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logoORCID: <https://orcid.org/0000-0001-8176-283X> (2020)

Functions of spontaneous and voluntary future thinking: Evidence from subjective ratings. Psychological Research.

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Short title: FUNCTIONS OF SPONTANEOUS FUTURE THOUGHTS

Cite as:

Duffy, J. & Cole, S. N. (in press). Functions of spontaneous and voluntary future thinking: Evidence from subjective ratings. *Psychological Research*,
Accepted for publication, doi: 10.17605/OSF.IO/86A59

Functions of spontaneous and voluntary future thinking: Evidence from
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Acknowledgments: We would like to extend our thanks to Chloe Kemsley for help in data collection, and Krystian Barzykowski for helpful comments on an earlier version of this manuscript. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Abstract

Future thinking is defined as the ability to withdraw from reality and mentally project oneself into the future. The primary aim of the present study was to examine whether functions of future thoughts differed depending on their mode of elicitation (spontaneous or voluntary) and an attribute of goal-relatedness (selected-goal-related or selected-goal-unrelated). After producing spontaneous and voluntary future thoughts in a laboratory paradigm, participants provided ratings on four proposed functions of future thinking (*self, directive, social* and *emotional regulation*). Findings showed that spontaneous and voluntary future thoughts were rated similarly on all functions except the directive function, which was particularly relevant to spontaneous future thoughts. Future thoughts classed as goal-related (selected-goal-related) were rated higher across all functions, and there was largely no interaction between mode of elicitation and goal-relatedness. A higher proportion of spontaneous future thoughts were selected-goal-related compared with voluntary future thoughts. In general, these results indicate that future thinking has significant roles across affective, behavioural, self and social functions, and supports theoretical views that implicate spontaneous future thought in goal-directed cognition and behaviour.

Functions of spontaneous and voluntary future thinking: Evidence from subjective ratings

1. Introduction

Future thinking refers to the ability to withdraw from reality and mentally project oneself into the future (Atance & O'Neill, 2001; Szpunar, 2010). For example, while driving a car, one's mind may jump forward to an enjoyable meal at a restaurant while on holiday in the summer. Future thinking can arise in consciousness via two routes or modes; one voluntary and one spontaneous (Cole & Kvavilashvili, 2019b; Berntsen & Jacobsen, 2008). When intentionally initiated, cognitive control mechanisms are employed at the construction stage to consciously select and simulate details of a future event, resulting in what has been termed voluntary future thinking (Cole & Kvavilashvili, 2019a). In contrast, spontaneous future thinking is defined as "*unintended thought, related to the future, that comes to mind with little effort and little control over its content*" (p. 635, Cole & Kvavilashvili, 2009a). Such future thoughts spontaneously 'pop up' without intent (Berntsen & Jacobsen, 2008; Cole, Staugaard & Berntsen, 2016)¹. Reflecting this distinction, notions of *dual processes* (i.e., 'generative' versus 'direct') of future thinking have been adopted by several authors (Anderson, Dewhurst & Nash, 2012; Cole et al., 2016; Jeunehomme & D'Argembeau, 2016; see Cole and Kvavilashvili, 2019b for a theoretical proposal concerning a dual process account). It should be noted that, although distinct, spontaneous future thoughts share some common features with other spontaneous cognitive phenomena, such as mind wandering².

¹ For an in-depth discussion of conceptual differences between spontaneous and voluntary future thought, see Cole & Kvavilashvili, (2019b).

² There are several phenomena that are related to spontaneous future thinking. For example, mind wandering is described as a shift in one's attention away from events in the environment and towards mental content generated by the individual, and is often, but not necessarily, about the future (Smallwood & Schooler, 2015). Daydreaming is related to both mind wandering and spontaneous future thinking but generally involves withdrawing from the surrounding environment and moving one's thoughts onto absent or imaginary

Future thinking is proposed to have important functions for our everyday lives including planning, emotion regulation and instantiating a temporally extended and coherent identity (D'Argembeau, Renaud & Van der Linden, 2011; Boyer, 2008; Finnbogadóttir & Berntsen, 2011; Suddendorf & Corballis, 2007). Although theoretical formulations have proposed specific functions of future thinking (e.g. Baumeister, Vohs & Oettingen, 2016; Bulley, Henry & Suddendorf, 2016; Conway, Loveday & Cole, 2016; Schacter, Benoit, & Szpunar, 2017, Schacter, 2012), a precise understanding of how functions map on to voluntary and spontaneous future thinking has yet to emerge. This may be because, to date, there exists a limited amount of studies systematically assessing different functions of future events, and how they depend on phenomenological qualities (e.g., more or less abstract) or emotional valence (e.g., D'Argembeau et al., 2011; Rasmussen & Berntsen, 2013). To our knowledge, the present study represents the first in which the functions of spontaneous *and* voluntary future thinking are systematically examined and compared using an established laboratory technique (Barzykowski, Radel, Niedźwieńska, & Kvavilashvili, 2019; Cole et al., 2016; Plimpton, Patel & Kvavilashvili, 2015).

Future thinking, in general, relies on episodic content, but is underpinned by semantic knowledge: One must have an understanding of what the world will be like in the future to integrate sensory-perceptual specific content (*semantic scaffolding hypothesis*; see Irish & Piguet, 2013). Although there are different forms of future thinking (e.g., *simulation*, *prediction*, *intention* and *planning*, Szpunar, Spreng, & Schacter, 2014), the present study will focus on *simulations* – defined as a ‘detailed mental representation of a specific

events/objects. Importantly, daydreaming and mind wandering can involve volitional processes (Dorsch, 2015; Seli et al., 2016), whereas a cardinal property of spontaneous future thought is its unbidden nature (see Cole & Kvavilashvili, 2019a).

autobiographical future event’ (Szpunar, Spreng & Schacter, 2014, p. 18416). This conceptualisation is consistent with most of the primary research on future thinking (see Schacter et al., 2017). This conceptual clarity will make predictions and explanations clearer, because (1) it does not conflate types of future thinking and (2) we base our predictions on the most studied and well-understood variant.

1.1. Spontaneity and Goals in Relation to Future Thought

In the following we will discuss spontaneous and voluntary processes in future thought as well as briefly addressing the relationship between episodic future thoughts and goals. Previous research has demonstrated the existence of shared characteristics of spontaneous and voluntary event simulations. For example, future events tend to be emotionally positive and draw upon the same autobiographical knowledge, regardless of how they are elicited (see Berntsen, 2009; Cole et al., 2016). However, spontaneous and voluntary future thinking differ on several characteristics. For instance, spontaneously elicited thoughts have been found to be more specific, less vivid, and are elicited faster than voluntarily elicited thoughts (see Cole et al., 2016).

Researchers have typically used different methodologies to examine voluntary and spontaneous future thinking: Voluntary future thoughts are typically generated in laboratory settings by asking participants to consciously imagine an event in their personal future (e.g., Addis, Wong & Schacter, 2008; Rasmussen & Berntsen, 2013). On the other hand, studies have utilised a more naturalistic *structured diary method* to investigate spontaneous future thoughts (e.g., Berntsen, 1996; Berntsen & Hall, 2004; Berntsen & Jacobsen, 2008; Kvavilashvili & Mandler, 2004). Using a diary method means spontaneous future thoughts cannot always be recorded in ‘real time’; therefore, relying on retrospection. This becomes a methodological issue as such thoughts are easily forgotten, which may lead to retrospective

guessing (see Schlagman & Kvavilashvili, 2008). Nevertheless, diary studies have made important discoveries: For example, that spontaneous thoughts occur mainly when an individual is participating in routine tasks that require little attention (Berntsen & Jacobsen, 2008; Kvavilashvili & Mandler, 2004) and are elicited by identifiable cues either from the external environment or from internal triggers (Berntsen, 1998; Berntsen & Jacobsen, 2008).

