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The Importance of Situational Information for Abstract Concepts

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A thesis submitted in partial fulfillment of the requirements for the degree in Master of Science

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Abstract

Very little is known about how people understand abstract concepts. While a good deal is known about concrete concepts such as *chair* or *apple,* concepts that are perceptually elusive, such as *idea* or *freedom,* remain a challenge for theories of conceptual knowledge. Past research has explained how these concepts are understood by focusing on how they differ from concrete concepts, suggesting they are primarily understood by their relations to other words. However, recent research recognizes that this is not a comprehensive view of their representation, and that it excludes much of people's everyday experience. Accordingly, current theories of grounded cognition propose that real-world situational knowledge plays a key role in how people understand abstract concepts. Experiment 1 supports this idea by showing that short scenario descriptions prime abstract concepts in the absence of any word association. In Experiment 2, I grouped concepts according to whether they relate multiple aspects of a situation, or refer to internal states. The former shows significant priming but the latter does not. These experiments demonstrate the importance of situational knowledge for the representation and processing of abstract concepts, including how the relationship between situations and abstract concepts is important to delineating among them.

Keywords: Abstract concepts, Situational information, Semantic knowledge, Conceptual Act Theory

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The Importance of Situational Information for Abstract Concepts

Abstract concepts such as *idea* or *freedom* remain almost as much a challenge for theories of conceptual knowledge today as they were centuries ago. Indeed, despite quite a bit of research, these concepts are still not well understood. One relatively uncontroversial observation is that abstract concepts differ from concrete concepts such as *chair* or *apple.* And in fact, abstract concepts are typically defined as those that are *not* concrete, that is, "entities that are neither purely physical nor spatially constrained," (Barsalou & Wiemer-Hastings, 2005). Due to the comparison with concrete concepts, a primary focus of past research has been defining the differences between these two broad classes behaviourally and neurally with the goal of elucidating the mechanisms that are responsible for processing concepts that are essentially intangible.

The majority of these attempts have taken the following approach. Abstract and concrete concepts are selected from established norms in which people rate them on a scale from one to seven, moving from abstract to concrete respectively (Paivio, 1986). These two groups are then compared on a range of tasks. Behavioural studies using words as stimuli have demonstrated that, compared to abstract concepts, concrete concepts are recognized faster in lexical decision tasks (Bleasdale, 1987; Whaley, 1978), remembered better in serial recall (Paivio, Yuille, & Smythe, 1966; Romani, McAlpine, & Martin, 2007), and are read faster in naming studies (de Groot, 1989). These findings have led to the general conclusion that abstract concepts are more difficult to process than are concrete concepts, referred to as *the concreteness effect*.

The majority of explanations of these effects have emphasized the role of language in the representation of abstract concepts, leaving little or no room for other influences. The goal of the present thesis is to address abstract concepts from a somewhat different approach, one that emphasizes the role of real-world situational information. Specifically, I tested the hypothesis that providing situational information in the absence of direct linguistic relations (i.e., word association) primes abstract concepts. This must be the case given any theory in which situational knowledge is a key component of abstract concepts, such as Barsalou's Perceptual Symbol Systems theory (1999). After establishing this basic but critical effect, I classified abstract concepts into two categories, relational and internal state, based on the aspects of situations to which they correspond. This classification is inspired by the Conceptual Act Theory of Emotion (Barrett, 2006; Wilson-Mendenhall et al., 2011). I found significant situational priming for relational but not for internal state concepts. I interpret these results as demonstrating the importance of real-world situations for how people learn, represent, and use abstract concepts.

In the remainder of the Introduction, I begin by discussing the dominant view of abstract concept processing, Dual Coding Theory (Paivio, 1986, 2007), as well as its shortcomings. Following this, I review grounded theories of cognition and their accounts of abstract concepts, with focus on Conceptual Metaphor Theory (Lakoff & Johnson, 1980) in particular. I conclude with Barsalou's Perceptual Symbol Systems theory (1999) – a unique account that may hold promise for better understanding abstract concepts, and one I test in the Experiments that follow.

Dual Coding Theory

The most popular account of concreteness effects is Dual Coding Theory (DCT) (Paivio, 1986, 2007), which states that processing differences between abstract and concrete concepts result from representational differences in two brain systems, the imagistic and verbal (linguistic) systems. Concrete concepts are represented in the imagistic system, which contains modality-specific information (visual, haptic, gustatory, etc.), as well as in the verbal system, which represents the relationships among words that frequently co-occur in language. In contrast, abstract concepts are represented only in the verbal system.

