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A time for creativity: How future-oriented schemas facilitate creativity

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ABSTRACT

According to the creative cognition approach, the infrequent generation of truly creative ideas could be due to the pervasive reliance on schemas during creative ideation. People tasked to generate creative ideas tend to anchor on accessible schemas, thus many of these ideas predictably conform to pre-existing exemplars or concepts. It is reasonable to argue that suppressing the reliance on conventional schemas coupled with activating unconventional schemas could broaden the sources of inspiration and facilitate creativity. Grounded in social schema research, I hypothesize that people tend to project high societal change in the future, and that future construal will activate these change and progress schemas to instigate higher creativity. Results of three experimental studies confirm my mediation prediction that future (vs. present) temporal construal activates schemas of change and progress, which subsequently fosters creative performance in domains that require divergent thinking (albeit not convergent thinking). By experimentally manipulating accessibility of the change and progress schemas under future construal, Study 3 further supports the causal direction in the mediation. I discuss the broad implications of how the study of schematic perceptions about the future contributes to research on creative cognition.

Keywords: Creativity; future temporal construal; schema; divergent thinking

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CHAPTER 1: INTRODUCTION

Creativity and innovation hold the key to a better future. This is hardly an overstatement; some difficult problems today require significant restructuring of some preconceived notions about the societies and human life in order to revolutionize the world for a better tomorrow through social innovation (Mulgan, Tucker, Ali, & Sanders, 2007; Phills, Deiglmeier, & Miller, 2008). For example, in order to achieve global inclusivity, there have been many attempts to bridge the digital divide by connecting the less privileged communities to the Internet, a vital resource for modern education. A revolutionary social innovation project by the University of North Carolina did just the opposite, by emulating the Internet offline. The developed eGranary digital library provides a more cost-effective and accessible Internet-based educational resources offline for communities without Internet access (The WiderNet Project, 2015). Such an undertaking requires breaking free from existing schemas and preconceptions to entertain new possibilities in hopes of resolving emerging problems in the foreseeable future.

Unfortunately, radically creative ideas remain relatively rare. One key reason is because people generate new ideas by building upon easily retrievable schemas and knowledge that are anchored to conventional or commonplace concepts (Ward, 1994; Ward, Smith, & Vaid, 1997). In the current research, I propose that thinking about the future, or future temporal construal, promotes the accessibility of more unconventional schemas associated with change and progress, which can in turn afford the generation of highly novel ideas. Accessibility of future-oriented schemas will also temporarily replace creativity-constraining schemas that typically orient individuals to efficiently navigate recurring events in the present world. In other words, thinking in terms of future-oriented schemas characterized by change and progress could unanchor people's thinking in preexisting concepts, thereby substantially boosting creativity.

The Creative Cognition Approach to Creativity

Creativity chiefly entails the production of novel and useful ideas (Amabile, 1982; Runco & Jaeger, 2012). There have been various perspectives to studying creativity, for instance, as an ordinary cognitive process (Bink & Marsh, 2000; Ward, Smith, & Finke, 1999), a product of emotions (Baas, De Dreu, & Nijstad, 2008; Fredrickson, 1998; Isen, Daubman, & Nowicki, 1987), a personality trait (Simonton, 2000, 2003), and even a form of intelligence (Lee & Therriault, 2013; Sternberg & O'Hara, 1999). Based on the creative cognition approach, this paper focuses on the effects of cognitive schemas on creativity (e.g., Bink & Marsh, 2000; Ward et al., 1999). In particular, it focuses on understanding the dominant contents that characterize people's future-oriented schemas and how these schemas could benefit creative idea generation.

The creative cognition approach postulates that remarkable ideas are generated from observable and ordinary cognitive processes that are accessible to laypeople and not just creative geniuses; these assumptions open creativity to scientific inquiry (Bink & Marsh, 2000; Runco & Chand, 1995; Ward et al., 1999; Weisberg, 1986, 1993). The approach proposes that creativity comprises two fundamental processes, *generation* and *exploration* of "pre-inventive structures" or mental representations that could lead to the realization of creative solutions (Ward et al., 1999). Generative processes include retrieval of existing conceptual structures from memory (Smith, 1995; Ward, 1994, 1995), forming associations between structures (Mednick, 1962, 1968), transferring analogical knowledge between conceptual domains (Holyoak & Tahagard, 1995), and synthesizing conceptual structures to produce emergent concepts (Bink & Marsh, 2000). Exploratory processes further elaborate on generated ideas and assess its functions, appropriateness, implications, and limitations (Finke, Ward, & Smith, 1992). If an idea proves futile, a restructuring process may be required to question and reconceive the assumptions and approach to a problem (Ash & Wiley, 2006).

Thus, the process cycles between generation and exploration until a creative solution is reached (Ward et al., 1999).

Structured imagination. Unfortunately, truly creative ideas are often rare, chiefly because people typically initiate the idea generation process by first retrieving accessible schemas and knowledge structures before modifying them to create new ideas (Bink & Marsh, 2000; Ward, 1994; Ward, Patterson, Sifonis, Dodds, & Saunders, 2002; Ward et al., 1997). This leads to a phenomenon referred as *structured imagination*, where creative outputs predictably retain the characteristics of schemas used to generate them. This is unsurprising as schemas serve as a cognitive mechanism to organize, assimilate, and aggregate similar sets of knowledge and experiences in order to facilitate rapid and effortless retrieval of prior knowledge and learning of new knowledge (Price & Driscoll, 1997; Rumelhart, 1980). Whilst a schema set contains rich amounts of information (e.g., knowledge structures, conceptual information, prototypical exemplars, identifying and discriminating features; Marshall, 1995; Rosch, 1975), it functions to provide individuals a form of *generalized* knowledge or heuristics to efficiently make sense of familiar experiences (Anderson, 1977; Rosch, 1978).

The reliance on schemas give rise to structured imagination and is observable when ideas intended to be creative retain characteristic properties of the concept from which the creative idea originates. For example, participants who imagined alien animals with ‘wings’ often included ‘feathers’ rather than ‘fur’ features in the alien (i.e., applying the schema of birds); similarly, ‘scales’ also coincided highly with ‘fins’ and ‘gills’ (i.e., applying the schema of fishes; Ward, 1994; Ward et al., 2002). Even when participants included atypical features in their alien designs, they invariably served the same functions as those features of earth animals (Brédart, Ward, & Marczewski, 1998). Findings generally support that the generation and synthesis of ideas systematically conform to one’s schemas (see review by Bink & Marsh, 2000).

Path of least resistance model. Another reason why idea generation is structured by schemas is because people tend to take the *path of least resistance* by first retrieving and modifying representative instances of a known concept (i.e., exemplars; Ward et al., 2002). Representative exemplars exhibit two properties: typicality (i.e., how well it satisfies the ideal of a conceptual domain) and retrievability (i.e., how easily it comes to mind). Concepts high in typicality and retrievability are also high in *accessibility* (Higgins, 2011), which predicts their likelihood of being used as starting anchors for new ideas (Ward et al., 2002).

Importantly, the use of schemas is unlikely a consequence of a conscious retrieval strategy, but rather an automatic process recruited to meet the demands of the idea generation task (Bink & Marsh, 2000). Even with a clear goal of generating truly original ideas, creativity is often anchored to existing schemas commonly encountered in everyday life. For a historical example, when passenger rail trains were first implemented in the U.S. in 1830s, they were directly modeled after horse-drawn stagecoaches with conductors sitting outside the train cabin. As a result, although the direct transfer of this design facilitated the rapid implementation of railway travel, many conductors sitting outside the train cabin fell off and were killed at the time (Ward, 2007; White, 1978). In empirical research, given a clear goal to produce “wildly different” drawings of aliens from a planet markedly different from earth, participants continued to draw bilaterally symmetric creatures with two or four limbs and with major sensory organs highly typical of earth animals. Highly accessible earth animals (e.g., dogs) are also often reported as reference points for new ideas (Ward, 1994; Ward et al., 2002; Ward & Sifonis, 1997).

The reliance on schemas is quite pervasive. Some research show that even when task-specific hints are recently provided, people remain biased to using generalized schematic knowledge to solve insight problems (Perfetto, Bransford, & Franks, 1983; Perkins, 1988; Weisberg, DiCamillo, & Phillips, 1978). Marsh, Landau, and Hicks (1996) found that

providing examples of unusual combination of ideas (e.g., an animal with claws and antennae) did not boost creativity, however, providing highly schematic examples (e.g., an animal with four legs and a tail) significantly constrained the originality of ideas. Situations involving time pressure and cognitive load further exacerbate people's reliance on heuristics and schemas, making them less creative (Antes & Mumford, 2009; De Dreu, Nijstad, Baas, Wolsink, & Roskes, 2012). Although technical knowledge is sometimes requisite for creativity (Amabile, 1983), even experts can become uncreative in their subject domain, presumably because they have acquired well-developed schemas through their extensive experience that they apply as heuristic solutions even in novel situations (Wiley, 1998). Together, these studies show that people readily use schemas rather than exploring radically new ideas in their creative endeavors.

Based on this existing research, I conjecture that highly creative ideas are more likely to ensue if (a) individuals reduce the reliance on typical schemas and (b) they make use of the atypical schemas that represent those concepts and knowledge that diverge from everyday experiences. The first proposition in (a) is consistent with the prior research demonstrating that experiences that destabilize the use of one's schemas can enhance creativity. For instance, immersive multicultural experiences both challenge the validity of one's culturally grounded schemas and broadens one's pool of knowledge that is deemed conducive for creative conceptual expansion (Leung, Maddux, Galinsky, & Chiu, 2008; also see Gocłowska & Crisp, 2014). By extension, individuals who are more psychologically prepared to deviate from their cultural schemas, such as those higher in openness to experience (Leung & Chiu, 2008) and lower in need for cognitive closure (Leung & Chiu, 2010), are more likely to harness the creative benefits of their multicultural experiences. In another research, Gocłowska and colleagues showed that primed exposure to counter-stereotypes (e.g., a female mechanic, a Black president) promote people's thinking outside the constraints of stereotypic

schemas, thus boosting their cognitive flexibility and originality on divergent thinking tasks (Goclowska, Baas, Crisp, & De Dreu, 2014; Gocłowska & Crisp, 2013; Goclowska, Crisp, & Labuschagne, 2012). In a similar vein, Ritter and colleagues (2012) found that an experience with schema violation, such as navigating a virtual reality world that defies the laws of physics or reversing the typical steps of making a chocolate chip sandwich, enhanced cognitive flexibility. It was also found that the effects of these schema violations on creativity are associated with heightened activation of the right temporal parietal junction in the brain, an area implicated in creative insight performance (Ritter et al., 2014).

The second proposition in (b) is based on a novel conjecture that some schemas can guide thinking to become more creativity-facilitating. In the next section, I advance a hypothesis that orienting individuals to think of the future could activate future-oriented schemas associated with concepts of change and progress that could in turn foster creativity.

Future Construal Benefits Creativity

Past research has alluded to the link between future construal and creativity. In particular, Forster, Friedman, and Liberman (2004) had consistently found that participants who imagined their future selves completing creativity tasks a year later (distant future condition) outperformed those who imagined themselves completing the tasks a day later (proximal future condition). These findings align with the Construal Level Theory, which posits that mental representations of distal entities such as the farther future would induce people to think abstractly (for recent reviews, see Liberman, Trope, & Stephan, 2007; Trope & Liberman, 2010). Abstract thinking has previously been shown to facilitate creativity through supporting more loose and novel connections between concepts (Ward, Patterson, & Sifonis, 2004). For insight problems, whereas a fixation on concrete details often leads to an impasse, abstraction facilitates restructuring to gain insights into the correct solutions (Ash & Wiley, 2006). More specifically, Forster and colleagues (2004) found that future construal

benefits divergent thinking when tasks are framed abstractly rather than concretely, and benefits creative rather than analytical problem solving (Forster et al., 2004). In other studies, Forster, Epstude, and Ozelsel (2009) manipulated construal level by priming love (future-oriented) or sex (present-oriented; see also Diamond, 2003; Mikulincer, 1998). Results revealed that thoughts of love facilitated creativity, and thoughts of sex impaired creativity but improved analytic thinking (Forster et al., 2009). Such effect of future construal on creativity was mediated through global processing that emphasizes the holistic, abstract, and general features of stimuli (Navon, 1977; Trope & Liberman, 2003). Overall, the premise of the Construal Level Theory holds that future temporal orientation promotes creativity through an increased tendency to think abstractly under a high-level construal mindset.

