	Sprained wrist	Sraipned riswt
Dropping out	Years from now	Being arrested	Bieng aresdter
Righting wrongs	In the offing	Smiling face	Lmsiing afce
Getting fired	Maybe sometime	Bad breath	Abd ebrath
Solving problems	Consequences	Treasured friend	Reutasred friend
Career setback	In the foreseeable	Bad drivers	Adb rvdries

Untimely death	Don't jump the gun	Soiled clothes	Siedlo ltcoehs
Valued contribution	Best foot forward	Fresh bread	Frhes baedr
Work issues	A hen tomorrow	Feeling bored	Eenflig roedb
Poor prospects	Bide your time	Feeling exhausted	Elfgien ehxutades
Unattractive job	Down the line	Hay fever	Yha evfer
Being lonely	Into the long grass	Having an argument	Aihvgn na aregtmun
Close friendship	Recurring	Happy times	Happy itmse
Direct action	Never again	Achieving a goal	Chaieivng a lgao
Car theft	After an interval	Bad karma	Dba akrma
Humiliation	On the way	Broken glass	Broken gassl
Breaking up	Keep me posted	Being condemned	Ebnig ocnemdedn
Sense of purpose	Next page	Good genes	Oodg esegn
Being sterile	Return	Self-doubt	Sefl-outbd
Early heart failure	It won’t happen	Feeling grumpy	Efleing rgumpy
Lost hopes	Some way away	Puffy eyes	Upffy yese
Unwell relative	Another time	Jet lag	Jte alg
Stolen valuables	Weeks from now	Feeling tired	Eefilng eirtd
Community leader	Some other time	Ecstatic Crowd	Sctecait Orcdw
Car accident	Matter of time	Limb amputation	Lbim mapunattoi
Protecting nature	As and when	Christmas tree	Hricsmtsa reet
Lovely home	When I get time	Enterprising scheme	Rripgstinene chesme
Two earners	Expectations	Shared memories	Ahsred emomiser
Recognition	Wait and see	Favourite music	Vafouirte msuic
Steady work	On and on	Coming home	Mcingo emho
Serious illness	Ahead of time	Fear of flying	Aefr of lfyign
Caring for others	Some time later	Having money to spare	Hvngia noeym to saper
Avoiding hard work	Eventually	Peace & harmony	Epcae & ahrmony
Getting mugged	Shortly	Lack of energy	Alck of egnrey
Dental procedure	In the end	Stab wound	Satb owdun
Satisfaction	A long way off	Music concert	Umsic concrte
Poor timekeeping	Henceforth	Feeling frustrated	Eelifgn frsteuartd
Unemployment	At a later date	No electricity	No yielctectir
Spiritual needs	Something new	Good business	Ogod sssubnie
Social values	To be confirmed	Stars at night	Astsr ta night
Proud parents	In the long term	Feeling uplifted	Efinleg puleftid
Famous musician	Sometime far from now	Warm weather	Marw ewathre
Having fun	Down the road	Extremely competent	Exeterlmy mptoeentc
Family disapproval	End of next year	Bullying someone	Bulligyn eosmone
Traditional marriage	Generational shift	Feeling happy	Fileegn phpay
Failed ambitions	The long game	Road works	Ador owrsk
Keeping informed	Ad infinitum	Favourite cocktail	Oavrfuiet ckcotail
Physical injury	I'll let you know	Split-up	Plist-up
Unexplained pain	Looming large	Nasty feeling	Ansyt feelnig
Loss of security	Approaching curve	Bad music	Dba suimc
Lung cancer	Do it again	Coughing all night	Unohcgig lla inght
Peacekeeping	Hereafter	Laugh out loud	Lgauh tuo odlu