The activation of these systems relies on the information predominantly included in them (modality-specific information versus linguistic information). Although they are separate, there are referential connections between them such that a concept's linguistic form is connected to modality-specific information about its referent and vise versa. However, abstract concepts do not have physical perceptually-based referents, and therefore are not represented in the imagistic system. They are understood primarily via the linguistic system by virtue of their association to other words.

Accordingly then, abstract concepts are more difficult to process due to the singular nature of their semantic representation. Whereas concrete concepts have two sources of knowledge available to them at all times, abstract concepts have only one. And indeed, there is a strong correlation between concreteness ratings and how imageable people believe a concept to be (Paivio, 1986). Furthermore, a number of fMRI studies have shown increased activation in left-hemisphere language regions, primarily the left IFG and MTG, for abstract compared to concrete concepts (Binder et al., 2005; Wang et al., 2010). These findings are taken to support a greater reliance on verbal processing for abstract concepts, and thus support predictions made by DCT.

Yet, several findings remain that are not easily incorporated into this account. For example, there are instances in the literature that do not readily support the concreteness effect. In an edible/non edible judgment task, Pexman et al. (2007) found shorter decision latencies to abstract than to concrete concepts. Presumably this task depends on the type of deeper semantic processing that would, in fact, highlight a semantic processing advantage or disadvantage. Further, with other variables controlled, Kousta et al. (2011) obtained shorter lexical decision latencies for abstract than for concrete concepts. Finally, patients with deep dyslexia often have difficulty recognizing and pronouncing abstract words. However, Newton and Barry (1997) demonstrated that while these patients cannot physically annunciate them, they do show understanding of them in a task using pictures.

Noteworthy in itself is the remarkable inconsistency of imaging data. In fact, a number of studies have produced findings that are not well explained by any theory, such as greater activation in the RIFG for abstract concepts (Rodriguez-Ferreiro et al., 2009). Furthermore, although a meta-analysis conducted by Wang et al. (2010) found that the left IFG was a common denominator across studies, it is not entirely clear what increased activation in the left IFG reflects. Although this finding is often taken as evidence that abstract concepts rely more on verbal information than do concrete concepts, the left IFG has been crucially implicated in other functions ranging from semantic selection and integration (Huang et al., 2012; Thompson-Schill et al., 1997) to response inhibition (Swick, Ashley & Turken, 2008), and even social perception (Keuken et al., 2011).

Perhaps the most striking issue at hand is that there is currently no convincing account of what constitutes the conceptual representation of abstract concepts. Regarding DCT, it is difficult to imagine how the required richness of meaning could be derived from word association alone, as the word associates to many abstract concepts are themselves abstract. Whereas much research has recognized that word association alone is insufficient (Pecher et al., 2011), we are still left with a definition that characterizes abstract concepts as being "not concrete," with no compelling explanation otherwise.

Grounded Cognition

A substantial amount of insight into the human conceptual system has been provided by embodied or grounded cognition theories (Barsalou, 2010; Borghi & Pecher, 2011). While there are several different theoretical variations of this school of thought, all argue that people understand concepts, to varying degrees, through modality-specific regions in the brain (Barsalou, 2010; Chaterjee, 2010). Whereas conceptual knowledge was formerly thought to be stored in amodal symbols, in grounded cognition theories, people's understanding of a given concept instead makes use of modality-specific areas that process perception and action, and in this sense, are modal. For example, we understand *kick* via motor regions that are activated when we physically perform this action (Hauk, Johnsrude, & Pulvermuller, 2004). And indeed, there is an impressive body of research demonstrating this to be the case for concrete nouns and verbs (see Martin, 2007, for a review).

The amount of support for these ideas is almost indisputable regarding concrete nouns and verbs (Barsalou, 2010; Borghi & Pecher, 2011). However, the degree to which they provide insight into the representation and processing of abstract concepts is not entirely clear. While grounded theories state that all concepts, to some degree, are understood through modality-specific brain regions, it has long been assumed that abstract concepts do not have modality-specific features. The difficulty then is to determine whether abstract concepts be understood through such mechanisms.