Recently, a task was designed in the field of autobiographical memory (Schlagman & Kvavilashvili, 2008) and adapted to future thinking research (Cole et al., 2016; Plimpton et al., 2015) which enabled researchers to assess spontaneous and voluntary future thoughts under similar conditions in the laboratory. In this paradigm, conditions in which spontaneous thoughts naturally occur are simulated in controlled conditions: Participants are presented with a vigilance task, whereby it is emphasised to participants that they must identify infrequent visual stimuli (vertical line arrays). As a ‘secondary task’ (which is actually the main outcome measure) participants are also asked to pay attention to their thoughts, and report any thought which may be spontaneous and future-oriented. Word phrases are embedded within the vigilance task which are intended to act as verbal cues to trigger spontaneous future thoughts. External reliability of the laboratory paradigm has been established by the demonstration of common findings across laboratory and diary studies (Bernsten & Jacobsen, 2008; Cole et al., 2016; Finnbogadóttir & Berntsen, 2013). For example, spontaneous thoughts - assessed in everyday life and the laboratory - are more specific and have a greater emotional impact than voluntary thoughts (e.g., Cole et al., 2016; Berntsen & Hall, 2004). The present study utilised this laboratory paradigm to examine voluntary and spontaneous future thinking.

Of course, as well as imagining possible futures, individuals can, and do, mentally project themselves into the past (Conway, 2005). Indeed, some researchers have synthesised

past and future thinking into one capacity - *mental time travel* (Wheeler, Stuss, & Tulving, 1997). However, in designing a study of functions of voluntary and spontaneous future thought, it would be unwise to simply assume that specific functions of past mental time travel (e.g., Bluck, Alea, Habermas, & Rubin, 2005; Harris, Rasmussen, & Berntsen, 2014) apply to future thinking. For this reason, the current paper identifies those functions that conceptually and logically map on to future thinking, and used these in constructing the questionnaire used to assess functions in this study.

Finally, previous research has investigated the relationship between future thinking and goals by utilising the concept of current concerns (Klinger, 1975). Current concerns refer to higher-order goals (e.g., losing weight) rather than drives (e.g., hunger) or specific ‘action plans’ (Cole & Berntsen, 2016). Current concerns can influence the content of one’s thoughts and dreams (e.g., Klinger, Barta, & Maxeiner, 1980; Nikles, Charles, Brecht, Klinger, & Bursell, 1998) from goal commitment until goal completion or abandonment (see Klinger, 1975). Studies have found that selected-goal-related future thoughts have different characteristics than selected-goal-unrelated future thoughts (Cole & Berntsen, 2016; D’Argembeau et al., 2010; D’Argembeau & Mathy, 2011). For example, selected-goal-related future thoughts have been found to be more rehearsed, vivid, emotionally intense and positive, and more frequently have an impact on current mood (Cole & Berntsen, 2016). Consistent with Cole & Berntsen (2016), the present paper adopts a technique whereby participants list their most salient current concerns and then self-code whether each future thought is related to these (hence the term *selected-goal-related*), or not, thereby creating a way to compare qualities of future thoughts that are, and are not, particularly goal-relevant.

1.2. Functions of Future Thinking

We now briefly summarise possible functions of future thinking in relation to mode of elicitation and goals. From a limited search of the literature, four broad categories of functions were identified that may apply to future thought: *Directive* (guide thinking and behaviour), *self* (self-continuity and identity formation), *social* (social bonding and social identity), and *emotional regulation* (prepare and reassure) (e.g., Barsics, Van der Linden, & D'Argembeau, 2016; D'Argembeau, Renaud & Van der Linden, 2011).

The *directive function* is suggested to derive from evolutionarily early adaptations (enhancing 'biological fitness', see Suddendorf & Corballis, 2007) and assumes that future thoughts also guide planning, problem-solving and self-regulation of behaviour in contemporary life (Schacter, 2012; Schacter et al., 2017, for relevant reviews; see Pillemer, 2003 for a review of directive functions of autobiographical memories). An example of the planning function is highlighted by *temporal discounting* - the tendency to prefer smaller rewards that are temporally close over larger temporally distant ones (Benoit, Gilbert, & Burgess, 2011): Studies have shown that future thinking attenuates this effect, ensuring individuals make more rational and healthy choices (Daniel, Stanton & Epstein, 2013; Peters & Büchel, 2010).

If spontaneous future thought could spontaneously trigger plans based on our ongoing behaviour (circumventing or reducing the requirement of cognitive control), its role in human planning could be more prominent and efficient than voluntary future thought (see Berntsen 2009 for similar arguments). Indeed, a naturalistic study of daily thoughts indicated that future thoughts are categorised mostly as having a planning function (D'Argembeau, Renaud & Van der Linden, 2011). Although spontaneity was measured by D'Argembeau and colleagues (2011), the directive function of future thoughts were not subdivided based on

whether they were truly spontaneous, leaving open the relevance to spontaneous future thoughts.

A recent study did establish that spontaneous future thoughts reach consciousness before those that employ wilful control processes (Cole et al., 2016), which could be useful in situations that call for immediate action such as escaping negative or risky life events (Pillemer, 2003). Also, spontaneous thought processes are assumed to underlie key aspects of human self-regulation, such as when making explicit if-then plans (*implementation intentions*, Gollwitzer, 1999) and retrieving explicitly generated memories of future tasks (*prospective memory*, McDaniel & Einstein, 2000). In line with these approaches, it is proposed here that, after a plan is generated voluntarily, spontaneous thought processes follow on to aid successful goal completion. In other words, spontaneous future thoughts are a well-suited form of mental representation to orient and reorient individuals to their future plans (see Cole & Kvavilashvili, 2019b). It is noteworthy that directive functions manifest themselves differently in remembering and imagining the future: In memory, this may involve negative events as opportunities to change future behaviour (e.g., Michael Jordan's rejection of entry into a varsity team provided inspiration and motivation to succeed, Pillemer, 2003), whereas in future imagining, this may simply involve a positive scenario one wants to have happen (e.g., helping a team win first place in the basketball league). Interestingly, as discussed by Pillemer (2003), directive memories may occur spontaneously too.

Some argue that episodic future thinking has a key role in shaping one's sense of self and identity (*self-function*, Conway, Loveday & Cole, 2016; D'Argembeau, Lardi & Van der Linden, 2012; Prebble, Addis & Tippett, 2013). It is known that wilfully-generated future thoughts are rated higher on the self-function than autobiographical memories (Rasmussen &

Berntsen, 2013) and that individuals can and do experience self-defining future projections (i.e., relevant to one's identity) (D'Armentau et al., 2012) which contribute to the formation of an adult identity during adolescence (Dunkel & Anthis, 2001). Markus and Nurius (1986) utilised the term *possible selves* to portray representations of future selves. Possible selves can be *hoped-for* and involve one's future self being happy and satisfied (Dunkel & Anthis, 2001). Possible selves can also be *feared selves*, involving concerns such as developing a critical illness (Fleury, Sedikides, & Donovan, 2002). Future thoughts of possible selves contribute to the formation and the exploration of an individual's identity (Dunkel & Anthis, 2001) and they have been found to motivate behaviour change (Ruvolo & Markus, 1992).

Herein, we propose that both voluntary and spontaneous future thoughts will have a broadly equivalent *self-function*. It is also predicted that goal-relevance will moderate this function such that selected-goal-related future thoughts will be rated higher on the self-function than selected-goal-unrelated future thoughts. This is based on a study by Cole and Berntsen (2016) showing selected-goal-related future thinking was more associated with the self-function than selected-goal-unrelated future thinking. Similarly, a study of mind-wandering found a greater number of spontaneous future-directed thoughts (than past) were produced following a self-reflection exercise (see Smallwood et al., 2011).

We may intuitively define future thoughts that have a *social function* as those which are shared with other individuals, perhaps to increase feelings of 'closeness' or community. In autobiographical memory research, memories are shared to demonstrate empathy or intimacy, ease communication, or facilitate social bonding (Bluck et al., 2005). Although this is an important component of the social relevance of prospection, one may also imagine future thoughts because they contribute to one's social identity. Social identity can be defined as how we categorise ourselves in terms of social groups. Social identity can exert powerful

effects on feelings, attitudes and behaviour, and explains how in-group biases are ever-present (Tajfel & Turner, 1986). Do future thoughts link us closer with social bonds? One previous study found that voluntarily-generated future thoughts were rated lower than autobiographical memories on the social function (Rasmussen & Berntsen, 2013), suggesting this type of future thought has a comparatively weaker function in the social domain, at least compared with memories. The current study will make further steps in examining the social function of future thoughts.