Future schemas of change and progress. Whereas previous research attributes the creative advantage of future temporal construal to processing style (i.e., abstract thinking), the present research offers an alternative perspective by studying the creative consequence of making salient the schemas associated with future construal. Scant research has studied people's future-oriented schemas or their lay perceptions of the future, but the few research that exists showed that people tend to perceive the future to progress with unrealistic optimism (Weinstein, 1980). Depressed individuals, however, tend to project uncertainty and negative events onto the future (Andersen, Spielman, & Bargh, 1992). Recent experimental studies also showed that simulation of the future leads people to perceive more meaning in life and greater well-being (Waytz, Hershfield, & Tamir, 2015), as well as to believe in an illusion of human progress in order to buffer against existential anxiety and secure a sense of control over the future (Rutjens, van der Pligt, & van Harreveld, 2009; Rutjens, van Harreveld, & van der Pligt, 2010).

Recent work has also shed light on the schematic ways people perceive the future of human life and its societies. For instance, the folk theory of social change (Kashima et al.,

2009) posits that people in general have relatively fixed and consistent implicit beliefs about societal progress. Based on the two-dimensional model of stereotype content (Fiske, Cuddy, Glick, & Xu, 2002), this theory postulates that people stereotype others mainly on the constructs of warmth (e.g., likeability, friendliness) and competence (e.g., intelligence, skillfulness). Whilst competence and warmth are semantically independent, people tend to stereotype these attributes as bipolar opposites (Fiske et al., 2002). Hence, people tend to also perceive that in the future humankind would have progressed with greater levels of competence but lower levels of warmth (Kashima et al., 2009). These schematic perceptions about the future are stronger in countries undergoing a greater degree of globalization (Kashima et al., 2011).

In the collective futures framework, Bain, Hornsey, Bongiorno, Kashima, and Crimston (2013) went beyond person-level traits (i.e., competence, warmth, morality) to examine collective-level future projections of societal dysfunctions (e.g., inequality, terrorism, global warming) and societal development (e.g., technological and scientific progress). They found that people's future projections of some of these dimensions can motivate attitudinal change and drive political behavior in the present day. Specifically, the future projection of a benevolent society (i.e., high warmth and morality) emerged to be the most consistent motivator that justified present day political choices (Bain et al., 2013). Another line of research showed that although people remain relatively unconvinced about the importance of mitigating anthropogenic climate change, a future projection that climate change mitigation could bring about technological and economic progress, and a more benevolent society, motivates people to identify with and engage in pro-environmental actions (Bain, Hornsey, Bongiorno, & Jeffries, 2012; Bain et al., 2016). Extending these prior findings, the current research looks into people's future-oriented schemas when they are asked to project on the future societies. I predict that future construal will bring to the fore forward-

looking schemas associated with societal change and progress, which can in turn boost creative thoughts.

Research Overview

To reiterate, the creative cognition research postulates that people often generate ideas by relying on schemas, thus limiting their creativity. I contend that activating a future temporal construal could facilitate creativity if individuals become less reliant on creativity-inhibiting present-focused schemas, and their thinking becomes broadened by creativity-facilitating future-focused schemas. Specifically, I test the following hypotheses:

H1: Individuals' future-oriented schemas are dominantly characterized by expectations of change and progress.

H2: Under a future temporal construal, individuals will exhibit higher creative performance relative to the present temporal construal or the control condition.

H3: The effect of a future temporal construal on creative performance is mediated by increased accessibility of future-oriented schemas associated with expectations of change and progress.

These hypotheses were tested across three experimental studies. To confirm the dominance of change and progress concepts in people's future-oriented schemas (H1), in a preliminary study I had participants generate words associated with the future in a word-listing schema accessibility measure (Ward, 2007; Ward et al., 2002) and in Study 1 I coded participants' open-ended narrations of how they perceived the future.

To test the effect of future construal on creativity (H2), Studies 1 and 2 asked participants to vividly imagine and describe their perceptions of human life in the present day or 50 years later in the future (a control condition was also included). This experimental induction did not direct participants to think of change and progress. Instead, I captured these concepts as they naturally manifested in participants' open-ended narrations about the future

(Study 1) or with an adapted rating scale from Bain and colleagues (2013) that measured participants' projections about what future societies would be like (Study 2). Study 2 also allowed a test of the predicted mediation model (H3). Finally, by experimentally manipulating the perceived level of change in the future, Study 3 further clarified the causal role of construing a future with high, but not low levels of change in activating schemas of societal change and progress and fostering creativity (H2 & H3).

Across the three studies, I measured creativity with creativity design tasks, and a series of insight problems and Remote Associates Tests. Design tasks are arguably a more superior measure of creativity than pure divergent thinking tasks (see Ward, 2007). Divergent thinking is a necessary but insufficient operationalization of creativity presumably because they do not require responses to be realistic nor useful (Runco & Acar, 2012). However, design tasks require participants to produce actual ideas that can be reliably scored on a variety of dimensions including novelty, elaboration, practicality, and schema deviance. The current studies also included measures of insight creativity and global processing similar to those used in past research (Forster et al., 2009; Forster et al., 2004). This would allow a test of whether future construal also promotes insight problem solving and abstract thinking, as previous research has shown (Forster et al., 2009). However, I note that it is not the intention of the current research to make a direct comparison with the prior studies and challenge the value of these earlier findings that were based on construal level theorizing.

CHATPER 2: STUDY 1

Preliminary Study

A preliminary study was conducted prior to Study 1 to establish that people's future-oriented schemas are associated with dominant expectations of change and progress. College students from a university in Singapore (N = 67, 30% male; M = 21.12, SD = 1.85) participated for course credits as part of a larger unrelated study. Participants were asked to vividly imagine what human life will be like 50 years in the future for one minute, and then list 20 words associated with the future as it comes to their mind. Words with similar meanings grouped into concepts to obtain a measure of schema accessibility indexed by *output dominance,* defined by the proportion of the total responses that can be coded under a given concept (Ward, 2007). To further summarize the rich data, these concepts were organized into five superordinate themes, each characterized by the corresponding positive or negative valanced content resulting in a total of 10 coding categories (see Table 1). As predicted, the data suggests that the schema of the future was chiefly characterized by change and progress (34%), with the concept of technological advancement (15%) being most commonly mentioned. However, it was also not uncommon that participants projected the future to be full of strife (6%), could face a possible apocalypse (5%), and is bleak (4%).

Participants and Design

A total of 115 students (30.4% male; M_{age} = 21.51, SD_{age} = 1.50) from a university in Singapore participated in Study 1 in exchange for course credits.[1] The study employed a between-groups design experiment with three conditions. Participants were randomly assigned to a (1) future construal, (2) present construal, or (3) control condition.

Procedures

Temporal construal induction. Participants in the future (present) construal condition were asked to produce a detailed description of the world 50 years in the future (in the present

day). The control participants did not complete this task. Prior research showed that a projection of 30-50 years is a sufficiently distant for people to expect significant changes in society, yet close enough to reasonably project what the society might look like (Bain et al., 2013). Participants responded to the following prompt:

> "In the most vivid details as possible, describe how you perceive people and human life will be [is] like 50 years in the future [in the present day]. Think about how they spend time on their everyday activities and how they socialize."

Two independent coders who were blind to the research purpose and participants' condition scored each response on the extent that participants' projection of the future is characterized by perception of change and progress (1 = *very low*, 4 = *moderate*, 7 = very high). To facilitate consistency, each coder kept an independent log of example responses that they awarded very low, moderate, or very high scores. Both coders made similar judgments which exhibited good inter-rater reliability (*ICC* = .76).

Affect measure. As prior research has shown that creative performance was associated with both positive (Clore, Gasper, & Garvin, 2001; Isen et al., 1987; Murray, Sujan, Hirt, & Sujan, 1990) and negative affect (Baas et al., 2008; De Dreu, Baas, & Nijstad, 2008; Nijstad, De Dreu, Rietzschel, & Baas, 2010) and that people tend to feel illustriously optimistic about the future (Taylor & Brown, 1988, 1994; Taylor & Gollwitzer, 1995; Weinstein, 1980), I controlled for participants' affective states measured with the PANAS (Watson, Clark, & Tellegen, 1988). Neither positive affect ($\alpha = .79$) nor negative affect ($\alpha = .94$) differed across experimental conditions (F's < .84, p's > .43), nor did they correlate with any creativity index (all $|r|$'s <.13, p's >.17). Thus, these affect measures will not be discussed further.

Global processing. Following Forster and colleagues (2009), an alleged "visual matching task" was included to measure global processing style (Gasper, 2004; Gasper & Clore, 2002) in order to test for a related mechanism predicted by the Construal Level Theory.

In each trial, participants were shown a target, which is a compound geometrical figure made of same-shaped, smaller geometrical figures (e.g., squares in a square-shaped arrangement). They were then asked to determine which of the two figures are similar to the target: One figure is similar to the target in its global arrangement (e.g., a square-shaped arrangement made of triangle-shaped features) and another figure is similar in local features (e.g., square-shaped features in a triangle-shaped arrangement). Over 12 trials, the number of times the participants made the similarity judgment based on global arrangement is taken as an index of global processing ($\alpha = .89$).

Creative design task. Creativity was measured with a toy design task adapted from Smith, Ward, and Schumacher (1993). Participants received the following instructions:

> "Imagine that you are employed by a toy company that is in need of new ideas for toys. Your task is to design some new toys (for any age group) for the company. Within 10 minutes, draw as many new and different toys of your own creative design as you can. You are not expected to include those toys that currently exist or have already existed. Your ideas should be as creative as possible, so that they are *different* from the concepts that already existed or once existed. These creative ideas should also be *appropriate* for their purpose. After completing each drawing: (1) label each part, (2) briefly describe and explain the toy, and (3) continue to the next page and draw a new toy. You are only judged based on the creative details and not on your ability to draw."

After the creativity task, participants reported the extent to which they perceived the task to be enjoyable and difficult.

Two independent coders who were blind to the research purpose and participants' conditions scored each idea on three dimensions: (1) novelty – the extent that the overall idea is original or deviates from existing toys in the market, (2) elaboration – the extent of details

and component elements injected into the idea, (3) practicality – the extent that the design serves its purpose (e.g., fun, educational) and is appropriate (e.g., safe, suitable for the target age group). All three dimensions were coded on a 1 (*very low*) to 7 (*very high*) scale. Coders were instructed to base their judgment on first impressions as if they first saw the given ideas in a store and to avoid projecting unnecessary thoughts or deliberation about the design. After an initial round of coding, the *ICC* for the three dimensions fell between .42 and .54. A third coder discussed disagreements exceeding two points with the two initial coders and independently provided a third set of coding. The three scores were averaged to compute the final dimension score (ICC_{novelty} = .89, $ICC_{\text{elaboration}}$ =.88, and $ICC_{\text{practicality}}$ = .76).

Creative insight tasks. Participants were given three insight problems to complete within 90 seconds per item. These items were adapted from past research examining the link between time construal and creativity (Forster et al., 2004). The first two verbal insight problems read:

> Problem 1: A prisoner was attempting to escape from a tower. He found a rope in his cell that was half as long enough to permit him to reach the ground safely. He divided the rope in half, tied the two parts together, and escaped. How could he have done this?
>
> Problem 2: A dealer in antique coins got an offer to buy a beautiful bronze coin. The coin had an emperor's head on one side and the date 544 B.C. stamped on the other. The dealer determined the coin was a fake. Why?

The last visual insight item is presented in Appendix A[2].

Remote Associates Task (RAT). Participants were given three minutes to complete a 10-item RAT (Mednick, 1968). The task requires participants to find a target word that connects three seemingly unrelated words (e.g., fish, mine, rush; the answer is gold). The RAT can be classified as a creative insight task, requiring both divergent and convergent

thinking. As words in an RAT item are conceptually distant, divergent thinking is required to search for non-dominant meanings of certain words before the solution can be found. In turn, convergent thinking is required to narrow down a singular word that connects with all the three words (Bowden & Beeman, 1998; Smith, Huber, & Vul, 2013). Less creative individuals tend to be biased by high-frequency word associations, thus they are less likely to identify the correct solution (Gupta, Jang, Mednick, & Huber, 2012).