This challenge has prompted researchers to look for ways in which the motor and perceptual systems of the brain could possibly represent abstract concepts. Research using this point of view has largely revolved around Conceptual Metaphor Theory, initially proposed by Lakoff and Johnson (1980), but strongly advocated also by Gibbs (1992, 1994). According to Conceptual Metaphor Theory, abstract concepts are extensions of concrete relations that act as "vehicles." For example, people understand the concept *anger* through analogy to heat or boiling water. Similarly, concrete relationships such as *up/down,* and *left/right* serve the basis for abstract relations such as *good/bad.* These basic concepts or primary metaphors create image schemas that allow people to think about abstract concepts in ways that are linked to sensory experiences, such as associating "good" with upward or rightward, and "bad" with leftward or downward. Similarly, time is viewed as moving from left to right, love as a journey, anger as heat, and so forth.

Conceptual Metaphor Theory began with the recognition that we often use spatially-oriented words to describe abstract relations, such as "*over* the hill," or "*out* of time," but has since been tested beyond the realm of metaphorical language. Meier et al. (2007) demonstrated that positively valenced pictures (God-like images) are remembered better when they are presented at the top of a computer screen, whereas negatively valenced pictures (devil-like images) are remembered better when presented at the bottom. Also, handedness affects whether people see good or bad on the left or right side of space (Casasanto, 2009), the direction of an individual's written language system affects what direction she conceptualizes time flow (Boroditsky, Fuhrman, & McCormic, 2010), and the perception of time is influenced by spatial judgments (Casasanto & Boroditsky, 2008). Thus, it has been argued that concepts like valence and time are grounded in spatial relations; people talk about them in spatial terms because they are extensions of previously established concrete spatial relations.

Yet, there are several problems with these findings. For example, it is not clear what makes space a good candidate for time or valence. For an abstract concept domain to systematically map onto a concrete domain, it must have some initial structure or content (Chaterjee, 2010). If this was not the case, it is unclear how such mapping could possibly occur. Furthermore, although people may make use of spatial orientation to elaborate or enrich their understanding of abstract concepts, this may not be necessary in all conditions. The necessity of metaphorical mapping has indeed been called into question (Chatterjee, 2010). For example, there are dedicated neural circuits in the brain that process time, so it may be unnecessary to assume that people's perception of spatial orientation is fundamental to understanding time when they already have mechanisms in place for doing so (Kranjec & Chatterjee, 2010). Finally, there are various abstract concepts for which there are no intuitive metaphorical mappings. *Argument, decision, relief,* and *challenge,* among many others, do not neatly correspond to spatial image schemas. In summary, whether metaphorical mapping is necessary is unclear, and the scope of abstract concepts it can possibly account for is limited.

Perceptual Symbol Systems

Another way in which abstract concepts could be grounded is in terms of sensory and motor experience. Perceptual Symbol Systems theory (Barsalou, 1999, 2003, 2008) offers a unique account of how this may occur. Like most embodied accounts, Perceptual Symbol Systems theory claims that people understand concepts using the same modality-specific areas that are involved in perception and action. For a given concept, modality-specific information is encoded in respective brain areas regarding what its referent looks like, feels like, moves like, and so on, and this state is captured by neural association each time we experience an instance of that concept. Accordingly, conceptual understanding stems from partial reenactment, or simulation, of these experiences, which creates a certain profile of brain activation. The simulations are never full in that it is not the case that all accumulated knowledge is reactivated, but rather, they are partial such that they are tailored to the constraints of a given circumstance.

In Perceptual Symbol Systems theory, abstract concepts are represented through complex relations among objects, people, places, actions, as well as an individual's internal environment (introspection, thought, bodily sensations, mentalizing, and so on). For simplicity's sake, these forms of knowledge can be referred to as situational knowledge. Unlike Conceptual Metaphor Theory, abstract concepts do not extend directly from a single sensory dimension, but express complex relations among concepts that are still very much perceptual, and typically co-occur in situations that are actually experienced, or are heard or read about, over time.