Finally, considering emotion, emotionally positive future thoughts may provide insight in terms of the emotional regulation function. Several studies have established that, compared to past events, future events are *more* positive (termed the ‘future positivity bias’) when participants freely self-generate events (e.g., Berntsen & Bohn, 2010; Rasmussen & Berntsen, 2013). It has been proposed that the future positivity bias serves to optimistically motivate people toward their future (Berntsen & Bohn, 2010). Positive future thinking may also have an emotional regulation function as it reassures individuals about themselves and their potential future (see Barsics et al., 2016). This finding also illustrates how one future thought may serve several functions (see *Methods*).

Further evidence for an *emotional regulation function* has been found in research that manipulated participant’s future thinking. When participants were instructed to imagine a particular future thought (e.g., how to prepare for an exam) they were more likely to engage in coping strategies (e.g., increased study) which was found to decrease the negative emotions they felt towards the event (Pham & Taylor, 1999). Future thinking may assist in emotional regulation because it allows individuals to anticipate their emotional states for future scenarios and develop some perceived control over them (see Armitage & Reidy, 2012; Pham & Taylor, 1999). In the present study, it was assumed that future thoughts with

an emotional regulation function allow individuals to experience their emotions with a future focus and develop control over them before/if a particular scenario occurs. Therefore, the participants will feel more prepared/reassured because they feel in control of their emotions. The present study will examine *present-orientated emotional regulation* (i.e., to reassure oneself), and *future-orientated emotional regulation* (i.e., to prepare oneself) as subtypes of emotional regulation, consistent with Barsics et al (2016).

1.3. Research Aims and Hypotheses of the Current Study

It is clear that some indirect and direct evidence exists concerning the possible functions of future thinking. However due to the relative paucity of research in the domain of spontaneous future thought (Cole & Kvavilashvili, 2019a), it is an open question *whether* and *how* voluntary and spontaneous future thoughts differ from voluntary future thoughts in terms of their perceived function/s.

By using a tailored laboratory paradigm (Cole, Staugaard & Berntsen, 2016) the present study allowed us to examine perceived functions of voluntary and spontaneous forms of future thinking within a single study. This differs from previous studies which either examined voluntary future thoughts only (Rasmussen & Berntsen, 2013) or did not categorise future thoughts into spontaneous or voluntary subtypes (D'Argembeau, Renaud & Van der Linden, 2011). Also, neither of these studies included measures of all four abovementioned functions (D'Argembeau, Renaud & Van der Linden, 2011; Rasmussen & Berntsen, 2013).

Using this laboratory paradigm, the present study aimed to address several research questions, by measuring directive, self, social, and emotion regulation functions of future thinking.

Research Questions and Predictions

1: What are the functions of future thoughts and do perceived functions differ between voluntary and spontaneous future thoughts (if so, in what way)?

2: Are perceived functions of future thoughts affected by goal-relatedness? It was predicted that selected-goal-related future thoughts would be rated higher for the self-function than selected-goal-unrelated future thoughts (e.g., D'Argembeau et al., 2012); and selected-goal-related future thoughts would be rated higher on the directive function, based on evidence from decision-making (O'Donnell, Daniel, & Epstein, 2017). Due to an absence of any other functional differences between selected-goal-related and selected-goal-unrelated future thinking in the literature, no further predictions were made.

3. Is there an interaction between mode of elicitation and goal-relatedness in the way that people perceive functions of future thought?

4: How frequently are spontaneous and voluntary future thoughts related to current concerns (i.e., relevant to an ongoing goal)? Previous data tentatively suggests that proportionally, more spontaneous future thoughts versus voluntary thoughts related to current concerns (Cole & Berntsen, 2016). We aimed to ascertain if this result reliably replicates.

5: It was predicted that we would confirm previous results indicating that selected-goal-related future thoughts will be elevated in terms of vividness, emotional positivity, and specificity, than selected-goal-unrelated future thoughts (in line with Cole & Berntsen, 2016) supporting the notion that personal goals have an important role in episodic future thinking (D'Argembeau & Mathy, 2011).

6. In line with several previous studies, we predicted that key differences between voluntary and spontaneous future thoughts would be evident in our study (Berntsen & Jacobsen, 2008; Cole, Staugaard & Berntsen, 2016). Specifically, we predicted that spontaneous future thoughts would be more emotional and specific, but less effortfully produced, than voluntary future thoughts.

2.

Method**2.1. Participants**

The participants were undergraduate psychology students from York St John University, recruited from a research participation scheme. A total number of 46 participants completed the experiment each receiving participant credits for taking part. Due to the increased statistical power of using a within-groups design, a priori power was determined by halving the N size of a recent two-arm independent-group study (Cole & Berntsen, 2016) assessing a comparable research question¹. Four participants were excluded from the analysis due to self-reported mental illness ($N=3$) and not understanding task instructions ($N=1$). Therefore, frequency data from 42 participants (41 female, 1 male; mean age 19.40 years, SD 2.52, range 18-31 years) was assessed. Eleven participants were then excluded from analysis of functions and phenomenological characteristics due to an absence of at least one selected-goal-related thought in both the spontaneous and voluntary conditions ($N= 10$), and an absence of at least one selected-goal-unrelated thought in both the spontaneous and voluntary conditions ($N=1$). Therefore, 31 participants were included in the analysis of subjective ratings (30 female, 1 male; mean age 19.23 years, SD 2.31, range 18-31 years) due to reporting at least one voluntary and spontaneous representation that was selected-goal-related and selected-goal-unrelated.

¹ The principle underlying our decision to match the N size to a previous study was based on the fact that this study (Cole & Berntsen, 2016) which had effect sizes (η_p^2) of .10 - .26 comparing selected-goal-related and non selected-goal-related future thoughts. This previous study had large enough effect sizes to find significant differences at the .05 and .01 levels. But because Cole & Berntsen (2016) included 32 participants in past and future groups, and we had only one future group, an N size of 32 was deemed adequate to find differences in a within-groups design.

2.2. Design

The participants completed both the voluntary and spontaneous tasks, so mode of elicitation was within-subjects. The spontaneous condition was always presented before the voluntary condition, to avoid contaminating the spontaneous processes if the condition order was switched (see also Cole, Staugaard & Berntsen, 2016). Also, participants reported both selected-goal-related and selected-goal-unrelated thoughts, so this factor was also within-subjects. Thus, a 2 (Spontaneous, Voluntary) \times 2 (Selected-goal-related, Selected-goal-unrelated) within-subjects design was employed. In line with the open science agenda (see Munafò, Nosek, Bishop, Button, Chambers et al., 2017), the data are accessible in the Open Science Framework repository: doi:10.17605/OSF.IO/86A59.

2.3. Materials

The spontaneous and the voluntary tasks were presented on desktop computers with E-Prime Professional (Version 2.0). The vigilance task and verbal phrases were identical to Cole, Staugaard and Berntsen (2016). The tasks consisted of cue phrases (e.g., *gaining insight*, *chewing gum*) that were presented centrally on a white background and were surrounded by black line arrays. The cue phrases were displayed in the same order for each participant. The line arrays were distributed pseudo-randomly around the cue phrases and were either horizontal or vertical. The lines differed on how they were arranged on the screen (12 variations) and the amount of lines there was on each slide varied (4-8). The cue phrases were presented in an Arial font with an 18-font size. The external reliability of the task has been verified because research has found consistent results with diary studies (see Schlagman & Kvavilashvili, 2008) and convergent validity verified in an unpublished study that found frequency of spontaneous future thoughts within the vigilance task predicted frequency of those produced in daily life, spanning one week (Cole, Barnes, Jones & Elwell, 2019).