Results

Future construal of change and progress. To recap, my first hypothesis that the future (but not the present) is dominantly in terms of change and progress. By extension, it can be predicted that people will perceive more change and progress in the future compared to the present. Analyzing the coder ratings of participants' open-ended responses to the temporal construal manipulation, an independent samples *t*-test supports that participants in the future construal condition (M = 4.45, SD = 1.84) projected significantly more change and progress in society than did participants in the present construal condition (M = 1.50, SD = 0.75), $t(75) = 9.15$, $p < .001$, $d = 2.10$, $95\%CI_{diff}$ [2.31, 3.59].

Future construal and creativity. Next, I tested the second hypothesis that participants from the future construal condition will be more creative than the present construal or control condition. The scores for all creativity indices for the toy design task are summarized in Figure 1.

Novelty. The main effect of temporal construal was significant for the novelty dimension of the toy design, $F(2, 112) = 9.14$, $p < .001$, $\eta_p^2 = .14$. As hypothesized, pairwise comparisons revealed that participants produced more novel ideas in the future construal condition (M = 3.65, SD = 0.96) than those participants in the present construal (M = 2.88, SD = 0.95, g = 0.82, $95\%CI_{diff}$ [0.35, 1.19]) and control condition (M = 2.84, SD = 0.90, g = .96,

95%CI_{diff} [0.39, 1.23]), both *p*'s < .001. The novelty score in the present construal and control condition was not different (*p* = .86).

Elaboration. Although the main effect of time construal for the elaboration dimension was not significant, $F(2, 112) = 2.98$, $p = .06$, $\eta_p^2 = .05$, the hypothesized pairwise comparisons showed the expected pattern that there were more elaborated ideas in the future construal condition (*M* = 3.28, *SD* = 1.18) compared to the present construal condition (*M* = 2.73, *SD* = 0.85, *p* = .016, *g* =56, 95%CI_{diff} [0.10, 1.00]). The degree of elaboration in the control condition (*M* = 2.99, *SD* = 0.90) did not differ significantly from that in the present construal (*p* = .25), and the future construal condition (*p* = .21).

Practicality. The main effect of time construal for the practicality dimension was not significant $F(2, 112) = 0.55$, $p = .58$. Participants in the future construal (*M* = 3.57, *SD* = 0.84), present construal (*M* = 3.65, *SD* = 0.80), and control condition (*M* = 3.77, *SD* = 0.81) produced ideas with similar levels of practicality (*p*'s >.30).

Fluency. The fluency of ideas was similar across conditions, $F(2, 112) = 0.83$, $p = .44$. Participants in the future construal (*M* = 2.26, *SD* = 0.99), present construal (*M* = 2.26, *SD* = 0.98), and control condition (*M* = 2.53, *SD* = 1.16) produced similar number of ideas (*p*'s > .26).

Global processing. The construal level account was examined to see if the creative benefits of future construal could be attributable to greater abstract processing. However, an ANOVA on the global processing score revealed that the levels of abstract processing did not differ across the temporal construal conditions, $F(2, 112) = 0.16$, $p = .85$.

Insight problem solving. Participants' performance on the creative insight problems did not vary across conditions, $F(2, 112) = 0.81$, $p = .45$. Participants in the future construal (*M* = 0.46, *SD* = 0.60), present construal (*M* = 0.50, *SD* = 0.56), and control condition (*M* = 0.63, *SD* = 0.67) completed similar number of insight problems (*p*'s > .23).

RAT. No main effect was found for RAT performance across temporal construal conditions, $F(2, 112) = 1.73$, $p = .18$. Participants from the future construal condition solved marginally more RAT problems ($M = 3.31$, $SD = 1.75$) than the control group ($M = 2.55$, $SD = 1.75$, $p = .07$). However, the future construal condition did not outperform the present construal condition ($M = 3.00$, $SD = 1.87$, $p = .45$). The present construal condition and control condition also did not differ in their RAT scores ($p = .28$).

Discussion

Study 1 provides preliminary support for the hypotheses. Supporting Hypothesis 1, participants tend to describe future societies dominantly in terms of change and progress. Supporting Hypothesis 2, relative to those in the present or control condition, participants in the future temporal construal condition generated toy designs that were judged to be higher in novelty, which is a defining characteristic of creativity. A similar effect was also observed in the elaboration dimension, but not the practicality dimension. Together, these findings confirm the prediction that future construal promotes creativity by activating schemas of the future that are associated with change and progress, which could benefit divergent thinking as reflected in the novelty and elaboration of ideas. However, this effect might not necessarily extend to convergent thinking as reflected in practicality and insight problem solving.

I notice that the current study did not replicate the prior findings by Forster and colleagues (2004) that future construal facilitates abstract processing and creative insight performance. Notably, the way future construal was manipulated in the current study was different from that in the previous study. Forster and colleagues (2004) had participants imagine solving the insight tasks a year later, thus future construal was conjoined with the tasks; the current study had participants describe their perceptions of the future before performing the insight tasks, thus future construal was not tied to the timing of solving the tasks. However, I also note that in other studies Forster and colleagues (2004) did show that

future construal was beneficial to divergent thinking when the temporal construal manipulation was not tied to when the divergent thinking tasks were solved (i.e., in the present vs. the future; Studies 5 and 6). Thus, with a different manipulation of temporal construal, the present research replicates the prior finding on divergent thinking, but not insight problem solving.

CHAPTER 3: STUDY 2

Study 2 further tested the robustness and replicability of the schema accessibility predictions with different measures of schema accessibility and creativity. One limitation of Study 1 is that the measure of schema accessibility is open-ended, so in Study 2 I adapted a scale developed by Bain and colleagues (2013) that measures the degree to which individuals perceive a list of attributes to be characteristic of a society either in the present or the future. This provides a quantifiable measure of the schemas associated with the present or future temporal construal. This measure of schema accessibility is operationalized as the mediator for the effect of temporal construal on creativity, thus testing Hypothesis 3.

Participants and Design

A total of 152 students (28% male; M_{age} = 21.88, SD_{age} = 1.87) from a university in Singapore participated in the study in exchange for $5 Singapore dollars. No data points were removed. The study employed a between-groups experiment with a partially-crossed factorial design (2 × 2 with an added control group). The first factor pertains to temporal construal (present vs. future). The second factor pertains to the priming context (general social life vs. consumer product context). A control group that did not undertake the temporal construal manipulation was included as a comparison. A power analysis showed that a sample size of 152 provided 79.4% power to detect a medium effect (η_p^2 = .06), and 99.6% power to detect as effect as large as the main effect found in Study 1 (η_p^2 = .14).

Procedures

Temporal construal induction. Identical to Study 1, participants were randomly assigned to a future temporal construal, a present temporal construal, or a control condition. Further, extending Study 1's temporal construal induction that focused on everyday social activities, Study 2 added another context for inducing present or future temporal construal to explore if the creativity-enhancing effects of future construal could be stronger by having

participants think about future consumer products and technologies, which is a context relevant to the subsequent creativity task of designing a dining table. Participants in these conditions responded to the following prompt:

> "In the most vivid details as possible, describe how you perceive people and human life will be [is] like 50 years in the future [in the present day]. Think about the consumer products and technologies that they have access to."

Schema accessibility. Adapted from Bain and colleagues (2013), participants in the priming conditions responded to a "Societal Perception Scale" which asked about their projections of some attributes (e.g., scientific progress, crime) in present or future societies. I also developed additional items based on the most common themes that emerged from participants' open-ended narrations about the present or the future in Study 1 (e.g., rapid change, novelty, diversity, aging population, social isolation). Participants rated the extent that they perceive each attribute to be characteristic of society and human life in the present day or 50 years later in the future dependent on their condition. These attributes are organized into six factors: (1) change and progress (e.g., scientific progress, rapid change), (2) social community (e.g., social welfare, volunteerism), (3) societal dysfunction (e.g., diseases, terrorism, crime), (4) warmth (e.g., warm, caring), (5) morality (e.g., trustworthiness, sincerity), and (6) competence (e.g., resourcefulness, achievement).

Extending Bain and colleagues' (2013) original categorization, I distinguished the factor of social development into two factors (i.e., change and progress, social community). Change and progress is the factor of interest in this study, which captures perceptions of technological innovation, scientific progress, increased novelty, and rapid change. The social community factor, on the other hand, captures perceptions of social inclusion and prosociality within communities. Analysis confirms that these two factors are independent, $r = -.05$, $p = .62$. Importantly, the separate social development and social community factors allow a more

focused test for the present study. Future construal is hypothesized to facilitate creativity specifically through accessibility of schemas associated with societal change and progress., thus participants are predicted to rate the change and progress dimension to be more characteristic in the future relative to present societies.

A confirmatory factor analysis (CFA) was conducted to evaluate the reliability and validity of the schema accessibility measure. The model was refined by removing items with a standardized loading < .50 until a satisfactory model was obtained. The final model exhibits satisfactory fit indices (Anderson & Gerbing, 1988; Hu & Bentler, 1999; Kenny, 2013), with RMSEA = .078, CFI = .91, TLI=.90, and $\chi^2(177) = 305.76$. Next, construct reliability (CR) was assessed with Joreskog ρ (Fornell & Larcker, 1981), which indicated that all factors were deemed reliable when being evaluated against the criterion of CR > .70 (Bagozzi & Yi, 1988). The final items, factor loadings, and CRs are tabulated in Table 2.

Affect measure. As per Study 1, participants reported their affective states on the PANAS (Watson et al., 1988). Results suggested that neither positive (α = .89) nor negative affect (α = .90) scores were different across the temporal construal conditions (*p*'s > .17). In addition, neither positive nor negative affect scores were significantly correlated with most creativity indices (*p*'s > .16), with three exceptions. Positive affect was inversely correlated with practicality ($r(150) = -.24$, $p = .01$) and RAT scores ($r(150) = -.18$, $p = .03$); negative affect was inversely correlated with RAT scores ($r(150) = -.20$, $p = .02$). However, affect was not a significant predictor when included in the main analyses nor did controlling for affect change the study's conclusions. Thus, these affect measures will not be discussed further.

Global processing. As per Study 1, participants completed the global processing measure (Gasper, 2004; Gasper & Clore, 2002) as an explanatory mechanism predicted by the Construal Level Theory (α = .89).

Creative design task. Whereas the design task in Study 1 is more open-ended, Study 2 asked participants to generate ideas for designing dining tables. As most people would have a highly prototypical schema for the features of dining tables (e.g., a symmetrical table with seats being arranged in a circular or rectangular form), the task is more creatively challenging and can provide a stronger test of the schema accessibility hypothesis. Further, the task allows a more objective scoring procedure through evaluating the extent to which participants' new designs deviate from schematic prototypes of dining tables and incorporate novel aesthetic or functional features. The nature of this task resonates with the well-established alien drawing task in which creative individuals are more likely to come up with alien drawings that do not resemble stereotypical earth animals possessing symmetrical limbs or typical senses and appendages (e.g., Ward, 2007; Ward et al., 2004). However, my task has the strength of also assessing applicability, as designing dining tables is considerably a more practical innovation as opposed to merely a creative imagination. Participants read the following prompt:

> "In this task, imagine and design dining tables (with seats) for a family of four. Within 10 minutes, design and draw as many ideas as possible but focus on quality rather than quantity. You are encouraged to be as creative and imaginative as possible. Within each idea, you may include as many details and features as you can imagine. Focus on the table and seats only, without drawing the surrounding environment. Creative ideas are defined by high levels of both novelty and usefulness. Please also label each part and provide captions or a brief description of the overall design. You are only judged based on the creative details and not on your ability to draw."

After the creativity task, participants reported the extent to which they perceived the task to be enjoyable and difficult.

Similar to Study 1's coding procedure, two independent coders blind to the research purpose and participants' condition scored each idea on dimensions of novelty, elaboration, and practicality on a 7-point scale (1 = *very low* to 4 = *average* to 7 = *very high*). To help coders evaluate the practicality dimension, it was explained to them that the average score of 4 represents a dining table that can fully serve its typical purpose (e.g., a table that is stable, of sufficient size, and has a flat surface). A higher or lower score was given based on whether the design improved or compromised usefulness of the table.