One important point highlighted by a situational-based view of abstract concepts is that concepts do not exist in a vacuum. That is, concepts are always part of an ongoing situation or context. In this sense, they are always situated; one cannot remove one's self from situational contexts, and all concepts are processed within them. While concrete concepts are relatively local in time and space, abstract concepts are not. But this does not exclude them from being accessed through experience. Instead, abstract concepts rely on complex interactions that occur over space and time. And indeed, people express types of situational information when asked to provide item properties (their characteristics) or contextual properties (relevant contexts) for abstract concepts. They provide properties expressing subjective experiences, especially situations related to social contexts (Wiemer-Hastings & Xu, 2005). Thus, people use situations to define abstract concepts.

Furthermore, because abstract concepts are flexible in that they integrate aspects of situations over time, their meaning changes depending on context. To illustrate, consider the abstract concept *advice*. The concept of *advice* entails an agent, a patient, and a context that includes an exchange of information. Yet the semantics of *advice* changes depending on who is giving the *advice* (a friend, a therapist, a lawyer, a parent), who is receiving it, and the context in which the act is occurring (a school, an office, a court, a house). Because abstract concepts relate aspects of a situation, they are inherently more flexible and guided by situations and their respective elements (people, objects, actions, setting, etc., Wilson-Mendenhall et al., 2011). In other words, whereas concrete concepts have situations as backgrounds (e.g., bread in your kitchen, a restaurant, or the supermarket), abstract concepts are aspects of the situation itself (Barrett et al., 2012). While both types of concepts individuate aspects of a situation to categorize the world around us in ways we can comprehend (Barsalou, 1999), abstract concepts are less specific and individuated because they are inherently relational. Logically then, the semantics of a given abstract concept is impoverished in isolation and can change substantially depending on context (Wilson-Mendenhall et al.).

The Role of Situations

Past research has tended to abstract concepts in isolation. It is well documented that context modulates behavioural effects in various ways (Barsalou 1982; Pecher & Raajimakers, 2004). Yet, regarding abstract concepts, the role of context has been largely unexplored. One exception is Wilson-Mendenhall et al. (2011), who looked at patterns of activation to the abstract concept *observe* when it was conceptualized as part of a physical threat or social threat situation. They demonstrated that when conceptualized as part of a scenario, *observe* elicited different profiles of activation than has been typically reported (left IFG, MTG).

Importantly, activation profiles differed depending on context. In a social threat situation, *observe* showed more widespread activation in dorsal and ventral visual processing areas, as well as auditory regions bilaterally, whereas activation was much more constrained in the physical threat situation – with little overlap between them. Thus, Wilson-Mendenhall et al. (2011) concluded that an abstract concept is processed differently in the brain when it is part of a situational context, and this effect is mediated by the specific context in which it is processed, providing support for the idea that the semantics of a given abstract concept is largely guided by situational context.

The idea that situational knowledge is important for how people represent abstract concepts is further supported by Ghio and Tettamanti (2010), who performed dynamic causal modeling on a previously published data set in which participants read action-related sentences (e.g., "Now I push the button.") or abstract sentences (e.g., "Now I appreciate the loyalty"). For action-related sentences, left hemisphere language areas were more functionally coupled with regions thought to subserve action representation (LSMG, LpITG). However, for abstract sentences, left-hemisphere language areas were more functionally coupled with areas thought to be involved in coding contextual information and monitoring introspective states (areas in the retrosplenial cortex).

Ghio and Tettamanti (2010) interpreted their results as top-down, modality-specific reactivation of brain areas that process the semantics of both concept types. To understand sentences that describe actions, areas of the brain that process action are activated, whereas to understand sentences that involve abstract concepts like *loyalty* and *appreciate,* areas of the brain that process contextual information and introspective states are activated. Thus, regions that process introspective states and contextual information (which we generally term situational knowledge) may partially represent concepts like *appreciate* akin to how the motor system partially represents verbs like *run*.

While the aforementioned studies provide support for a view in which situational information is paramount, this idea, at present, remains relatively unexplored. As stated by Pecher et al., (2011, p. 232), "Words for abstract concepts might activate specific, concrete situations that are instances of the concept or that provide a context for the concept. There is at present still very little evidence for this view." A fundamental claim of theories that focus on the centrality of situational information is that abstract concepts are activated when situational information is provided. In a sense, this type of information could be conceptualized as the features of abstract concepts. So in the same way that providing "An animal with a tail that barks and is often a pet" should activate *dog*, so too should situational information activate an abstract concept. Crucially, this has not been demonstrated.