2.3.1 *The spontaneous future thinking condition*

In the spontaneous condition, participants were presented with a vigilance task which required them to identify targets. The targets were vertical lines ($N=11$) which were pseudo-randomly distributed throughout the task (every 40-60 trials) and the non-targets were horizontal lines ($N=589$). When the participants identified vertical lines, they were required to press the spacebar on the keyboard. Each time participants pressed the spacebar, they would receive audio feedback (a bell sound). Cue phrases were presented within the lines ($N=600$). Each slide was presented to participants for 1.5 s. The participants were instructed to press the mouse when they experienced a spontaneous future thought. This paused the task and the participants then had to complete Part one of the Future Thought Characteristics Questionnaire. The participants had to pressed enter on the keyboard to return to the task.

2.3.2. *The voluntary future thinking condition*

The voluntary condition contained 12 cue phrases. Different cue phrases were used for the voluntary and spontaneous conditions (cue phrases were extracted from a study of spontaneous memory, Schlagman & Kvavilashvili, 2008). The amount of cue words classified as emotionally positive, negative or neutral were evenly spread within each condition (based on ratings by eight independent coders in Schlagman & Kvavilashvili, 2008), and emotional valence of verbal cues did not differ between the conditions. Additionally, concreteness and imageability of verbal cues did not differ between conditions (see Cole, Staugaard & Berntsen, 2016 for further details). The cue phrases were presented centrally among horizontal line arrays which was the same format as the spontaneous condition when no target was presented. The participants were instructed to wilfully generate a future thought for all the cue phrases they were presented with, one at a time. The slides were presented for one minute each and the participants had to press the mouse button when

they had a voluntary thought. The participants then had to complete Part one of the Future Thought Characteristics Questionnaire for voluntary thoughts. To return to the task the participants had to press enter on the keyboard and if they could not think of a future thought within one minute, the next phrase appeared automatically.

Part one of the Future Thought Characteristics Questionnaire was completed immediately after each thought had been experienced. This allowed the participants to immediately record the retrieved event. Also, it acted as a cue for when the participants completed part two. The Current Concerns Questionnaire was presented after all spontaneous and voluntary thoughts had been recorded. Part two of the Future Thought Characteristics Questionnaire was presented after the current concerns questionnaire had been completed. All questionnaires were presented in paper format.

2.3.3. Current Concerns Questionnaire

This questionnaire involved participants recording their five most important current concerns – that is, their most relevant personal goals. The questionnaire included a description of current concerns and provided two examples. Consistent with Cole and Berntsen (2016), the description of current concerns referred to them as something you would like to achieve or complete (i.e., positive) or something you would like to cope with or prevent (i.e., negative). The examples that were provided were, avoiding bankruptcy and allocating more time to hobbies. The participants were instructed to choose their own current concerns and not be prompted by the examples. This represented a shortened version of the instrument used by Johannessen and Berntsen (2010).

2.3.4. *Future Thought Characteristics Questionnaire*

The participants had to complete a *Future Thought Characteristics Questionnaire* for each of the thoughts they had. A maximum of 24 thoughts could be recorded, 12 spontaneous and 12 voluntary. Participants had separate booklets for each condition. Each questionnaire was presented on a single A4 page in the booklet. Part one was completed on the left side of the A4 page, Part two on the right. Part two was covered with an adhesive note until after the current concerns questionnaire was completed.

Part one was completed immediately after the participants experienced a future thought (see Appendix A for Part one of spontaneous condition). In Part one, the participants were asked to write a short description of the thought they had and were asked 4 questions. The first question addressed the effort that was required to bring the thought to mind (*1 to 5; 1= No effort at all, 5=Extreme effort*). The second question asked participants to indicate if the thought referred to a particular situation (*binary; yes, no*). The participants were then asked 2 questions concerning temporal distance which are not reported herein as they were part of a related but independent project. In the voluntary condition, the participants were asked to provide the cue phrase that they used to construct the future thought. The spontaneous condition had an additional space in Part one where participants were asked to describe what triggered the thought.

Part two was completed after the Current Concerns Questionnaire and it was covered with adhesive notes until it needed completing (see Appendix B for Part two). In Part two the participants provided a more detailed description of the event and answered a further 12 questions. The questions addressed vividness (*-2 to +2; -2= not at all vivid, +2= extremely vivid*) and emotional valence (*-2 to +2; -2=very negative, +2=very positive*). The following 8 questions concerned the perceived functions of the future thought and were all rated on 8-

point scales (*0 to 7; 0=do not agree, 7=completely agree*) (see Table 1 for function questions). The questions were derived or modified from Barsics et al. (2016) and Rasmussen and Berntsen (2013). There was one question addressing the self-function of future thoughts. To measure the sharing and social identity components of the social function, we utilised two items: One concerning social sharing, drawing upon the concept from Bluck et al., 2005; and one from Rasmussen and Berntsen (2009) concerning social identity. The directive function was addressed with three questions concerning action planning, intention formation (i.e., setting oneself a goal) and decision making. Emotional regulation was measured for both a present orientated focus (i.e., i.e., reassure oneself), and a future orientated focus (i.e., prepare oneself). We note that individual future thoughts can have multiple functions (e.g., a future thought of a dinner with friends next weekend may serve a planning and social function) and may serve one function more than another (functions may operate orthogonally, Barsics et al., 2016). As such, participants completed subjective ratings on several scales rather than selecting only one function per future thought (see D'Argembeau et al., 2011). After the function questions the participants had the opportunity to describe what they thought the function of their future thought was if it was not specified in the questions above. The last question asked participants if the event was related to one of the current concerns they recorded in the Current Concerns Questionnaire. If the thought was related to one of the current concerns, the participant responded by writing what number (1-5) concern it related to. With this information, we could aggregate ratings of thoughts related to current concerns ('selected-goal-related future thoughts') and compare this with the aggregate for those not related to any of their most important current concerns ('selected-goal-unrelated future thoughts'), in line with previous research (Cole & Berntsen, 2016).

Table 1: Statements Used to Measure Functions of Future Thinking

Function Statement (proposed function in parentheses)

1. (Self) This imagined future event tells me something about my identity.
 2. (Social) I will often share this imagined future event with other people.
 3. (Social) Imagining this future event gives me a sense of belonging with other people.
 4. (Directive) This imagined future event helps me plan my actions in present or future situations.
 5. (Directive) This imagined future event contributes to me setting up a new goal.
 6. (Directive) This imagined future event helps me to make a decision.
 7. (Emotional) This imagined future event helps to emotionally reassure me about present or future situations.
 8. (Emotional) This imagined future event helps me to prepare myself emotionally for present or future situations.
-

Note: The following items were totalled to form indexes of each of the four functions (2-3; 4-6; 7-8).

2.4. Procedure

Ethical approval was granted by York St John University's ethics committee. The participants signed up to the experiment through an online participation scheme where they had to respond to an online advert. At this point, to prevent participant bias, the actual aims of the experiment were withheld. Instead, the participants were told the experiment was investigating the effect of a vigilance task on concentration.

Participants were tested individually in a workstation containing a desktop computer, headphones, and questionnaires in paper format. After reading an information sheet the participants provided informed consent. An experimenter gave verbal instructions and the participants were prompted to ask questions if required. Detailed instructions were provided on E-Prime before the experiment started.

The instructions on E-Prime stated that the participant's first task is to complete a vigilance task. They were told that during this task they would be required to press the spacebar each time they identified a target (vertical lines) and to ignore nontargets (horizontal lines). Each time participants pressed the spacebar, they would receive audio feedback (a bell sound). Participants were also told that they would see phrases as well as lines, but they were to ignore these as these as they were for use in another condition, but actually no such condition existed. The participants then completed a 1-minute practice session and were then provided with more on-screen instructions. Participants were told that they may find themselves thinking about other things due to the task being quite monotonous. They were also provided with examples such as, future goals, daydreams and were provided with a description of spontaneous future thoughts. They were told that spontaneous future thoughts could be in the near or distant future and could be specific or general. They were provided with examples and were told that they may have experienced the thought many times before or never before. Finally, they were instructed to press the left mouse button as soon as a spontaneous future thought comes to mind. They were also reminded that their main aim was to press the space bar each time they saw an image with vertical lines.