Two other dimensions – futuristic design and deviance – were also coded for this design task in a more objective manner. Coders evaluated the futuristic design dimension on a three-point categorical scale, with 0 = *the design requires technology that has existed for more than 5 years*; 1 = *the design incorporates recent technology that has proliferated within the last 5 years (e.g., significant integration of small digital and computing devices into the dining table design, automatic and sensor driven functions)*; and 2 = *the design incorporates technology only possible with futuristic or imagined technology (e.g., integration of holographic displays, computers with very high levels of artificial intelligence).* Hence, the futuristic design dimension further extends the novelty dimension to reflect participants' push for a forward-looking innovation. Coders also evaluated the deviance dimension on the degree to which the design deviates from highly typical schemas of dining table. Each of the following attributes were rewarded one point: (1) asymmetry, (2) unconventional shape (e.g., not circular or rectangular), (3) unconventional size, (4) unconventional theme, (5) multifunctional with added function(s) atypical of a table (e.g., built-in food refrigeration, built-in computer). Thus, the deviance score (range from zero to five) captures the extent that participants' design can creatively break free from the constraints of existing mental schemas and prototypes. Reliability indices suggested satisfactory inter-rater consistency after one

round of coding ($ICC_{novelty}$ = .78, $ICC_{elaboration}$ =.75, $ICC_{practicality}$ = .70, $ICC_{futuristic}$ = .91, $ICC_{deviance}$ = .88).

Remote Associates Test and insight problems. For comparison purpose, participants completed the same RAT items and three insight problems as per Study 1.

Results

Future construal and creative performance in dining table designs. Consistent with Hypothesis 2, a series of Two-way ANOVAs showed that future construal facilitated creativity on the novelty, elaboration, futuristic design, and schema deviance dimensions. However, both the main effect of priming context (social activities vs. consumer products), and the interaction effect between priming context and temporal construal were not significant across all creativity dimensions (see Table 3). Thus, for brevity, I report only the simple contrast that captures the main effect of temporal construal below. The scores for all creativity indices for the dining table design task are summarized in Figure 2.

Novelty. The main effect of temporal construal on the novelty dimension of the dining table design task was significant, $F_{contrast}(2, 147) = 5.56$, $p = .005$, $\eta_p^2 = .07$. As hypothesized, follow-up pairwise comparisons revealed that participants produced more novel ideas in the future temporal construal condition ($M = 2.78$, $SD = 1.11$) compared to both the present construal ($M = 2.26$, $SD = 0.90$, $p = .005$, $g = 0.52$, $95\%CI_{diff}$ [0.16, 0.90]) and control conditions ($M = 2.17$, $SD = 1.08$, $p = .007$, $g = 0.60$, $95\%CI_{diff}$ [0.17, 1.07]). The difference in novelty scores between the present temporal construal and the null control conditions were not significant ($p = .70$).

Elaboration. Similarly, the main effect of temporal construal on elaboration was significant, $F_{contrast}(2, 147) = 6.49$, $p = .002$, $\eta_p^2 = .08$. Pairwise comparisons showed more elaborated ideas in the future temporal construal condition ($M = 2.46$, $SD = 1.31$) compared to the present construal ($M = 1.94$, $SD = 0.80$, $p = .005$, $g = 0.51$, $95\%CI_{diff}$ [0.16, 0.91]) and the

control conditions (M = 1.74, SD = 0.84, p = .002, g = 0.70, 95%CI_{diff} [0.28, 1.18]). Participants' elaboration scores were not different between the present construal and control conditions (p = .40).

Futuristic design. As expected, there was a significant main effect of temporal construal on the futuristic design dimension, $F_{contrast}(2, 147) = 3.11$, p = .048, η_p^2 = .04. As predicted, participants in the future construal condition produced more futuristic designs (M = 0.24, SD = 0.38) than did those in the present construal (M = 0.11, SD = 0.27, p =.03, g = 0.40, 95%CI_{diff} [0.01, 0.24]) and the control (M = 0.10, SD = 0.25, p = .05, g = 0.44, 95%CI_{diff} [0.00, 0.28]) conditions. Participants' scores in the present construal condition did not differ from those in the control condition on the futuristic design dimension (p = .87).

Deviance. Consistent with other creativity indices, the main effect of temporal construal on the deviance dimension was significant, $F_{contrast}(2, 147) = 12.85$, $p < .001$, η_p^2 = .15. As predicted, participants in the future construal condition (M = 1.14, SD = 0.76) produced designs that are more deviant from the typical schemas of dining table than those in the present construal (M = 0.60, SD = 0.45, p <.001, g = 0.88, 95%CI_{diff} [0.33, 0.77]) and the control condition (M = 0.69, SD = 0.56, p = .001, g = 0.73, 95%CI_{diff} [0.18, 0.72]). The deviance scores of the present construal and control condition were not different (p = .48).

Practicality and fluency. The two-way ANOVA results did not suggest any main effects nor interaction effects between temporal construal and priming context on the practicality or fluency score, all $F(1,147) < 2.41$, all p's > .12.

Testing the mediation model. As the pattern of results were consistent over the four creativity indices (i.e., novelty, elaboration, futuristic design, and deviance) and these indices are highly interrelated (.45 < r < .76), an overall creativity index was created to test the mediation model by obtaining the average of their standardized z-scores.

To recap, Hypothesis 3 predicts that the creativity-facilitating effect of future construal is mediated through increased accessibility of the change and progress schema measured by participants' ratings on how they perceived the future or present societies on a list of attributes. The other mediators (i.e., perceived warmth, morality, competence, social community, and societal dysfunction) were included in initial analyses, but were removed from the final model as they were not significant predictors of creativity. Note that the analyses were based on a fully crossed 2 × 2 model without the control group, because the control participants did not undertake the temporal construal priming and report their perceptions about the future/ present societies.

The results support that future temporal construal promoted creativity through the mediation of perceived change and progress. In the first path, future construal predicted higher ratings of change and progress (B = .61, t = 2.46, p = .02, 95%CI [0.12, 1.10]). The main effect of priming context (B = .27, t = 1.09, p = .28) and the priming context × temporal construal interaction effect (B = -.39, t = -1.11, p = .27) on ratings of change and progress were not significant. In the second path, perceptions of change and progress predicted higher creativity (B = .16, t = 2.07, p = .041, 95%CI[0.007, 0.32]). The direct effect of future construal on creativity remained significant (B = .48, t = 3.18, p = .002, 95%CI [0.18, 0.78]), suggesting a partial mediation.

The significance of the indirect effects was evaluated with bootstrapped 95% confidence interval with 1000 sampling iterations using the SPSS PROCESS macro (Preacher & Hayes, 2008). The indirect effect of the moderated mediation model with priming context as a first stage moderator was not significant, with the bootstrapped index of moderated mediation 95% CI including zero [-.26, .04]. Next, the indirect effect of future construal on creativity mediated through perceptions of change and progress was tested. In this model, priming context and its interaction term were specified in the model as covariates in the first

path. The bootstrapped 95% CI of this simple mediation model did not bound zero [.003, .26], supporting the hypothesis that the creativity-facilitating effects of future construal is mediated through accessible perceptions of change and progress. To determine the variance explained by the indirect effect, I computed kappa-squared as per Preacher and Kelley (2011, p. 106), which indicates the "proportion of the maximum possible indirect effect", $\kappa^2 = .04$.

Global processing. Next, the construal level account was tested to see if the creative benefits of future construal could be attributable to greater abstract processing. However, the main effect of temporal construal on global processing score was not significant, $F_{contrast}(2,147) = 0.04$, $p = .97$. Global processing also does not predict any of the creativity indices, all $|r|$'s $<.13$ p's $> .12$.

Insight problem solving and RAT. The main effect of future construal on insight problem solving was not significant, $F_{contrast}(2,147) = 1.53$, $p = .22$. The main effect of future construal was also not significant for the RAT, $F_{contrast}(2, 147) = 2.11$, $p = .13$. However, participants in the control condition ($M = 3.42$, $SD = 2.00$) marginally outperformed the present construal ($M = 2.55$, $SD = 1.90$, $p = .053$), and future construal ($M = 2.65$, $SD = 2.04$, $p = .09$) conditions. The future and present construal conditions performed similarly ($p = .74$).

Discussion

The results of Study 2 support the hypotheses and replicate the key findings obtained in Study 1. With a different creative design task, participants under future construal generated more novel and elaborate designs than those in the present construal or control condition. Based on more objective scoring, I also found that participants in the future construal condition generated designs that are more futuristic and deviate more from schematic designs of existing dining tables. Of import, results confirmed that the creative benefit of future temporal construal is mediated by increased accessibility of schemas associated with change and progress. Participants primed to think about future societies reported more accessible

projections of change and progress in these societies, which in turn predicted higher levels of novelty, elaboration, and futuristic design in their responses.

Convergent with Study 1, future temporal construal did not reveal any effect on the practicality of designs, the RAT, and the insight problems. Overall, findings of Studies 1 and 2 showed that the activation of schemas related to change and progress is more conducive to enhancing aspects of creativity that reflect divergent and novel thinking, but less so for those aspects reflecting practicality and convergent thinking.

Notably, I also explored in Study 2 whether the creativity-facilitating effects of future construal could be made stronger if the priming context was more relevant to the later creative design task. However, the findings suggest that future temporal construal tends to produce a generalized creative advantage; participants who were exposed to either priming context under future construal induction performed similarly.

CHAPTER 4: STUDY 3

Both Studies 1 and 2 showed that future construal is creativity-facilitating because it activates the change and progress schema that people typically use to characterize future societies. Study 3 extended this finding by experimentally manipulating the levels of perceived future change and progress, thus establishing the causal role of that increasing accessibility of schemas associated with high (vs. low) levels of change and progress would promote greater creativity.

In addition, Study 3 examined whether priming high versus low change would result in participants adopting different approaches to creativity. Prior research have differentiated two approaches to creativity, radical versus incremental creativity (e.g., Gilson & Madjar, 2011; Madjar, Greenberg, & Chen, 2011). Radical creativity emphasizes divergent exploration of revolutionary and breakthrough ideas, with the final products often exhibiting mental set-breaking that do not fundamentally resemble existing ideas. In contrast, incremental creativity emphasizes exploitation and modification of existing ideas. Building on Studies 1 and 2 where the creativity tasks mainly captured divergent and original thinking, I hypothesize that priming a future characterized by high levels of change and progress will promote radical creativity. Prior finding suggests that solving well-defined and contextualized problems tends to call for incremental as opposed to racial creativity (Gilson & Madjar, 2011). It is reasonable to conjecture by priming a future characterized by low change, situations that are well-defined and contextualized become more accessible which also could promote the tendency to apply an incremental approach to creativity.

Participants and Design

A total of 124 students (25% male; M_{age} = 20.64, SD_{age} = 1.74) pursuing a variety of majors from a university in Singapore participated in the study in exchange for course credits. None of these participants participated in the earlier studies. No data points were removed.

The study was a between-groups experiment comprising one factor with two levels: future construal with high change versus low change. The significant main effects of interest ranged between effect sizes of $\eta_p^2 = .04$ to $\eta_p^2 = .15$. The current sample was large enough to detect this range of effect sizes between a power of 61.6% to 99.6% respectively; or a 79.7% power to detect a medium effect ($\eta_p^2 = .06$).

Procedures

Temporal construal induction. Participants were randomly assigned to one of the two conditions that construed the future with either very high or very low levels of change and progress. The instructions read:

> "Imagine the world 50 years in the future that is characterized by very high [very low] levels of change and progress. Think of aspects of human life and the world that will advance to become radically different [are fundamentally unchanging and will remain similar]. In the most vivid details as possible, describe your perceptions of people and human life in this world 50 years from now, and why this version of the future might happen."

Schema accessibility. Participants then responded to the "Societal Perception Scale" as a schema accessibility measure identical to Study 2. Again, CFA showed satisfactory fit (RMSEA = .075, CFI = .94, TLI = .93, $\chi^2(177) = 300.94$). All factors exhibit high composite reliability (CR > .70) measured by Joreskog ρ (see Table 2).

Emotions measure. After the manipulation, participants reported their emotional states on the PANAS as per the earlier studies. Results suggested that both positive ($\alpha = .90$) and negative affect ($\alpha = .94$) scores were similar across experimental conditions ($p > .14$) and did not correlate with any of the creativity indices (p's > .18).