Business person	Coming up	Wedding anniversary	Iddenwg seniaraynvr
Masters degree	The following month	Lottery win	Tolteyr niw
Mental breakdown	Sooner or later	Chapped lips	Ahpcped ilps
New experiences	For the foreseeable	Comfy chair	Omcfy hcair
Drinking problem	On the up and up	Lack of motivation	Alkc of omttviinoa
Error of judgment	Keep on going	Run down	Nru odnw
Attempted suicide	Pushing onwards	Delayed flight	Delaeyd iglhft
Having plenty	Radical change	Happy thoughts	Ahypp htoughts
Writing well	How it falls out	Good music	Godo umsic
Relationship issues	As of next week	Being punished	Gebni niudshep
Financial crisis	Next instalment	Receding hair	Ernecdig hari
Exciting lifestyle	Leave it for now	Valentine's day	Veatnlien's ady
Lack of purpose	Not looking likely	Locked out	Loecdk uot
Living together	I'll do it	New car	Wen arc
Legal proceedings	Several years hence	Stubborn behaviour	Tsubbonr ebhrivoua
Influential job	New horizons	Being saved	Iebgn vdsea
Reading widely	Subsequently	Inquisitive mind	Sqviintiieu imnd
Business owner	Let's wait and see	Super smile	Uspre imles
Breaking a bone	In the coming weeks	Flat tyre	Altf tyre
Being skint	Matter of time	Feeling low	Eefling wlo
Legal trouble	Come back around	Angry conversation	Nayrg sonrvneatoci
Artistic success	Distant future	Visiting an old friend	Svitingi na dol ifernd
Overdrawn account	The leading edge	Stolen car	Soetnl acr
Social exclusion	Day after tomorrow	Heat rash	Eaht rash
Falling out	Months from now	Lousy day	Oulsy yda
Helping people	What I predict	Dressing up	Idersnsg pu
Mental illness	Buy some time	Being undecided	Benig duneecidd
Happy children	Descendants	Winning a prize	Wiinngn a pirze
Healthy marriage	Probably never	Treasured possession	Reautrsed psossseoin
Decent career	Downward trend	Living life to the full	Lvingi feli to teh full
Science paper	Ultimately	New clothes	Enw lcoeths
Behind on work	Indefinitely	Falling off a horse	Llfaing off a hosre
Having children	Fullness of time	New relationship	Enw oitiphersanl

Mean (SD) character length for each list:

Goal-Related Cues	**Future-Related Cues**	**Standard Cues**	**Scrambled Cues**
14.5	13.7	13.5	13.5
(2.4)	(3.0)	(3.5)	(3.5)

Appendix II. Goal-Related Cues Used in Study 2 (Chapter 2)

Note. Modified cues highlighted in **bold**.

Public affairs	Career setback	Failed ambitions
Sick leave	Untimely death	**Well-informed**
Moving abroad	Valued contribution	**Ailments**
Losing friends	Work issues	Unexplained pain
Heart attack	Poor prospects	Loss of security
Failed marriage	Unattractive job	Lung cancer
Manager	**Loneliness**	Peacekeeping
Low self-esteem	Close friendship	Business person
Serious illness	Direct action	Masters degree
Physical health	Car theft	Mental breakdown
Cramped office	Humiliation	**Lucky break**
High-flying career	**Breakup**	Drinking problem
New experiences	Sense of purpose	Error of judgment
Bad teeth	**Sterility**	**Suicide attempt**
Early divorce	Early heart failure	Affluence
Supporting the arts	Lost hopes	Writing well
Contracting an STI	**Sick relative**	Relationship issues
Sports success	Stolen valuables	**Financial ruin**
Raising a family	Community leader	Exciting lifestyle
Missed payments	**Collision**	Lack of purpose
Ethnic harmony	Protecting nature	Living together
Aspirations	Lovely home	Legal proceedings
Getting burgled	Two earners	Influential job
Meaningful work	Recognition	Reading widely
Personal philosophy	Steady work	Business owner
Accomplishment	Serious accident	Breaking a bone
Developing cancer	**Altruism**	Being skint
Expert in the field	Avoiding hard work	Court case
High earner	Getting mugged	**Creative drive**
Public service	Dental work	**Overdrawn**
Bereavement	Satisfaction	Social exclusion
Prosperity	Poor timekeeping	**Arguments**
Death in the family	Unemployment	Helping people
Original work	Spiritual needs	Mental illness
Happy family	Social values	Happy children
Auto breakdown	Proud parents	Healthy marriage
Dropout	Famous musician	Decent career
Righting wrongs	Having fun	Science paper
Getting fired	Family disapproval	**Overworked**
Solving problems	Traditional marriage	Having children