When participants experienced a spontaneous thought and they pressed the left mouse button, text was presented. This instructed participants to complete Part one of the questionnaire in the booklet and then press enter to return to the concentration task. The concentration task took 15 minutes to complete without any breaks, but participants took longer due to pauses they took in order to record future thoughts. To prevent expectation effects, the participants were never informed about the maximum number of thoughts they could record. If the participants recorded all 12 thoughts before the last slide, they continued the concentration task until it was completed without recording any additional thoughts. When the concentration task was completed the participants were instructed to request the

experimenter's assistance. The experimenter then initiated the voluntary condition and provided participants with a Voluntary Future Thought Characteristics Questionnaire booklet and loaded a voluntary E-Prime experiment on the desktop computer.

In the voluntary condition participants had to consciously construct an event and there was no vigilance task. The participants were provided with instructions informing them that they will be presented with some lines and phrases on the screen. They were then told to think of a future thought for all the phrases they were presented with, one at a time. The phrases were on screen for one minute each and the participants were told to press the left mouse button as soon as a future thought comes to mind. The participants were told that if they cannot think of a future thought within one minute, the next phrase will appear automatically. After the experiment the participants were asked to request the experimenter.

The participants were then asked to complete the Current Concerns Questionnaire and then to remove the adhesive notes covering Part two of the Future Thought Characteristics Questionnaires. After the participants removed them, they were instructed to complete Part two for every thought, both voluntary and spontaneous. Finally, participants were instructed to complete the Beck Anxiety Inventory, but these findings will not be described further as they are part of a separate project. The participants were debriefed and were prompted to ask questions. The whole experiment took an average of 75 minutes to complete.

2.5. Data Analysis

A future thought was considered selected-goal-related if the participant indicated that it was based on one of their five most important current concerns. The data were entered under four within-group conditions, *selected-goal-related spontaneous thoughts*, *selected-goal-unrelated spontaneous thoughts*, *selected-goal-related voluntary thoughts*, and *selected-goal-unrelated voluntary thoughts*. For continuous variables, means were calculated for each

participant. Specificity was calculated with the proportion of representations that were classed as specific. Differences and interactions were calculated using a series of repeated measure ANOVAs. All of the participants who were included in the analysis of subjective ratings completed both the spontaneous and voluntary tasks and they all recorded at least one selected-goal-related thought and one selected-goal-unrelated thought. An alpha level of .05 was set to determine statistical significance.

3. Results

3.1. Vigilance Task

The vigilance task that was utilised in the spontaneous condition was completed with reliably high levels of accuracy with participants identifying on average 10 out of 11 targets ($M= 93.72$, $SD= 9.52$).

3.2. Future Thoughts: Frequency

Examination of the completed Future Thought Characteristics Questionnaires showed that of all spontaneous future thoughts, 56% were triggered by cue phrases, 8% by thoughts, 7% by the environment, and 29% had no known trigger. This demonstrates that, like previous findings (e.g., Cole et al., 2016; Schlagman & Kvavilashvili, 2008), most triggers were cue phrases from the concentration task. Future thoughts were checked by the first author to ensure it was an appropriate description and that Part 1 and 2 of the autobiographical questionnaire was completed. Four of the future thoughts did not fulfil this criterion and were excluded (three excluded because the ratings on the autobiographical questionnaire were insufficient and the other was excluded because it was not future-oriented).

After these exclusions there were a total of 566 future thoughts: 129 selected-goal-related thoughts in the spontaneous condition, 105 selected-goal-related thoughts in the voluntary condition, 138 selected-goal-unrelated thoughts in the spontaneous condition, and 194 selected-goal-unrelated thoughts in the voluntary condition. On average, individuals produced 3.07 ($SD= 2.56$, range= 0-10) selected-goal-related thoughts in the spontaneous condition and 2.50 ($SD= 2.05$, range= 0-8) selected-goal-related thoughts in the voluntary condition. The corresponding numbers for selected-goal-unrelated thoughts were 3.29 ($SD= 2.10$, range=0-9) in the spontaneous condition and 4.62 ($SD= 2.31$, range= 1-10) in the

voluntary condition (see Table 2). A 2 (Spontaneous; Voluntary) X 2 (Selected-goal-related, Selected-goal-unrelated) analysis of variance on the frequency of thoughts demonstrated that there were significantly more selected-goal-unrelated future thoughts than selected-goal-related thoughts ($F(1, 41) = 7.42, p < .01, \eta_p^2 = .15$), but there was no difference between the amount of spontaneous and voluntary thoughts ($F(1, 41) = 2.03, p > .05, \eta_p^2 = .05$). It also demonstrated an interaction ($F(1, 41) = 11.24, p < .005, \eta_p^2 = .0.22$) that can be decomposed as follows; although amounts of selected-goal-related and unrelated future thoughts were similar in the spontaneous mode, when in the voluntary mode, there was an increase in selected-goal-unrelated thoughts and a decrease in selected-goal-related future thoughts. The proportional data, which takes propensity to experience and report spontaneous future thoughts into account, indicated higher proportions of selected-goal-related future thoughts in the spontaneous versus voluntary condition ($t(41) = 2.16, p < .001, d = .34$).

For illustration purposes, representative examples of selected-goal-related and selected-goal-unrelated thoughts are provided in Appendix C.

Table 2. Frequencies of Spontaneous and Voluntary Future Thinking ($N = 42$)

	Spontaneous		Voluntary	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Overall	6.36	3.46	7.12	2.61
Frequency				
Selected-goal-unrelated	3.29	2.10	4.62	2.31
(frequency)				
Selected-goal-related	3.07	2.56	2.50	2.05
(frequency)				
Selected-goal-related	.43	.28	.34	.23
(proportion)				

3.3 Future Thoughts: Functions and Phenomenological Properties

The means, standard deviations, and ANOVA statistics, for all phenomenological characteristics and functions, are reported in Table 3. In contrast to the *self function*, *social*, *directive* and *emotion* functions incorporated multiple items, therefore items were averaged to form three indexes for each of these conditions (all cronbach's alphas indicated acceptable covariance, .76 - .93, except social current concern index items, $\alpha = .43$. For this reason, social function items were also analysed separately).

3.3.1 Functions

When examining function items, there were no significant difference for voluntarily- and spontaneously- elicited thoughts on the self, social or emotional regulation functions (see Table 3). There was, however, a significant difference of mode of elicitation for the directive function, indicating that spontaneously-elicited thoughts are more strongly associated with planning, goal-setting and decision making than voluntarily-retrieved thoughts (see Table 3). Additionally, based on findings from autobiographical memory research (Waters, Bauer & Fivush, 2014), one might expect specificity to affect the perceived functions¹. However, when tested in a series of repeated measures ANOVAs (using an alpha level of .01 to reduce Type 1 Error), it was found that neither self ($F(1,22) = 0.79, p = .39, \eta_p^2=.03$), directive ($F(1,22) = 1.22, p = .28, \eta_p^2=.05$), nor emotion regulation functions ($F(1,22) = 1.04, p = .32, \eta_p^2=.05$) were affected by specificity. The only function affected by specificity was social ($F(1,22) = 5.55, p = .03, \eta_p^2=.20$), whereby more specific future thoughts were associated with higher ratings than non-specific future thoughts.

There were significant effects of goal-relatedness for *all* of the function questions indicating that selected-goal-related thoughts were more tightly connected to directive, self, social and emotion functions than selected-goal-unrelated thoughts. This was the case when

¹ We thank an anonymous reviewer for raising this point.

each social function item (see Table 1) was analysed separately (both $ps < .001$). The effect sizes (with partial eta squared, see Table 3) were considered large for all functions, and all were significant at the .005 level except the self-function).

In terms of the self function, a significant interaction emerged between mode of elicitation and goal-relatedness, such that goal-relatedness increased self function ratings in the spontaneous condition to a greater extent than in the voluntary condition (see Table 3). Pairwise comparisons of self function ratings contrasting goal-related and non goal-related future thoughts indicated that the spontaneous selected-goal-related condition had significantly higher ratings than the spontaneous non-selected-goal-related condition ($p < .005$); but no other pairwise differences proved statistically significant. There were no other interactions between mode of elicitation and goal-relevance among function measures¹.