Creative design task. An adapted version of the alien creature design task (Ward, 1994; Ward et al., 2002) was used as the primary measure of creativity. Participants were

given up to 10 minutes to design one creative creature that could be a movie character following the given prompt:

> "Many successful movies include nonexistent creatures as characters. Sometimes, the movie producers seek their potential audience to provide inputs in order to inspire their creative design. In this task, you assume the role of suggesting to a movie producer one creative design of a nonexistent creature. As creatively as you can, imagine and draw an imaginary creature that does not exist in real life. Provide as much detail as possible as to how this creature looks like, its various parts (e.g., sense organs, other visual features), and the functions that those parts serve. Draw a front view and a side view of this creature. Label all major parts of this creature and mention the functions of those parts. You will only be judged on the creative details of your design and not your ability to draw."

Participants were also asked to describe what the creature actually is and summarize its key characteristics. This information is taken into consideration during scoring.

Similar to Studies 1 and 2, two independent coders blind to the research purpose and participants' condition scored each idea on the novelty, elaboration, and practicality dimension on a 7-point scale (1 = *very low* to 4 = *average* to 7 = *very high*). Novelty and elaboration is defined similarly as Studies 1 and 2, and practicality is defined as the likelihood that the creature design is useful for a movie. In addition, I had coders objectively score the degree to which an idea deviates from prototypical animals on earth on three dimensions in terms of unconventionality, bilateral asymmetry, and disproportion. Following previous studies (Ward, 1994; Ward et al., 2002), each design was coded for the presence of unusual appendages (e.g., wings, legs, arms, tails, horns), and unusual sense organs (e.g., eyes, ears, mouth, nose, skin) or sensory ability. Coders rated the feature of the creature as unconventional if it is not typical of animals on earth, or it exhibits a novel use for an

otherwise common feature of earth animals (e.g., taking nourishment through the legs). The presence of each unusual sense or appendage accrues one point to the dimension of unconventionality. Each design was also coded for the presence of bilateral asymmetry (0 = *symmetrical*, 1= *some asymmetrical features*, 2= *highly asymmetrical overall design*) and disproportion (0 = *proportionate*, 1= *somewhat disproportionate*, 2= *highly disproportionate*). Coders were mindful to distinguish poor artistic ability from intentionally unconventional/asymmetrical/disproportionate designs, which were often labeled by the participants. Consistency indices show satisfactory to excellent inter-rater reliability for the subjectively coded dimensions (ICC_{novelty} = .89, $ICC_{\text{elaboration}}$= .74, $ICC_{\text{practicality}}$= .81) and the objectively coded dimensions ($ICC_{\text{unconventionality}}$ = .90, $ICC_{\text{asymmetry}}$ .83, $ICC_{\text{disproportion}}$ = .74).

Radical-incremental creative thinking. After the creature design task, participants provided open-ended responses about (1) their thought processes when creating their idea, (2) the real-life animals they thought of when producing the idea, and (3) whether they modified an existing idea to generate the new creature. Participants then reported the extent they approached the design task with radical or incremental creative thinking on a 11-point bipolar scale anchored as “I creatively improved upon existing designs” at one end, “My idea is uncreative” at the middle, and “I creatively produced a radically original design” at the other end.

Additionally, two independent coders coded the degree that the creature design exhibits radical or incremental creativity on a 15-point scale (-7 = very high *incremental creativity*, 0 = *uncreative*, +7= *very high radical creativity*). To avoid confounds, this dimension was coded on a separate occasion and coders made no reference to their earlier coding ($ICC_{\text{radical-incremental}}$ = .79).

Insight problems and RAT. Creative insight was measured with three insight items identical to those used by Forster and colleagues (2004) and a 10-item RAT similar to previous studies.

Results

Manipulation check. To ensure that the manipulation induced different levels of perceived change and progress in the future, two independent coders who were blind to the research purpose and participants' condition scored each response on the extent that participants' projection of the future is characterized by perception of change and progress (1 = *very low*, 4 = *moderate*, 7 = very high), *ICC* = .83. An independent *t*-test supports that participants in the high change condition (M = 5.36, SD = 1.09) perceived the future with higher levels of change and progress than the low change condition (M = 2.60, SD = 1.61), $t(122) = 11.13$, $p < .001$, $d = 2.01$, $95\%CI_{diff}$ [2.27, 3.25].

Levels of future change and performance in creature design. I examined the six indices of the creature design with a series of *t*-tests (for descriptive statistics, see Table 4). Construing the future with high rather than low levels of change had significant effects on promoting creativity in terms of inducing higher novelty ($t(122) = 3.02$, $p = .003$, $d = 0.54$, $95\%CI_{diff}$ [0.28, 1.36]), unconventionality ($t(122) = 2.45$, $p = .02$, $d = 0.44$, , $95\%CI_{diff}$ [0.13, 1.21]), and bilateral asymmetry in the design ($t(122) = 2.33$, $p = .02$, $d = 0.42$ $95\%CI_{diff}$ [0.03, 0.34]). Participants in the high change condition also produced more practical designs that were rated as more useful for turning into a movie character, ($t(122) = 2.26$, $p = .03$, $d = .41$, $95\%CI_{diff}$ [0.07, 1.04]). However, the high versus low change condition did not differ in the indices of elaboration ($t(122) = -0.04$, $p = .97$) and disproportion ($t(122) = -0.27$, $p = .79$).

Testing the mediation model. Next, I tested the hypothesis that the creativity-facilitating effect of future construal was mediated through increased accessibility of the

change and progress schema. I reported the mediation results for each creativity index as the mediation pattern was different for some indices.

As hypothesized, in the first path, imagining the future with high versus low levels of change led to higher accessibility of change and progress (B = 1.02, t = 3.59, p < .001, 95%CI [0.46, 1.58]). In the second path, accessibility of change and progress predicted higher novelty (B = 0.20, t = 2.36, p = .02, 95%CI [0.03,0.37]). The direct effect of manipulating high versus low levels of change remained significant (B = .62, t = 2.19, p = .03, 95%CI [0.06,1.18]), thus indicating a partial mediation. The indirect effect (κ^2 = .07) was significant, as shown by a bootstrapped 95% CI [.06, .43] that did not bound zero. Higher accessibility of change and progress also predicted the inclusion of more unconventional features (B = .19, t = 2.19, p = .03, 95%CI [0.02, 0.36]). The direct effect of the change manipulation was not significant (B = .48, t = 1.69, p = .09), suggesting a full mediation. The indirect effect (κ^2 = .06) on unconventional features was significant as indicated by a bootstrapped 95% CI [.04, .41] that did not bound zero. However, participants' higher expectation of change and progress did not predict practicality (B = -0.10, t = -1.33, p = .19), nor the generation of asymmetric design (B = -0.01, t = -0.36, p = .72).

Distinguishing between radical and incremental creative thinking. Results showed that participants in the high change future construal condition scored higher on rated radical creativity as mediated through higher expectations of change and progress. Specifically, in the second path of the mediation model, perceptions of change and progress predicted higher rated radical creativity (B = 0.61, t = 2.53, p = .013, 95%CI [0.13, 1.08]) and the direct manipulation effect became insignificant (B = 0.16, t = 0.20, p = .84), thus indicating a full mediation. The indirect effect (κ^2 = .07) was significant, with bootstrapped 95% CI at [.08, 1.31]. Consistently, participants in the high versus low change condition were also more likely to self-report adopting a radical rather than incremental creativity approach (t(122) =

2.74, p = .007, d = 0.49, 95%CI_{diff} [0.36, 2.22]). However, this effect was not mediated through higher accessibility of the change and progress schema.

A post-hoc exploration was conducted to examine the adoption of a radical creativity approach as a mediator that transmits the future construal effect to benefit creativity. In the second mediation path, self-reported adoption of radical creativity positively predicted rated radical creativity of the creature design (B = 0.33, t = 2.31, p = .023, 95%CI [0.05,0.61]), and it increased variance explained from R = .06 to .10, $F_{change}(1,120) = 5.34$, p = .023. The indirect effect through self-reported radical creativity approach was significant, with bootstrapped 95% CI at [.09, 1.05]. The indirect effect through accessibility of change and progress remained significant, with bootstrapped 95%CI at [0.10, 1.34]. The direct manipulation effect was insignificant, indicating an overall full mediation model with bootstrapped 95% CI at [0.38, 1.90]. However, self-reported adoption of radical creativity approach did not appear to facilitate novelty and the inclusion of unconventional features in the design.

Creative insight performance. High versus low change future construal manipulation had no significant effect on creative insight. Participants' RAT scores did not differ in the high change (M = 3.01, SD = 2.18) versus low change condition (M = 3.29, SD = 2.20), $t(122) = -0.91$, p = 37. Participants also did not differ in the number of insight problems solved in the high change (M = 0.23, SD = 0.49) versus low change condition (M = 0.31, SD = 0.50), $t(122) = 0.49$, p = .49. Consistent with earlier studies, these results suggest that the activation of the change and progress schema through future construal primarily facilitates divergent or original thinking, but not necessarily convergent thinking.

Discussion

Findings of Study 3 support Hypotheses 2 and 3. Experimentally inducing the levels of change and progress foreseen in future societies establishes the causal role of construing a

future with high change in activating the change and progress schema and promoting greater creativity. Such creative advantage is more prominent for the dimensions of creativity that attest to divergent thinking such as generating a design that is novel, radically different, and includes unconventional and asymmetric features. Additionally, it was found that accessibility of the change and progress schema fully mediated the link between construing a future with high change and the rated unconventionality and radical creativity of the design, whereas a partial mediation was observed for novelty. Interestingly, participants primed to think of the future with high change and progress reported a tendency to adopt a radical rather than an incremental strategy to approach their creative ideation. This suggests that future construal could destabilize participants' reliance on existing schemas and motivate them to loosen the constraints to explore new ideas as opposed to only exploiting or modifying existing ones.

Notably, unlike the earlier studies, Study 3 did not find significant results for the elaboration dimension. It is plausible to argue that as Studies 1 and 2 had participants generate as many designs as they could, Study 3 only asked for one design, thus allowing more time for participants to elaborate on their creation and attenuating the detectable differences in elaboration between conditions.

Consistent with Studies 1 and 2, the current study also demonstrated that the creative benefit of future construal as mediated through the schema of change and progress is primarily on divergent thinking, but less so on convergent thinking (e.g., insight and RAT problems). Nevertheless, unlike the prior two studies, Study 3 found a creative benefit of future construal on practicality. It is reasonable to argue that in Study 3's movie character design task, novel ideas were also likely to be rated as practical for creating a movie character. Overall, these findings are congruent with the proposed schema accessibility account that the change and progress schema associated with future construal could destabilize preexisting representations and bring about generative thoughts.

CHAPTER 5: GENERAL DISCUSSION

To recapitulate, this research is based on the premise that people are often pervasively reliant on schemas during idea generation, which could limit their creative potentials (e.g., Bink & Marsh, 2000; Ward et al., 2002). It follows that creative benefits would accompany a reduced reliance on typical every day schemas that constrain creativity, and more so if there is an increased activation of creativity-facilitating schemas that further diversify sources of idea generation. I identified future construal as a process that triggers such benefits on creative potentials. Prior research hinted that people hold schematic beliefs about the future being characterized by change and progress (Bain et al., 2013; Kashima et al., 2009; Rutjens et al., 2009). If people construe the future prior to contemplating creative ideas, then the change and progress schemas made accessible are likely to shape these ideas and to instigate higher novelty. The present findings support these propositions.

Specifically, the preliminary study and Study 1 supported the first hypothesis that people dominantly construe the future with schemas of change and progress. Studies 1 and 2 confirmed the second hypothesis, showing that future temporal construal causes an increase in creative performance relative to present temporal construal. Supporting the third hypothesis, Studies 2 and 3 found that the creative-facilitating effect of future temporal construal was mediated through the accessibility of schemas associated with change and progress. Further, Study 3 further confirmed the causal direction stipulated in the second and third hypotheses, demonstrating the role of construing a future with high levels of change in making salient the change and progress schemas and in turn facilitating greater creativity. Additionally, across the three studies I observed a robust creativity-facilitating effect of future construal on the facets of creativity that require divergent thinking to produce ideas that are novel and deviant from preexisting prototypes. Nevertheless, future construal did not appear to benefit

components of creativity that rely on convergent thinking, such as figuring out the correct solutions for creative insight problems and the RAT, and ensuring that ideas are practical.