Context Availability Theory

One theory that has not been mentioned so far is Context Availability Theory (Schwanenflugel & Shoben, 1983). According to this theory, the difference between abstract and concrete concepts is due to differences in inherent context, such that people have greater difficulty generating contexts for abstract than for concrete concepts. While abstract concepts do not necessarily occur in fewer contexts, those contexts are not as readily available. The majority of their research (Schwanenflugel & Shoben, 1983; Schwanenflugel, Harnishfeger, & Stowe, 1988) has demonstrated that when a context is provided, abstract concepts are processed just as quickly as concrete concepts, thus eliminating the concreteness effect.

This research is often cited in support of theories that emphasize the importance of context for abstract concepts. Yet, the context that Schwanenflugel and Shoben (1983) provided was a single sentence, such as "Science is the pursuit of *truth."* Thus, upon closer inspection, their manipulation was actually designed to produce strong sentence-final word expectancies, and careful inspection of their stimuli suggests an influence of phrasal priming (i.e., "pursuit of *truth."*). It is possible that priming, in this respect, was due to the fact that the target, which was the final word of the sentence, was expected given a supportive sentence content (Stanovich & West, 1983). Critically, they did not provide the type of situational context that would lead one to conceptualize a circumstance as an instance of an abstract concept.

The Present Study

Abstract concepts are a particular challenge for theories of conceptual knowledge. Situational-based accounts hold insightful promise, but have rarely been tested (Pecher et al., 2011). Thus, the goal of the current research was to explore the idea that situational knowledge is important for how people understand and represent abstract concepts. Before proceeding, it is noteworthy to mention that all concepts used in the present thesis were abstract. The vast majority of past experiments included concrete words as well, so in this regard, I am purposely deviating from the way in which previous research on this topic has typically been conducted. Although I believe that comparing these two concept types has been insightful, a frustrating aspect of this approach is that doing so often reiterates that they are, in fact, different types of concepts, without providing a convincing account as to why. For example, the concreteness effect is a well-established finding using various paradigms (Bleasdale, 1987; de Groot, 1989; Paivio, 1986; Romani, McAlpine, & Martin, 2007; Schwanenflugel & Shoben, 1983; Schwanenflugel, Harnishfeger, & Stowe, 1988; Whaley, 1978), yet it is still unclear as to why abstract concepts are harder to process than concrete ones, and why some tasks produce exceptions (Pexman et al., 2007). Importantly, because this type of research compares small sets of items taken from the very large classes of concrete and abstract concepts, it may obscure important aspects of the two classes. Therefore, the current research focuses entirely on abstract concepts, studying them in their own right rather than comparing them to concrete concepts, under the assumption that doing so will be insightful.

The goal of Experiment 1 was to investigate whether situational knowledge does indeed activate abstract concepts. If it is the case that situational knowledge naturally elicits them, then abstract concepts should be primed when they are preceded by related scenario descriptions. In a sense, doing so follows the initial logic of Schwanenflugel and Shoben (1983), but more directly assesses the role of situational context. In this respect, results from Experiment 1 provide specific support for situational-based theories of abstract concept representation.

I began by creating three-sentence scenarios that described various abstract concepts based on my intuition. For example, the following situation was created for *advice*:

School has been really difficult and stressful this year. You feel like maybe you should just give up and you want someone to talk to. You pick up your cell phone and call your best friend.

Importantly, I ensured there were no word associates in the scenarios themselves to the abstract concepts of interest, ruling out the possibility that any priming might be due to word association. To validate intuitions about the relatedness between the abstract concepts and scenarios, a norming study was conducted in which participants rated relatedness on a scale from 1 (unrelated) to 7 (very related). Situation-concept pairs with high ratings were then used in a cross-modal priming study in which participants listened to the scenarios and then performed a visual lexical decision task. Unlike Schwanenflugel and Shoben (1983), the target abstract concept was not included as part of the scenario itself, eliminating the potential for both phrasal priming, and priming based on final word expectancy (Stanovich & West, 1983). Of interest was whether the same abstract concept was recognized faster when preceded by a related as opposed to an unrelated scenario.