3.3.2 Phenomenological Properties

In line with predictions, voluntary construction required significantly more effort than spontaneous elicitation (see Table 3). Second, in line previous findings (e.g., Cole et al., 2016), spontaneously-elicited thoughts were significantly more likely to be categorized as specific than voluntarily-elicited thoughts (see Table 3): Whereas 75% of spontaneously-elicited thoughts were rated as specific, this was only true for 61% of voluntarily-elicited thoughts (see Table 3). Third, there was no significant difference of valence ratings for voluntary and spontaneous retrieved thoughts (see Table 3). Fourth, there was no significant difference of vividness ratings for voluntary and spontaneous retrieved thoughts (see Table 3).

¹ Considering that one participant was male, it would be useful to ascertain the effect of mode of elicitation and goal-salience when this male is excluded; thus making our results generalisable to the female population. When this male was excluded, analyses of function ratings with the remaining 30 participants, with the same ANOVAs presented in section 3.3.1 showed consistent main effects and interactions as with the male included. Thus, we conclude that the addition of this male did not affect our main analyses.

In contrast to Cole and Berntsen (2016), and our prediction, there were no significant effects of goal-salience on any phenomenological characteristic. Finally, no significant interactions between goal-relevance and mode of elicitation were found for any phenomenological characteristic (see Table 2).

Table 3:*Descriptive and ANOVA statistics for phenomenological properties and functions*

Characteristic	Spontaneous				Voluntary				Main effects and interactions					
	GR		GUR		GR		GUR		Invol vs. Vol		GR vs. GUR		Interaction	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	η_p^2	<i>F</i>	η_p^2	<i>F</i>	η_p^2
<i>Phenomenology</i>														
Effort	1.85	.67	1.73	.68	2.50	.98	2.45	.87	18.93***	.39	1.05	.03	0.10	.00
Specificity	.75	.28	.75	.31	.65	.34	.57	.33	7.64*	.20	1.05	.03	0.60	.02
Vividness	.99	.70	.72	.86	.74	.97	.58	.76	1.67	.05	2.27	.07	0.28	.01
Valence	.79	.96	.60	1.08	.32	1.18	.52	.78	2.66	.08	0.001	.00	1.52	.05
<i>Function</i>														
Self	3.37	1.93	2.17	1.61	2.88	2.03	2.62	1.93	0.01	.00	7.86*	.21	4.37*	.13
Social	4.14	1.51	2.97	1.65	3.64	1.80	3.11	1.50	0.72	.02	13.99**	.32	1.45	.05
Directive	4.78	1.38	2.37	1.45	3.61	1.69	1.69	1.26	15.69***	.34	85.90***	.74	1.80	.06
Emotion	3.39	2.12	1.99	1.35	3.07	2.04	1.84	1.37	0.86	.03	26.70***	.47	0.14	.01

Note: GR=selected-goal-related; GUR= selected-goal-unrelated; ANOVA= analysis of variance; Invol= spontaneous retrieval; Vol= voluntary retrieval ; * $p < .05$, ** $p < .005$, *** $p < .001$

4.

Discussion

In this laboratory study, the primary aim was to examine the perceived functions of spontaneous and voluntary future thinking and whether these differed substantially, thus addressing a notable gap in the research on future thinking (Cole & Kvavilashvili 2019b). Additionally, we aimed to elucidate whether functions are affected by goal-relatedness, and whether spontaneous future thoughts are more frequently goal-related than voluntary future thoughts. In line with several recent studies (Barzykowski, Radel, Niedźwieńska, & Kvavilashvili, 2019; Cole et al., 2016; Plimpton, Patel & Kvavilashvili, 2015), we aimed to further characterise the phenomenological properties of spontaneous future thoughts, using voluntary future thoughts as the main comparator (see Cole & Kvavilashvili, 2019a for a discussion of this approach).

In general, findings showed that spontaneous and voluntary future thoughts were judged as similarly important on all four functions assessed (self, social, directive and emotional regulation). However, the directive function was judged as particularly relevant to spontaneous future thoughts. Future thoughts classed by participants as goal-related were endorsed to a greater degree across all four functions, and by and large, no interaction was found between mode of elicitation and goal-relatedness on functions (with self function as the exception). In conflict with our prediction based on a prior study (Cole & Berntsen, 2016), selected-goal-related future thoughts were not rated substantially higher on phenomenological properties such as vividness or emotional valence of the future thought. Nevertheless, we did replicate a prior finding (Cole & Berntsen, 2016): a higher proportion of spontaneous future thoughts were selected-goal-related compared with voluntary future thoughts. These findings will be contextualised within recent research on spontaneous future thinking, and future thinking in general.

4.1. Differences between spontaneous and voluntary future thoughts

It is important to first show that spontaneous future thoughts had the same identifying characteristics as shown in previous research, thus adding to the validity of the methods employed here. Consistent with previous work (Cole et al., 2016; Berntsen & Jacobsen, 2008), and initial predictions, the present study showed that voluntary future thinking required significantly more effort than spontaneous future thinking. This is consistent with research which found voluntarily elicited thoughts are elicited in a slower, more deliberative fashion (Cole, Staugaard & Berntsen, 2016), and are associated with greater activity in prefrontal brain regions than spontaneous elicited thoughts (Hall et al., 2014; Schlagman & Kvavilashvili, 2008). Low cognitive effort, in addition to the lack of an intention to construct a future event, are known to be cardinal properties of spontaneous future thought (Cole & Kvavilashvili, 2019b). The present study also replicated previous studies indicating that involuntarily elicited thoughts more frequently concern specific events than voluntarily elicited thoughts (Berntsen & Hall, 2004; Berntsen & Jacobsen, 2008). These findings solidify a small but rapidly-growing literature on spontaneous future thought (Bernsten & Jacobsen, 2008; Cole et al., 2016; Finnbogadóttir & Berntsen, 2013; Plimpton, Patel & Kvavilashvili, 2015; Warden, Plimpton & Kvavilashvili, 2019), and are consistent with a recent theoretical framework positing that voluntary and spontaneous future thoughts are associated with specific and dissociable characteristics (see Cole & Kvavilashvili, 2019b).

4.2. What are the primary functions of voluntary and spontaneous future thoughts?

The central question of this study was to identify specific functions of spontaneous and voluntary future thoughts and whether they differed. Overall, it was clear that participants endorsed all proposed functions – self, directive, social, and emotional regulation

- as moderately relevant, as shown by mid-point responses across the measures (approximately 3.5, on a 0-7 scale of importance). At least for self, social and emotional regulation functions, these ratings did not differ statistically between spontaneous and voluntary future thoughts. Directive functions were perceived as more relevant for spontaneous versus voluntary future thoughts. Although we allowed participants to describe idiosyncratic functions of future thoughts in addition to the scales (Table 1), the very small number of these responses (40/450 thoughts, 9% of responses), indicated that the scales adopted here captured at least the main functions to which future thoughts are associated.

To contextualise our results, there have been two previous studies which have attempted to measure functions of future thoughts via ratings scales or questionnaires. In Rasmussen and Berntsen (2013), participants rated each future thought on social, self and directive functions. However, in D'Argembeau et al (2011), participants were required to select *one function per thought*, from a set which included decision-making, planning, emotional regulation, non-functional daydreams or other (participant's qualitative description). The current study, however, adopted the approach of Rasmussen and Berntsen (2013) on the basis that some future thoughts may serve more than one function. In line with our results, Rasmussen & Berntsen (2013) found that self, directive and social functions were rated around the mid-point for future thoughts, on average, and additionally, that this was higher when positively valenced. Due to the nature of their assessments, D'Argembeau and colleagues (2011) used frequency data to show that around 50% of future thoughts served a directive function, 18% served a decision-making function and 10% played a role in emotion regulation. Although we contextualise our results within these studies' findings, it should be emphasised that this study is not directly comparable to either study, due to different assessment methods (D'Argembeau et al., 2011) and numbers of functions examined

(D'Argembeau et al., 2011; Rasmussen & Berntsen, 2013). We now expand on each of the four functions of future thinking assessed herein, in relation to mode of elicitation and goal-relatedness.