Theoretical and Practical Contributions

The present research enriches understanding of how situationally induced mental frames in tandem with our social schemas could influence creativity. In this regard, the research makes several key contributions by bridging the creative cognition approach with theories of schematic social perceptions to demonstrate the creativity-facilitating consequence of future-focused schemas.

First, the current research adds to existing knowledge that thinking outside typical schemas could produce a liberating effect from the confines of preexisting mental sets. For instance, past research demonstrated that encountering unusual experiences that violates one's schemas such as navigating a virtual reality world that defies physical laws, or following procedures unnatural to one's routines can promote cognitive flexibility (Ritter et al., 2012). Others have shown that immersive multicultural experiences (Leung et al., 2008; Maddux, Adam, & Galinsky, 2010), the reconciliation of different cultural identities (Cheng, Sanchez-Burks, & Lee, 2008; Gocłowska & Crisp, 2014), and exposure to counter-stereotypical concepts related to genders and professions (Gocłowska & Crisp, 2013; Goclowska et al., 2012) challenge one's sociocultural schemas, which in turn enhance people's cognitive flexibility and performance on divergent thinking tasks. Extending this literature, the current research suggests that thinking about the future might liberate people from fixating on present-oriented schemas, which usually offers a schematic and familiar way to navigate the present-day experiences and thus are typically creativity-constraining.

Second, building on the robust phenomenon of structured imagination, the current studies focused on examining the *contents* of schemas or mindsets that people retrieve to generate new ideas. Extant research on mindsets and creativity has more often focused on

identifying the kind of mindsets that affect the *ways* people process information, as opposed to the *contents* associated with these mindsets. For example, the construal level account argues that psychological distance induces a high-level construal mindset with which mental information is organized in conceptual and generalized terms, thus permitting greater flexibility when generating and synthesizing ideas. This contrasts with a low-level construal mindset, which governs more concrete and detail-oriented processing of information low-level mental construal (Forster et al., 2009; Forster et al., 2004; Trope & Liberman, 2010). For another example, in mood and creativity research Isen (1993, 1999) proposed that positive moods activate a more extensive range of information to support greater flexibility and novel synthesis of creative ideas. This work has primarily focused on the amount and diversity of information recruited and how information is more broadly categorized under positive mood states (Isen & Daubman, 1984; Isen et al., 1987), as opposed to the specific contents of the schemas activated by positive moods. Grounded on the creative cognition approach, my work seeks to contribute new knowledge by examining the *contents* of schemas or knowledge structures that are activated by future temporal construal. In this light, by acknowledging the different contents stored in schemas, the present research provides a novel perspective by revealing that not all schemas are creativity-inhibiting; schemas such as those that characterize the future with societal change and progress could in fact be creativity-fostering.

I want to note that my findings did not replicate the findings by Forster and colleagues (2004, 2009) that future construal facilitates creative insight and abstract thinking. To reconcile this discrepancy, I noticed some important differences in the experimental manipulation of future construal and potentially in the thought processes the manipulation induced between their studies and the present studies. Forster and colleagues (2004, 2009) had participants imagine their own future-selves solving the creative insight problems. This might lead participants to ponder, “How would I solve this differently in the future?”, thus

resulting in more abstract thought and restructuring at a broader level. In the present studies, participants were asked to vividly imagine how the future societies would be like and therefore might foresee the change and progress that the future brings in a less abstract manner. As such, the schemas of change and progress activated by the experimental induction in the current studies might have propelled more divergent thinking in participants' actual creative designs, rather than abstract and higher-order thinking as the previous research has shown.

I want to emphasize that the present research is not aimed to challenge the value of the construal level theory in explaining the link between future temporal construal and creative thinking. However, my work has pointed to several directions different from the construal level theoretical perspective. First, my schema accessibility account suggests that people might have the capability of not representing the future in abstract terms, but bring to mind some vivid details about the kind of change and progress the future might unfold. With this logic, it is plausible that the current future construal manipulation did not lead to more abstract thinking. Second, abstract thought is not always necessary for greater creativity. The schema accessibility account predicts that people could harness creative benefit by thinking in terms of the change and progress schemas, which could be mentally represented either in a concrete or abstract manner.

Limitations and Future Directions

I measured the mediator of schema accessibility with a self-report scale. Research from the cognitive tradition often prefers a reaction time measure of accessibility. However, a reaction time measure of schema accessibility does not seem to be methodologically viable for the current research. Reaction time measures typically require a large number of trials to be reliable. Hence, to measure a diverse range of schema contents (e.g., change and progress, warmth, competence, societal dysfunction) and to include neutral baseline trials as a

comparison, it would require a large number of trials and likely induce fatigue on participants. It might also cause the temporal construal manipulation effect to dissipate through the long duration of the reaction time task. Due to these reasons, I adapted from previous studies a rating scale to assess people's projections of the future. This approach aligns nicely with the existing literature that studies people's schematic perceptions of the future (Bain et al., 2013).

One aspect that remains unexplored in this study is how a temporal orientation about the past could be associated with creativity. In this regard, the predictions based on the construal level theory and the current schema accessibility perspective could diverge. Although the construal level theory often focuses on the distal future, psychological distance is defined relative to the present moment and thus the past is also a psychologically distant entity (Trope & Liberman, 2010). Studies showed that long-term memories of the distant past are often reconstructed in abstract and schematic terms, retaining relatively fewer concrete details (Ross, 1989; Semin & Smith, 1999). Thus, it is reasonable to predict that according to the construal level theory the distant past also induces a high level of mental construal and therefore facilitates creative thinking. In contrast, according to the schema accessibility perspective, I conjecture that future-oriented schemas are more creativity-facilitating than past-oriented schemas. Whereas the future is associated with perceptions of change and progress, people often view the past as traditional, simplistic, and falling short of development (Bain et al., 2013). The accessibility of these concepts that characterize the past-oriented schemas could be creativity-inhibiting. Nevertheless, an alternative perspective is that priming participants about the past juxtaposes the past with the present, and this comparison sensitizes participants to the change and progress necessary for creativity and innovation. Therefore, these possibilities open up avenues for future research testing. More broadly, future research could also explore other potential creativity-facilitating schemas.

Conclusion

Ultimately, the change and progress that is anticipated and desired of the future is contingent on the creativity and innovation that can be mustered in the present day. I argue that thinking about the future is more than just an imaginary endeavor. Rather, it materializes creative ideations to prepare people for the next leap of creative and innovative generations in the future. Future construal promotes the breaking of schematic mental sets that is conducive for the pursuit of radical creativity. Notably, there are ostensibly advanced and cutting-edge innovations that are being developed and pursued at the present. Yet, I should caution that the expertise and knowledge I rely on to make these creations possible might become liabilities and entrench us in schematic ways of thinking that limit or slow down the next creative breakthrough (Dane, 2010; Smith, 2003; Wiley, 1998). It is possible to argue that the next generation creative solutions have to address the increasing demand for social innovation, which requires effective and sustainable solutions to benefit the society as a whole (Mulgan et al., 2007; Phills et al., 2008). Such an undertaking requires breaking free from the schemas of how societies should operate and even the schemas of how to innovate. I contend that future construal of the much farther future could leapfrog social innovation by broadening our mental schemas to anticipate real but yet-to-emerge problems and to simulate long-term solutions for these problems before they come into being in the future.

Footnotes

1. In Study 1, a total of 117 participants was originally recruited. However, one participants' computer crashed and did not complete the study. Another participant did not complete the main creative design task. Both these data points were dropped from the reported analyses.
2. In both Studies 1 and 2, I had in fact administered four creative insight problems (see Appendix A). For brevity, I only focused on reporting the three items that past research on future construal and creativity had used. The main effects are not significant for both the three-item and four-item aggregate insight scores.

References

Amabile, T. M. (1982). Social psychology of creativity: A consensual assessment technique. *Journal of Personality and Social Psychology, 43*(5), 997-1013.

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology, 45*, 997-1013.

Andersen, S. M., Spielman, L. A., & Bargh, J. A. (1992). Future-event schemas and certainty about the future: Automaticity in depressives' future-event predictions. *Journal of Personality and Social Psychology, 63*(5), 711-723.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*(3), 411-423.

Anderson, R. C. (1977). Schema-directed processes in language comprehension. In A. Lesgold, J. Pelligrino, S. Fokkema & R. Glaser (Eds.), *Cognitive psychology and instruction*. New York, NY: Plenum.

Antes, A. L., & Mumford, M. D. (2009). Effects of time frame on creative thought: Process versus problem-solving effects. *Creativity Research Journal, 21*(2-3), 166-182.

Ash, I. K., & Wiley, J. (2006). The nature of restructuring in insight: An individual differences approach. *Psychonomic Bulletin & Review, 13*, 66-73.

Baas, M., De Dreu, C., & Nijstad, B. A. (2008). A meta-analysis of 25 years of mood–creativity research: Hedonic tone, activation, or regulatory focus? *Psychological Bulletin, 134*(6), 779-806.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16*(1), 74-94.

Bain, P. G., Hornsey, M. J., Bongiorno, R., & Jeffries, C. (2012). Promoting pro-environmental action in climate change deniers. *Nature Climate Change, 2*, 600-603.

Bain, P. G., Hornsey, M. J., Bongiorno, R., Kashima, Y., & Crimston, D. (2013). Collective futures: How projections about the future of society are related to actions and attitudes supporting social change. *Personality and Social Psychology Bulletin, 39*(4), 523-539.

Bain, P. G., Milfont, T. L., Kashima, Y., Bilewicz, M., Doron, G., Garðarsdóttir, R. B., . . . Pasquali, C. (2016). Co-benefits of addressing climate change can motivate action around the world. *Nature Climate Change, 6*(5), 538-538.

Bink, M. L., & Marsh, R. L. (2000). Cognitive regularities in creative activity. *Review of General Psychology, 4*(1), 59-78.

Bowden, E. M., & Beeman, M. J. (1998). Getting the right idea: Semantic activation in the right hemisphere may help solve insight problems. *Psychological Science, 9*(6), 435-440.

Brédart, S., Ward, T. B., & Marczewski, P. (1998). Structured imagination of novel creatures' faces. *The American Journal of Psychology, 111*(4), 607-625.

Cheng, C.-y., Sanchez-Burks, J., & Lee, F. (2008). Connecting the dots within creative performance and identity integration. *Psychological Science, 19*(11), 1178-1184.

Clore, G., Gasper, K., & Garvin, E. (2001). Affect as information. In J. P. Forgas (Ed.), *Handbook of affect and social cognition* (pp. 121-144). Mahwah, NJ: Lawrence Erlbaum.

Dane, E. (2010). Reconsidering the trade-off between expertise and flexibility: A cognitive entrenchment perspective. *Academy of Management Review, 35*(4), 579-603.

De Dreu, C. K., Baas, M., & Nijstad, B. A. (2008). Hedonic tone and activation level in the mood-creativity link: Toward a dual pathway to creativity model. *Journal of Personality and Social Psychology, 94*(5), 739-756.

De Dreu, C. K., Nijstad, B. A., Baas, M., Wolsink, I., & Roskes, M. (2012). Working memory benefits creative insight, musical improvisation, and original ideation through

maintained task-focused attention. *Personality and Social Psychology Bulletin, 38,* 656-669.

Diamond, L. M. (2003). What does sexual orientation orient? A biobehavioral model distinguishing romantic love and sexual desire. *Psychological Review, 110,* 173-192.

Finke, R. A., Ward, T. B., & Smith, S. M. (1992). *Creative cognition: Theory, research, and applications.* Cambridge, MA: MIT Press.

Fiske, S. T., Cuddy, A. J. C., Glick, P., & Xu, J. (2002). A model of (often mixed) stereotype content: Competence and warmth respectively follow from perceived status and competition. *Journal of Personality and Social Psychology, 82*, 878-902.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18,* 39-50.

Forster, J., Epstude, K., & Ozelsel, A. (2009). Why love has wings and sex has not: How reminders of love and sex influence creative and analytic thinking. *Personality and Social Psychology Bulletin, 35*(11), 1479-1491.