Mean (SD) character length for list:
13.7 (3.0)

Appendix III. Example Coding of Goal Elaborations for COVID-Related / Unrelated Personal Goals (Chapter 4)

Goal Type	Goal Title	Elaboration	Coded Elaboration (Desired Future = D, Present Reality = P)	No. of Statements	SRT Mode Classification
COVID-Related	Being able to see loved ones again	My girlfriend is a student in Paris and we are currently not able to see each other. I have not been able to see my parents since the lockdown started because they are both elderly and there is a risk that they could get infected with covid-19 if I visited them.	My girlfriend is a student in Paris [P] and we are currently not able to see each other. [P] I have not been able to see my parents since the lockdown started [P] because they are both elderly [P] and there is a risk that they could get infected with covid-19 [P] if I visited them. [P]	6	Dwelling
COVID-Related	Staying well	I want to remain well. I don't want to infect other people. I want to get back some normality in my life. I want to be able to see my friends and family.	I want to remain well. [D] I don't want to infect other people. [D] I want to get back some normality in my life. [D] I want to be able to see my friends and family. [D]	4	Indulging
COVID-Related	Maintain my tennis trainings despite courts being closed	It's really important to me to be ready and in peak form to play my best when the pandemic is over but it's hard to train without the possibility to go on the tennis court and to meet with others.	It's really important to me to be ready [D] and in peak form to play my best [D] when the pandemic is over [D] but it's hard to train without the possibility [P] to go on the tennis court [P] and to meet with others. [P]	6	Mental Contrasting
COVID-Related	Maintain a good sleep schedule	the change in my regular schedule e.g. commute and work hours, has made it hard to keep to my regular sleep schedule. I want to get back into good habits, not staying up too late and making sure to get 8 hours of sleep and be up at a reasonable time in the mornings instead of sleeping in	the change in my regular schedule [P] e.g. commute and work hours, [P] has made it hard to keep to my regular sleep schedule. [P] I want to get back into good habits, [D] not staying up too late [D] and making sure to get 8 hours of sleep [D] and be up at a reasonable time in the mornings [D] instead of sleeping in [D]	8	Reverse Contrasting

COVID-Unrelated	Starting my career after graduating in December	After graduating from a masters degree in December, I have failed to secure any professional employment. I am becoming increasingly anxious about how I will be able to begin my career. I feel like I am behind peers who did not complete a postgraduate degree who have been working professionally for a couple of years.	After graduating from a masters degree in December, [P] I have failed to secure any professional employment. [P] I am becoming increasingly anxious [P] about how I will be able to begin my career. [P] I feel like I am behind peers [P] who did not complete a postgraduate degree [P] who have been working professionally for a couple of years. [P]	7	Dwelling
COVID-Unrelated	Pass Uni first year	Pass all of my modules for first year with passing grade. Conduct more research and leanr how to havard reference properly. Write all of my reports up with lots of detail.	Pass all of my modules for first year with passing grade. [D] Conduct more research [D] and learn how to Harvard reference properly. [D] Write all of my reports up with lots of detail. [D]	4	Indulging
COVID-Unrelated	Reading often	I think reading will be very important to stimulate my mind and become more intelligent. It is also very relaxing but the problem is I don't have the motivation when it's so much easier to just go on my phone or laptop.	I think reading will be very important [D] to stimulate my mind [D] and become more intelligent. [D] It is also very relaxing [D] but the problem is I don't have the motivation [P] when it's so much easier to just go on my phone or laptop. [P]	6	Mental Contrasting
COVID-Unrelated	Exercise more	Unable to exercise much at home and would be great to go to the gym	Unable to exercise much at home [P] and would be great to go to the gym [D]	2	Reverse Contrasting

Appendix IV. Details on Scale Adaptation and Validation (Chapter 5)

1. Scale Adaptation A: MW-S (goal adaptation)

For the following statements, please select the answer that most accurately reflects your **everyday thoughts about current goals and concerns**.