4.2.1. Social Functions

First, in contrast to autobiographical memory research (e.g., Bluck et al., 2005, Waters et al., 2014), there is a surprising lack of research on the potential social function/s of future thinking. There are two notable exceptions: (1) A programme of research showing that generating voluntary future thoughts can increase empathic social behaviour (e.g. Gaesser, Keeler & Young, 2018) and (2) recent theoretical work highlighting the importance of *collective future thought*, defined as “how individuals think about the future of groups and how groups imagine and conceptualize the(ir) future” (p. 377, Szpunar & Szpunar, 2016). In autobiographical memory research, memories are shared to demonstrate empathy or intimacy, ease communication, or facilitate social bonding (Bluck et al., 2005). The present study adds to this pool of evidence, showing that; voluntary and spontaneous future thoughts differ little in terms of perceived relevance to social functions, and specific future events are rated as more important to the social function compared with general thoughts about the future.

The latter finding relates to autobiographical memory research showing that specific memories have more prominent roles in important everyday functions (Waters et al., 2014). We might speculate that specific *future* thoughts express more about individuals' plans than generic future thoughts, thus are more likely shared with others, and provide more about our place in social groups. However, further experimental and naturalistic studies investigating the roles that voluntary and spontaneous future thinking play in socio-psychological processes, will be necessary to follow-up on these findings.

4.2.2. Self Function

More widely known is the link between future thinking and the self (Conway, Loveday & Cole, 2016; Conway, Justice & D'Argembeau, 2019; Prebble, Addis & Tippett, 2013). Indeed, the way one perceives their future roles (e.g., 'I will be a father', Rathbone, Conway & Moulin, 2011), lifetime periods (see Thomsen, 2015 for a review) and the way individuals 'pre-experience' possible future events with vivid first-person mental imagery (D'Argembeau & Van der Linden, 2004) have all been argued to have important links with self-identity (Rasmussen and Berntsen, 2013; Conway, Justice & D'Argembeau, 2019; Prebble, Addis & Tippett, 2013).

In the present study, participants rated the self function of future thoughts similarly, independently of the mode of elicitation. Nevertheless, selected-goal-related future thoughts were rated as more important for self-identity than selected-goal-unrelated future thoughts, in line with predictions, indicating that selected-goal-related thoughts are more closely associated with an individual's identity and sense of self. This is consistent with D'Argembeau et al. (2010) who found that selected-goal-related thoughts had greater personal import (see Johannessen, & Berntsen, 2010, for similar results with past mental time travel). Therefore, the present study shows that the self function is moderated by goal-relatedness, in addition to valence of the future thought (Rasmussen & Berntsen, 2013).

Furthermore, there was an interaction between mode of elicitation and goal-relatedness, whereby goal-relatedness affected self function ratings to a greater extent when future thoughts were elicited spontaneously versus voluntarily: Goal relevance had little effect on self function ratings of voluntary future thoughts (see Table 3). Although it is surprising that an interaction was not also found for other functions, this result may be best understood in the context of a recent theoretical account that integrates the revised self memory system (Conway, Justice & D'Argembeau, 2019) to explain characteristics and functions of spontaneous future thoughts (Cole & Kvavilashvili, 2019b).

In sum, the current study extends previous findings by showing that future thinking may have a role in shaping our identity (or vice versa) even when they appear in consciousness with no attempt at bringing them to mind (see Conway, Justice & D'Argembeau, 2019, for related discussions).

4.2.3. Emotion Regulation Function

The emotion regulation function findings highlight a potentially important role for future thinking in regulating an individual's emotions – whether spontaneous or volitional (again, no differences were found across mode of elicitation). In support, mean emotional valence ratings herein were consistently positive across all future thinking conditions, suggesting both voluntary and spontaneous future thoughts may serve the function of improving one's mood (Cole, Staugaard & Berntsen, 2016; Rasmussen & Berntsen, 2013). The present study also found a main effect of goal-relatedness for the emotional regulation function indicating that selected-goal-related future thinking is more effective at preparing and reassuring individuals about the future. This extends findings from Barsics et al. (2016) who found that positive future thinking reassures individuals about the future whereas negative future thinking prepares individuals for future events (see also Rasmussen & Berntsen, 2013). The findings of the present study highlight an important function for selected-goal-related future thought. It suggests that individuals are anticipating what their emotions will be in imagined, selected-goal-related future scenarios and are developing perceived control over them (see Armitage & Reidy, 2012; Pham & Taylor, 1999). People then feel more prepared and reassured about the future which decreases negative emotions surrounding any potential goal-related future events. However, this explanation is somewhat speculative and future research should attempt to investigate the potential benefits of goal-

related future thinking for emotional regulation, using measures of attitudes and perceptions as well as behaviour (as in Armitage & Reidy, 2008).

4.2.4. Directive Function

Unlike other functions assessed here, it was found that there was a significant difference depending on mode of elicitation for the directive function, indicating that spontaneously elicited thoughts are associated with the directive function to a greater extent than voluntarily elicited thoughts. This is consistent with the idea that the spontaneous mode (in general) is less time demanding and so is potentially more useful in situations that call for immediate action (see Pillemer, 2003). Spontaneous thought processes are also assumed to underlie well-known self-regulation strategies (Gollwitzer, 1999).

Future thoughts were rated higher on directive functions (i.e., planning, goal-setting, and decision making) when they were related to goals: One is likely to generate more plans when their future thought is linked to an uncompleted goal (current concern)¹. This provides additional validity that our coding of selected-goal-related and selected-goal-unrelated thought was meaningful and related to the real-life future-oriented plans people experienced within this laboratory-based study.

In sum, the fact that a range of thoughts were elicited herein, and that both voluntary and spontaneous thoughts were measured within-participants, provides evidence that future

¹ Although somewhat related, as both refer to goals, we believe that current concerns and the directive function are conceptually different. Current concerns refer to higher order goals whereas the directive function is centred around the pursuit of these goals (so the thoughts/actions required to achieve goals, see Klinger, 1975; Pillemer, 2003). Also, data from the study indicated that some of the current-concern related thoughts were not rated as 10 (highly) for the directive function. This indicates that these could be related but separable constructs. In fact, 16.18% of current concern related thoughts were rated low (< 3) on the planning function, 33.82% for the goal setting function, and 32.35% for the decision-making function.

thoughts are perceived to have a key role in goal-directed behaviour, and supports prior work highlighting the perceived role of future thinking in directing behaviour (D'Argembeau et al., 2011). Further, this function is accentuated when future thoughts are spontaneous *and* related to current concerns.

These findings are in line with several recent theoretical developments (see Cole & Kvavilashvili, 2019b; Kvavilashvili & Rummel, 2020). Several studies indicate that spontaneous future thoughts largely consist of representations of future plans (see Plimpton, Patel & Kvavilashvili, 2015). However, more empirical work is needed to understand how and when spontaneous future thoughts aid future behaviour in everyday life, using more naturalistic approaches.

4.3. Frequencies of selected-goal-related spontaneous and voluntary future thoughts

It was predicted that there would be differences in the number of selected-goal-related future thoughts in the spontaneous compared to voluntary condition, whereby selected-goal-related thoughts would be significantly more frequent in the spontaneous condition than the voluntary condition. However, it should be noted that although Cole and Berntsen (2016) did report a higher proportion of selected-goal-related thoughts in the spontaneous condition, this was not present in their analysis of raw frequencies. Nevertheless, we now observe across two studies that, proportionally, spontaneous future thoughts are more linked with uncompleted goals than are voluntary future thoughts. This lends support to the long-standing hypothesis that spontaneous thought is inherently selected-goal-related (Klinger, 2009), and points to spontaneous future thinking as an especially important subtype of spontaneous thought for guiding cognition and action (see Cole & Kvavilashvili, 2019a and b; Berntsen, 2009; Kvavilashvili & Rummel, 2020).