Forster, J., Friedman, R. S., & Liberman, N. (2004). Temporal construal effects on abstract and concrete thinking: consequences for insight and creative cognition. *Journal of Personality and Social Psychology, 87*(2), 177-189.

Fredrickson, B. L. (1998). What good are positive emotions? *Review of General Psychology, 2*(3), 300-319.

Gasper, K. (2004). Do you see what I see? Affect and visual information processing. *Cognition and Emotion, 18,* 405-421.

Gasper, K., & Clore, G. (2002). Attending to the big picture: Mood and global versus local processing of visual information. *Psychological Science, 13,* 33-39.

Gilson, L. L., & Madjar, N. (2011). Radical and incremental creativity: Antecedents and processes. *Psychology of Aesthetics, Creativity, and the Arts, 5*(1), 21-28.

Goclowska, M. A., Baas, M., Crisp, R. J., & De Dreu, C. K. (2014). Whether social schema violations help or hurt creativity depends on need for structure. *Personality and Social Psychology Bulletin, 40*(8), 959-971.

Gocłowska, M. A., & Crisp, R. J. (2013). On counter-stereotypes and creative cognition: When interventions for reducing prejudice can boost divergent thinking. *Thinking Skills and Creativity, 8*, 72-79.

Gocłowska, M. A., & Crisp, R. J. (2014). How dual-identity processes foster creativity. *Review of General Psychology, 18*(3), 216-236.

Goclowska, M. A., Crisp, R. J., & Labuschagne, K. (2012). Can counter-stereotypes boost flexible thinking? *Group Processes & Intergroup Relations, 16*(2), 217-231.

Gupta, N., Jang, Y., Mednick, S. C., & Huber, D. E. (2012). The road not taken: Creative solutions require avoidance of high-frequency responses. *Psychological Science, 23*(3), 288-294.

Higgins, E. T. (2011). Accessibility Theory. In P. A. Van Lange, A. W. Kruglanski & E. T. Higgins (Eds.), *Handbook of social psychology: Volume one* (pp. 75-96). London: SAGE Publications.

Holyoak, K. J., & Tahagard, P. R. (1995). *Mental leaps*. Cambridge, MA: MIT Press.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55.

Isen, A. M., & Daubman, K. A. (1984). The influence of positive affect on categorization. *Journal of Personality and Social Psychology, 47*(6), 1206-1217.

Isen, A. M., Daubman, K. A., & Nowicki, G. P. (1987). Positive affect facilitates creative problem solving. *Journal of Personality and Social Psychology, 52*, 1122-1131.

Kashima, Y., Bain, P., Haslam, N., Peters, K., Laham, S., Whelan, J., . . . Fernando, J. (2009). Folk theory of social change. *Asian Journal of Social Psychology, 12*(4), 227-246.

Kashima, Y., Shi, J., Tsuchiya, K., Kashima, E. S., Cheng, S. Y., Chao, M. M., & Shin, S.-h. (2011). Globalization and folk theory of social change: How globalization relates to societal perceptions about the past and future. *Journal of Social Issues, 67*(4), 696-715.

Kenny, D. A. (2013). Measuring model fit. from davidakenny.net/cm/fit.htm

Lee, C. S., & Therriault, D. J. (2013). The cognitive underpinnings of creative thought: A latent variable analysis exploring the roles of intelligence and working memory in three creative thinking processes. *Intelligence, 41*, 306-320.

Leung, A. K.-y., & Chiu, C.-y. (2008). Interactive effects of multicultural experiences and openness to experience on creative potential. *Creativity Research Journal, 20*(4), 376-382.

Leung, A. K.-y., & Chiu, C.-y. (2010). Multicultural experience, idea receptiveness, and creativity. *Journal of Cross-Cultural Psychology, 41*(5-6), 723-741.

Leung, A. K.-y., Maddux, W. W., Galinsky, A. D., & Chiu, C.-y. (2008). Multicultural experience enhances creativity: The when and how. *American Psychologist, 63*(3), 169-181.

Liberman, N., Trope, Y., & Stephan, E. (2007). Psychological distance. In A. W. Kruglanski & E. T. Higgins (Eds.), *Social psychology: Handbook of basic principles*. New York, NY: Guilford Press.

Maddux, W. W., Adam, H., & Galinsky, A. D. (2010). When in Rome ... Learn why the Romans do what they do: How multicultural learning experiences facilitate creativity. *Personality and Social Psychology Bulletin, 36*(6), 731-741.

Madjar, N., Greenberg, E., & Chen, Z. (2011). Factors for radical creativity, incremental creativity, and routine, noncreative performance. *Journal of Applied Psychology, 96*(4), 730-743.

Marsh, R. L., Landau, J. D., & Hicks, J. L. (1996). How examples may (and may not) constrain creativity. *Memory & Cognition, 24*(5), 669-680.

Marshall, S. P. (1995). *Schemas in problem solving*. New York, NY: Cambridge University Press.

Mednick, S. A. (1962). The associative basis of the creative proccess. *Psychological Review, 6*, 220-232.

Mednick, S. A. (1968). The remote associates test. *The Journal of Creative Behavior, 2*, 213-214.

Mikulincer, M. (1998). Attachment working models and the sense of trust: An exploration of interaction goals and affect regulation. *Journal of Personality and Social Psychology, 74*, 1209-1224.

Mulgan, G., Tucker, S., Ali, R., & Sanders, B. (2007). *Social innovation: What it is, why it matters and how it can be accelerated*. Oxford, UK: Skoll Centre for Social Entrepreneurship, University of Oxford.

Murray, N., Sujan, H., Hirt, E. R., & Sujan, M. (1990). The influence of mood on categorization: A cognitive flexibility interpretation. *Journal of Personality and Social Psychology, 59*, 411-425.

Navon, D. (1977). Forest before trees: The precedence of global features in visual perception. *Cognitive Psychology, 9*, 353-383.

Nijstad, B. A., De Dreu, C. K., Rietzschel, E. F., & Baas, M. (2010). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology, 21*(1), 34-77.

Perfetto, G. A., Bransford, J. D., & Franks, J. J. (1983). Constraints on access in a problem solving context. *Memory & Cognition, 11*, 24-31.

Perkins, D. N. (1988). The psychology of human thought. In R. J. Sternberg & E. E. Smith (Eds.), *Creativity and the quest for a mechanism* (pp. 310-336). New York, NY: Cambridge University Press.

Phills, J. A., Deiglmeier, K., & Miller, D. T. (2008). Rediscovering social innovation. *Stanford Social Innovation Review, 6*(4), 34-43.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavioral Research Methods, 40*(3), 879-891.

Preacher, K. J., & Kelley, K. (2011). Effect sizes measure for mediation models: Quantitative strategies for communicating indirect effects. *Psychological Methods, 16*(2), 93-115.

Price, E. A., & Driscoll, M. P. (1997). An inquiry into the spontaneous transfer of problem-solving skill. *Contemporary Educational Psychology, 22*, 472-494.

Ritter, S. M., Damian, R. I., Simonton, D. K., van Baaren, R. B., Strick, M., Derks, J., & Dijksterhuis, A. (2012). Diversifying experiences enhance cognitive flexibility. *Journal of Experimental Social Psychology, 48*(4), 961– 964.

Ritter, S. M., Kühn, S., Müller, B. C. N., van Baaren, R. B., Brass, M., & Dijksterhuis, A. (2014). The creative brain: Schema-violations enhance TPJ activity and boost cognitive flexibility. *Creativity Research Journal, 26*, 144-150.

Rosch, E. (1975). Cognitive representation of semantic categories. *Journal of Experimental Psychology: General, 104*(3), 192-233.

Rosch, E. (1978). Principles of categorization. In E. Rosch & B. B. Lloyd (Eds.), *Cognition and categorization* (pp. 27-48). Hillsdale, NJ: Erlbaum.

Ross, M. (1989). Relation of implicit theories to the construction of personal histories. *Psychological Review, 96*, 341-357.

Rumelhart, D. E. (1980). Schemata: The building blocks of cognition. In R. J. Spiro, B. C. Bruce & W. E. Brewer (Eds.), *Thereotical issues in reading comprehension*. Hillsdale, NJ: Lawrence Erlbaum.

Runco, M. A., & Acar, S. (2012). Divergent thinking as an indicator of creative potential. *Creativity Research Journal, 24*(1), 66-75.

Runco, M. A., & Chand, I. (1995). Cognition and creativity. *Educational Psychology Review, 7*, 243-267.

Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. *Creativity Research Journal, 24*(1), 92-96.

Rutjens, B. T., van der Pligt, J., & van Harreveld, F. (2009). Things will get better: The anxiety-buffering qualities of progressive hope. *Personality and Social Psychology Bulletin, 35*(5), 535-543.

Rutjens, B. T., van Harreveld, F., & van der Pligt, J. (2010). Yes I can: Belief in progress as compensatory control. *Social Psychological and Personality Science, 1*(3), 246-252.

Semin, G. R., & Smith, E. R. (1999). Revisiting the past and back to the future: Memory systems and the linguistic representation of social events. *Journal of Personality and Social Psychology, 76*, 877-892.

Simonton, D. K. (2000). Genius and giftnessness: Same or different? In K. A. Heller, F. J. Monks, R. J. Sternberg & R. F. Subotnik (Eds.), *International handbook of research and development of giftedness and talent* (pp. 111-121). Terrytown, NY: Pergamon.

Simonton, D. K. (2003). Exceptional creativity across the life span: The emergence and manifestation of creative genius. In L. V. Shavinia (Ed.), *International handbook of innovation* (pp. 293-308). Oxford, UK: Elsevier.

Smith, K. A., Huber, D. E., & Vul, E. (2013). Multiply-constrained semantic search in the Remote Associates Test. *Cognition, 128*(1), 64-75.

Smith, S. M. (1995). Fixation, incubation, and insight in memory and creativity thinking. In S. M. Smith, T. B. Ward & R. A. Finke (Eds.), *The creative cognition approach*. Cambridge, MA: MIT Press.

Smith, S. M. (2003). The constraining effects of initial ideas. In P. B. Paulus & B. A. Nijstad (Eds.), *Group creativity: Innovation through collaboration* (pp. 15-31). New York, NY: Oxford University Press.

Smith, S. M., Ward, T. B., & Schumacher, J. S. (1993). Constraining effects of examples in a creative generation task. *Memory & Cognition, 21*(6), 837-845.

Sternberg, R. J., & O'Hara, L. A. (1999). Creativity and intelligence. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 251-272). New York, NY: Cambridge University Press.

Taylor, S. E., & Brown, J. D. (1988). Illusions and well-being: A social-psychological perspective on mental health. *Psychological Bulletin, 103*, 193-210.

Taylor, S. E., & Brown, J. D. (1994). Positive illusions and well-being revisited: Separating fact from fiction. *Psychological Bulletin, 116*(1), 21-27.

Taylor, S. E., & Gollwitzer, P. M. (1995). Effects of mindset on positive illusions. *Journal of Personality and Social Psychology, 69*(2), 213-226.

The WiderNet Project. (2015). eGranary Digital Library. from widernet.org/eGranary/

Trope, Y., & Liberman, G. (2003). Temporal construal. *Psychological Review, 110*, 403-421.

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review, 117*(2), 440-463.

Ward, T. B. (1994). Structured imagination: The role of conceptual structure in exemplar generation. *Cognitive Psychology, 27*, 1-40.

Ward, T. B. (1995). What's old about new ideas? In S. M. Smith, T. B. Ward & R. A. Finke (Eds.), *The creative cognition approach*. Cambridge, MA: MIT Press.

Ward, T. B. (2007). Creative cognition as a window on creativity. *Methods, 42*(1), 28-37.

Ward, T. B., Patterson, M. J., & Sifonis, C. M. (2004). The role of specificity and abstraction in creative idea generation. *Creativity Research Journal, 16*(1), 1-9.

Ward, T. B., Patterson, M. J., Sifonis, C. M., Dodds, R. A., & Saunders, K. N. (2002). The role of graded category structure in imaginative thought. *Memory & Cognition, 30*, 199-216.

Ward, T. B., & Sifonis, C. M. (1997). Task demands and generative thinking: What changes and what remains the same? *The Journal of Creative Behavior, 31*(4), 245-259.