When my mind wanders, my thoughts revolve around my current goals.

1	2	3	4	5	6	7
Rarely			*Sometimes*			*A lot*

I think about my goals even when I'm supposed to be doing something else.

1	2	3	4	5	6	7
Rarely			*Sometimes*			*A lot*

I find my train of thought straying spontaneously towards my current goals.

1	2	3	4	5	6	7
Rarely			*Sometimes*			*A lot*

It feels like I don't have control over when I think about my current goals.

1	2	3	4	5	6	7
Almost never			*Sometimes*			*Almost always*

2. Scale Adaptation B: MW-S (exam adaptation)

(Version used in Study 6; presented as *"Your thoughts about the exam"*)

For the following statements, please select the answer that most accurately reflects your **everyday thoughts about the upcoming exam**.

When my mind wanders, my thoughts revolve around the upcoming exam.

1	2	3	4	5	6	7
Rarely			*Sometimes*			*A lot*

I think about the exam even when I'm supposed to be doing something else.

1	2	3	4	5	6	7
Rarely			*Sometimes*			*A lot*

I find my train of thought straying spontaneously towards thoughts of the exam.

1	2	3	4	5	6	7
Rarely			*Sometimes*			*A lot*

It feels like I don't have control over when I think about the exam.

1	2	3	4	5	6	7
Almost never			*Sometimes*			*Almost always*

Measures adapted from:

Carriere, J. S. A., Seli, P., & Smilek, D. (2013). Wandering in both mind and body: Individual differences in mind wandering and inattention predict fidgeting. *Canadian Journal of Experimental Psychology*, *67*(1), 19–31. https://doi.org/10.1037/a0031438

3. Results of Online Validation Study

- 34 participants completed an online, self-caught version of the vigilance task similar to that used in Study 2 (Chapter 2), followed by the above scale (Adaptation A) and the published MW-S and MW-D (Carriere et al., 2013).
- Unlike in Studies 1 and 2, current goals were captured via the CCQ (Sellen et al., 2006; Cole & Berntsen, 2016) *before* the vigilance task.
- Thoughts captured in the vigilance task were filtered by spontaneity (retaining those rated 1–3 on 5-point Likert, as in Study 2)
- Spontaneous thoughts were then filtered by whether they were related to participants' previously reported current goals (indicated at point of report).
- Descriptive statistics were as follows:

Measure	**Mean (SD)**	***α***
Total Spontaneous Thoughts	8.56 (6.85)	-
Goal-Related Spont. Thoughts	3.03 (3.74)	-
Adapted Scale Score (MW-Sa)	17.4 (4.70)	.798
MW-S Score	19.5 (4.36)	.672
MW-D Score	18.4 (5.78)	.809

Note. Reliability (α) only computed for scale measures.

- Due to high skewness and kurtosis values, the key measure of *Goal-Related Spontaneous Thoughts* (GRST) was square-root transformed prior to correlational analysis.
- Intercorrelations between the key measures are shown below (significant coefficients in **bold**):

	1.	2.	3.
1. Sqrt (GRST)	-		
2. MW-Sa	**.440****	-	
3. MW-S	.039	.310†	-
4. MW-D	.152	.234	.217

$^{**}p < .01$, $^{\dagger}.05 < p < .10$.

- N.B. Specific ethical approval was sought, and granted, for this supporting study from York St John Research Ethics Committee for the School of Education, Language and Psychology.

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