Finally, we did not find supportive evidence that selected-goal-related future thoughts were elevated in terms of vividness, emotional positivity, specificity, than selected-goal-unrelated future thoughts (see Cole & Berntsen, 2016).

4.4. Limitations

In the present study, mode of elicitation was a within-group factor and one could argue that carryover effects from the spontaneous condition to the voluntary condition could have confounded the results. For example, participants may have utilised the content of their spontaneous future thoughts to construct their voluntary future thoughts. Therefore, a between-groups design for the mode of elicitation condition will be an important adaptation of this research. Nevertheless, it is unlikely that carry over effects can entirely account for the results because the present study found systematic differences between the spontaneous and voluntary conditions, replicating previous findings from naturalistic and laboratory studies (for a review of these studies, see Cole & Kvavilashvili, 2019a).

In addition, findings of the present study should be interpreted with the appreciation that they represent the participant's subjective perceptions about the functions and characteristics of their future thoughts. These subjective ratings naturally depend upon how aware participants are that they relate to their own lives (see Pillemer, 2003, for similar arguments concerning memories). Therefore, studies into behavioural measures of future thinking (such as *future-oriented behavioural paradigms*, e.g., Daniel, Stanton & Epstein, 2010; *visuo-spatial analogues*, Spreng, Stevens, Chamberlain, Gilmore & Schacter, 2010) and their relationship with subjective measures are required to establish convergent validity of these findings.

One must also acknowledge the focus here upon *simulations*, rather than other types of prospective thought (see Szpunar, Spreng & Schacter, 2014). Therefore, our results cannot be generalised to other forms of prospection. Indeed, it is possible that the type of prospective thought moderates the relationship between prospection and specific functions. For instance, intentions and plans may be more tightly related to certain functions (e.g., directive) than others (e.g., emotional regulation).

Although spontaneous and voluntary future thoughts may have been rated similarly on three out of four of the proposed functions, an open – and arguably more important question – is *how* future thoughts are utilised in daily life (see Kvavilashvili & Rummel, 2020). Taking the social function as an example, voluntary future thinking may be used to develop joint plans with a friend, whereas spontaneous future thoughts may bring these thoughts of plans ‘online’ between plan formation and the event in an unbidden fashion (see Cole & Kvavilashvili, 2019b). In the case of the directive function, where spontaneous future thoughts were rated higher than voluntary future thoughts, this could indicate that future thoughts are utilised *qualitatively differently* for planning and future decision-making depending on mode of elicitation. Specifically, voluntary future thoughts may be used to develop and construct novel plans in daily life, whereas spontaneous future thoughts may act as reminders between the time a plan was initiated and when it is enacted (see Kvavilashvili & Rummel, 2020; Cole & Kvavilashvili, 2019b for related discussions). The fact that future thinking may be utilised in qualitatively different ways in daily life, depending on mode of elicitation, and that these differences may not be captured in scales which are unidirectional, suggests that future work should focus on real world applications of future thinking. Initial applied work has utilised voluntary future thinking to reduce impulsive eating (Daniel, Stanton, & Epstein, 2013), but more work is necessary to elucidate how spontaneous future

thoughts benefit daily life activities (see Kvavilashvili and Rummel, 2020 for a discussion in relation to prospective memory and mind wandering).

Finally, in the present study participants could only record five current concerns in the Current Concern's Questionnaire, even though the participants could have potentially generated more. Therefore, it is possible that some selected-goal-related future thoughts may have been classified as selected-goal-unrelated because their concern was not reflected in the most important five they produced in the Current Concerns Questionnaire.

4.5. Conclusions

Rather than focussing on differences between past and future thought (Rasmussen & Berntsen, 2013), the present study adds to an emerging literature on spontaneous thought concerning future scenarios by comparing spontaneous and voluntary future thinking (see Cole & Kavavilashvili, 2019a) in terms of perceived functions. This study extends previous research (D'Argembeau et al., 2011; Rasmussen & Berntsen, 2013) by showing that future thinking may serve at least four functions. Novel results were found concerning the possible functions of spontaneous future thinking in guiding self-regulatory behaviour, confirming previous theoretical work on spontaneous thought (Klinger, 1975, 2009) and future thinking (Schacter, 2012; Suddendorf & Corballis, 2007). Crucially, across all functions, goal-related future thinking could be reliably distinguished from goal-unrelated future thinking. This study shows that more work is required examining a wide variety of functions, and how they may operate in applied settings, transferring results from the lab into the real-world.

Compliance with Ethical Standards

Conflict of Interest: Jessica Duffy declares that she has no conflict of interest. Scott Cole declares that he has no conflict of interest.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of York St John University ethics committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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Appendix A

Future Thought Characteristics Questionnaire (Part 1)

Participant no.:

Future Thought no.:

Please write a short description of the future thought:

.....

1. Was there anything that triggered the future thought, this could be either in your mind or in the environment? If not, please write an "X" for no trigger and proceed to the next question.

.....

2. Please indicate to what extent you actively brought this future thought to mind (please circle)

No effort at all 1 2 3 4 5 Extreme effort

3. Does the future thought refer to a particular situation in a particular day in your future (please circle)?

Yes / No

4. How old are you when the imagined future event takes place? (Age estimated in years)

5. If you indicated your current age in Question number 4, how many days from today is the event in the future? (Estimate in days)

Appendix B

Future Thought Characteristics Questionnaire (Part 2)

1. Please use Part One to remember your imagined future thought and describe it in as much detail as possible below:

.....

2. How vivid was the future thought (please circle)?

Not at all vivid -2 -1 0 1 2 Extremely vivid

3. What was the emotional valence associated with the future thought (please circle)?

Very negative -2 -1 0 1 2 Very positive

The next questions address the functions of imagined future thoughts, if you don't think an imagined future thought has a function rate it as 0. These statements will be rated on a scale of 0-7.

1. This imagined future event tells me something about my identity. (Please circle).

Not at all 0 1 2 3 4 5 6 7 to a very high degree

2. I will often share this imagined future event with other people. (Please circle).

Not at all 0 1 2 3 4 5 6 7 to a very high degree

3. Imagining this future event gives me a sense of belonging with other people. (Please circle).

Not at all 0 1 2 3 4 5 6 7 to a very high degree

4. This imagined future event helps me plan my actions in present or future situations. (Please circle).

Not at all 0 1 2 3 4 5 6 7 to a very high degree

5. This imagined future event contributes to me setting up a new goal. (Please circle).

Not at all 0 1 2 3 4 5 6 7 to a very high degree

6. This imagined future event helps me to make a decision. (Please circle).

Not at all 0 1 2 3 4 5 6 7 to a very high degree

7. This imagined future event helps to emotionally reassure me about present or future situations. (Please circle).

Not at all 0 1 2 3 4 5 6 7 to a very high degree

8. This imagined future event helps me to prepare myself emotionally for present or future situations. (Please circle).

Not at all 0 1 2 3 4 5 6 7 to a very high degree

9. If the function was not specified above please describe what you think the perceived function of the imagined future event is.

.....

.....

Please use your answers to the current concerns questionnaire to answer this question.

If this is related to one of your current concerns, please indicate which number.

.....

Appendix C

Examples of selected-goal-related and selected-goal-unrelated future thoughts

Example 1: selected-goal-related spontaneous future thought

“Shopping for Christmas gifts with my stepdad” (Female, 18).

Relevant current concern: Finishing Christmas shopping.

Example 2: selected-goal-related voluntary future thought

“Someone breaking my trust and hurting me” (Female, 18).

Relevant current concern: To try and talk with and meet new people.

Example 3: selected-goal-unrelated spontaneous future thought

“I pictured myself in a wedding dress getting married. Actively thinking about future goals” (Female, 20).

All five current concerns: (1) spend more time with friends, (2) make more time to see boyfriend, (3) need to do more reading for university, (4) I am proud of myself for reaching 36 points target on SONA, (4) I am excited to start my new job in summer.

Example 4: selected-goal-unrelated voluntary future thought

“Picking the phone up to my mam calling and asking about my day” (Female, 19).

All five current concerns: (1) finding a good job, (2) have a family, (3) travel, (4) find a nice house, (5) get my degree.