Ward, T. B., Smith, S. M., & Finke, R. A. (1999). Creative cognition. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 189-212). New York, NY: Cambridge University Press.

Ward, T. B., Smith, S. M., & Vaid, J. (1997). Conceptual structures and processes in creative thought. In T. B. Ward, S. M. Smith & J. Vaid (Eds.), *Creative thought: An investigation of conceptual structures and processes* (pp. 1-27). Washington, DC: American Psychological Association.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063-1070.

Waytz, A., Hershfield, H. E., & Tamir, D. I. (2015). Mental simulation and meaning in life. *Journal of Personality and Social Psychology, 108*(2), 336-355.

Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology, 39*(5), 806-820.

Weisberg, R. W. (1986). *Creativity, genuius and other myths*. New York, NY: Freeman.

Weisberg, R. W. (1993). *Creativity: Beyond the myth of genius*. New York, NY: Freeman.

Weisberg, R. W., DiCamillo, M., & Phillips, D. (1978). Transferring old associations to new problems: A nonautomatic process. *Journal of Verbal Learning and Verbal Behavior, 17*, 219-228.

White, J. H. (1978). *The American railroad passenger car*. Baltimore, MD: John Hopkins University Press.

Wiley, J. (1998). Expertise as a mental set: The effect of domain knowledge in creative problem solving. *Memory & Cognition, 26*, 716-730.

Tables

Table 1. Thematic-coding of responses in the word listing task in Pilot Study 1A.

Positive			Negative		
Theme	**Dominance**		**Theme**	**Dominance**	
Change and Progress	**460**	**34%**		**130**	**10%**
Technological Progress	205	15%	Apocalyptic	71	5%
Novelty, Discovery, and Incredulity	66	5%	Rigid, Mundane, Familiar	35	3%
Progress of Science and Knowledge	61	5%	Societal Dysfunctions and Large-Scale Problems (e.g., Climate Change)	24	2%
Space Exploration	47	4%			
Progress (Generic terms: Advancement, Progress)	32	2%			
Becoming Connected and Accessible	31	2%			
Creativity & Innovation	18	1%			
General Future Well-being	**58**	**4%**		**131**	**10%**
Positive Emotions (Peaceful, Happy)	38	3%	Bleak	57	4%
			Uncertain (Chaos, Instability)	35	3%
			Negative Emotions (Sad, Despair)	31	2%
Medical/Health/Wellbeing	20	1%	Unhealthy/Illness	8	1%
Lifestyle	**111**	**8%**		**74**	**6%**
Fast Paced (Quick, Efficient)	53	4%	Strife	74	6%
Success and Prosperity	37	3%			
Urbanization	21	2%			
Social Community and Diversity	**71**	**5%**		**94**	**7%**
Cultural, Diversity, and Equality	38	3%	Social Isolation	43	3%
Social, Communal, and Familial Relationships	25	2%	Aesthetics and Image	25	2%
			Artificial/Fake	15	1%
Freedom and Choice	8	1%	Inequality & Injustice	11	1%
Environmentalism	**43**	**3%**		**33**	**2%**
Environmental Concern & Sustainability	43	3%	Environmental Degradation	33	2%

Table 2. CFA results for the societal perception scale in Studies 2 and 3.

	Standardized Loading	
Factor / Item	**Study 2**	**Study 3**
Change and Progress	**CR = .81**	**CR = .93**
Technological Innovation	0.60	0.95
Scientific Progress	0.70	0.96
Novelty*	0.58	0.66
Progress and Advancement*	0.89	0.94
Rapid Change*	0.58	0.73
Social Community	**CR = .84**	**CR = .90**
Inclusive Communities*	0.73	0.88
Social Welfare	0.79	0.91
Volunteerism	0.85	0.72
Positive Change*	0.62	0.79
Diversity*	-	-
Societal Dysfunction	**CR = .87**	**CR = .87**
Terrorism and Crime	0.55	0.53
Resource Depletion	0.80	0.91
Global Warming	0.94	0.93
Aging Population*	0.84	0.74
Poverty	-	-
Gender Inequality	-	-
Prejudice and Discrimination*	-	-
Corruption	-	-
Diseases	-	-
Environmental Protection*	-	-
Warmth	**CR = .94**	**CR = .95**
Warmth (Relationships)	0.96	0.92
Caring	0.93	0.99
Unfriendliness	-	-
Insensitivity	-	-
Social Isolation*	-	-
Morality	**CR = .93**	**CR = .93**
Honesty	0.88	0.88
Sincerity	0.95	0.92
Trustworthiness	0.86	0.91
Immorality	-	-
Deceitfulness	-	-
Competence	**CR = .83**	**CR = .90**
Competence	0.82	0.76
Achievement	0.99	0.96
Resourcefulness*	0.50	0.86
Laziness	-	-
Incompetence	-	-

Note: *Indicates an item created for this study based on Study 1's data. Dashes (-) indicate that an administered item was removed due to a standardized loading of less than 0.50.

Table 3. Omnibus *F*-test values and corresponding *p* values for the series of Two-way ANOVAs testing the effect of temporal construal priming and priming context on the various dimensions of creativity performance.

	Main Effect of Temporal Construal		Main Effect of Priming Context		Interaction Effect	
Dimension	*F*(1,147)	*p*	*F*(1,147)	*p*	F(1,147)	*p*
Novelty	8.10	.005	1.17	.28	0.15	.70
Elaboration	7.97	.005	1.80	.18	0.19	.67
Futuristic	4.78	.030	1.49	.22	0.00	.95
Schema Deviance	23.53	<.001	0.03	.87	0.01	.92
Practicality	0.15	.70	2.41	.12	0.06	.81
Fluency	1.49	.22	0.13	.72	0.20	.66
Creative Insight	2.72	.10	0.71	.40	0.20	.66
RAT	0.05	.82	0.11	.74	0.07	.79

Table 4. Means and standard deviations (in parentheses) of various creativity indices across conditions for the creature design task in Study 3.

Index	Low Change Condition	High Change Condition
Novelty	3.02 (1.46)	3.84 (1.58)
Elaboration	3.40 (1.23)	3.39 (1.31)
Practicality	3.19 (1.40)	3.75 (1.34)
Unconventional Features	1.48 (1.55)	2.15 (1.49)
Bilateral Asymmetry	0.11 (0.36)	0.30 (0.52)
Disproportion	0.14 (0.34)	0.12 (0.33)
Incremental-Radical Creativity	2.29 (4.20)	3.06 (4.32)

Figures

Figure 1. Summary of creativity dimension mean scores by condition for the toy design creativity task in Study 1.

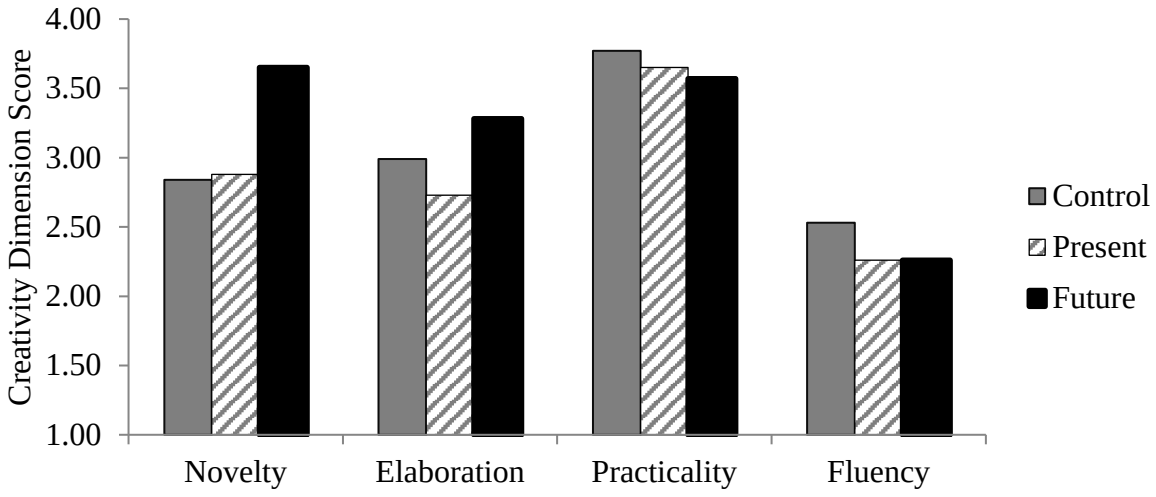
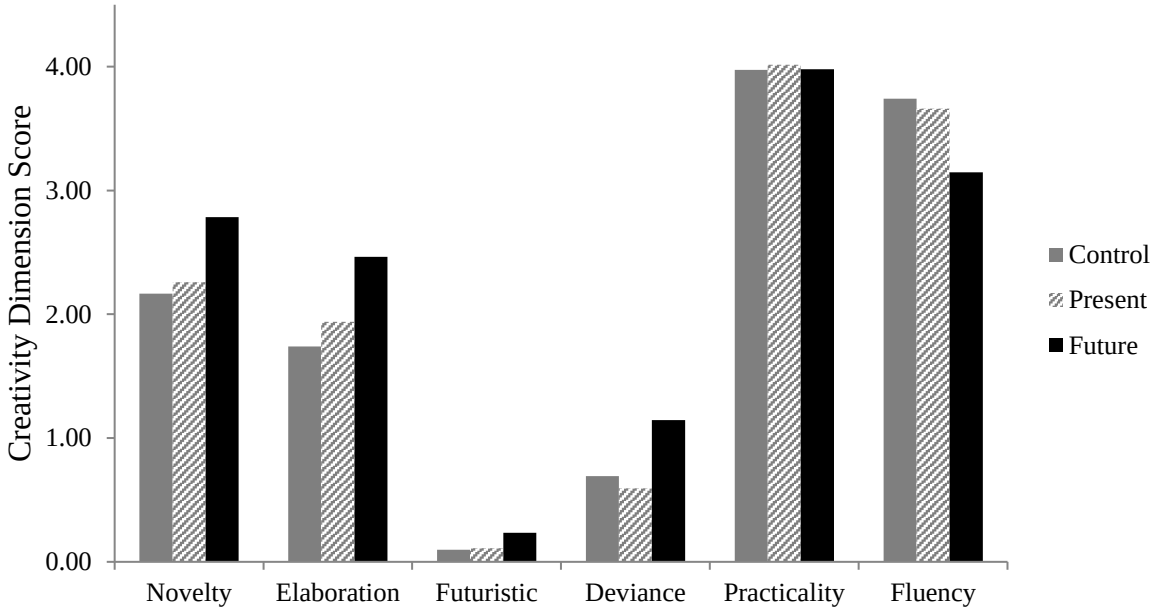


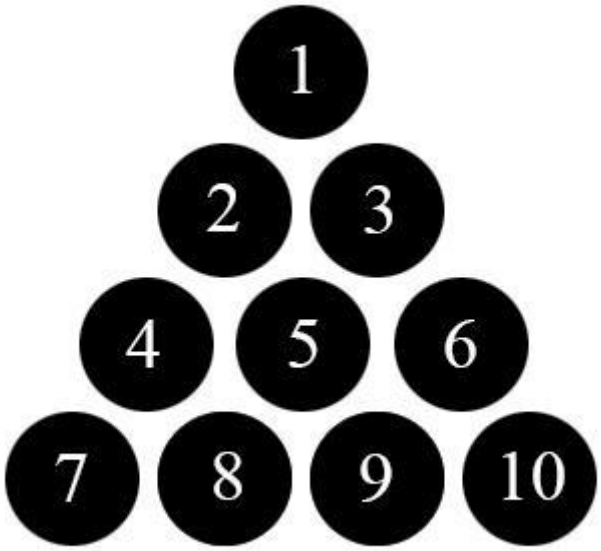
Figure 2. Summary of creativity dimension mean scores by condition for the dining table design creativity task in Study 2.



Appendix A

Insight Problem #3 (Forster et al., 2004)

The figure below shows a triangle pointing upwards made up of a set of 10 circles. Show how you can make the triangle point downwards by moving only three of the circles.



Insight Problem #4 (Ash & Wiley, 2006)[2]

In the figure below, each black circle represents a coin. Move only 2 coins so that each coin touches exactly 3 other coins. Hints: The coins will need to be separated into two groups. You may move the 2 coins in any way you deem fit.