After obtaining priming using two timing intervals, I examined the relationship between the scenarios and the targets they primed. The claim that situational knowledge is important for abstract concept representation is broad in terms of *what* information, and for *which* concepts. Thus, I categorized the concepts from Experiment 1 based on the contingencies they expressed with respect to the situations that primed them. Additionally, research has seldom evaluated different types of abstract concepts. While concrete nouns have long been differentiated categorically (e.g., artifacts versus natural kinds; Keil, 1989), abstract concepts do not lend themselves well to categorization. With the exception of emotion concepts in select cases (Kousta et al., 2011), abstract concepts have typically been treated a single group. Therefore, creating different types of abstract concepts based on their relations to situations is a novel contribution to research that provides further insight into the role of situations in understanding them.

I used a distinction made by the Conceptual Act Theory of Emotion (Barrett et al., 2006; Wilson-Mendenhall et al., 2011). Many concepts referred to internal states that a character would be feeling in the situation (e.g., *depressed*). Others, however, had less to do with internal states specifically, and more to do with the relationships among multiple aspects of the situation. For example, *ignore* describes an act, an agent performing this act, a patient being ignored, and so on, but one does not feel *ignore* internally. Thus, I divided concepts into two groups based on whether they referred to *internal state* or *relational* concepts, and investigated how situations differentially activated them.

Internal state and relational concepts were matched on 13 variables concerning the relatedness between the situation and the abstract concept, situation length (number of words), emotional variables (arousal and valence), as well as target lexical variables (frequency, familiarity, etc.). Using the same procedure as Experiment 1, Experiment 2 demonstrated that relational concepts showed significant situational priming whereas internal states did not. This effect was consistent at a 0 ms and a 500 ms ISI. A possible account of these findings, as well as their implications, are discussed in detail in the General Discussion.

Situation Norming Study

The purpose of this study was to empirically evaluate the relatedness of potential abstract targets to various situations. Participants read situation descriptions, and for each one, rated four to six abstract concepts based on how related they were to the situation.

Options consisted of potential targets, as well as unrelated abstract concepts that were included to anchor the scale. Abstract concepts with high ratings were then chosen as targets for Experiments 1 and 2.

Method

Participants

Forty undergraduate students from the University of Western Ontario participated for $10 compensation. For all experiments presented in this thesis, all participants were native speakers of English, had normal-to-corrected normal visual acuity, and did not participate in more than one study.

Materials

Fifty-eight abstract concepts were selected from the MRC psycholinguistic database (Coltheart, 1981; Wilson, 1988; available online at http://www.psy.uwa.edu.au/MRCDataBase/uwa_mrc.htm). Scenarios thought to reflect instances of each abstract concept were created. For example, the following scenario was created for *ignore.*

"*You're walking to get some food when you see a homeless man out of the corner of your eye. You do not turn your head. You keep walking."*

Each situation was three-sentences in length and used second-person narrative (i.e., "you"). Research has demonstrated that second person narrative is effective at inducing perspective (Brunye et al., 2008), so I framed the situations as such to help participants immerse themselves in the scenarios as much as possible. Finally, situations were carefully constructed to avoid any words that were strongly associated to the hypothetical target. This was verified using Nelson, McEvoy, and Schreiber's (1998) word association norms. Therefore, no results in Experiments 1 or 2 could be explained by word association.

A survey consisting of the 58 situations was employed. Each situation was paired with four to six abstract concepts. Participants were instructed to rate each concept based on its relevance to the situation, with "1" corresponding to "not relevant", and "7" to "very relevant" (full instructions can be found in Appendix A). To ensure that participants provided a range of responses, at least one word option was intuitively unrelated to the situation to anchor scores. To control for order effects, four versions of the survey were created that balanced the order of situations and word options.

Procedure

Participants completed the survey in pencil-and-paper format. They were read instructions and asked to circle the appropriate response. Thus, responses were collected for each abstract concept in every scenario from 40 participants in total (10 for each version of the survey). The task took less than one hour to complete.

Results

Average relatedness ratings for each abstract concept for each of the 58 situations were calculated. Of the original 58 items, 48 situation-word combinations were selected ($M = 6.40$, $SD = 0.23$, $range = 5.9 - 6.9$). A criterion of at least 5.9 provided items for which almost all participants had given ratings of 5, 6, or 7. This value appeared to give a suitable balance of strong relatedness with the power provided by 48 items. All situation-target pairs used in the present thesis can be found in Appendix B.

Importantly, the selected situations did not have strong lexical associations to their target abstract concepts. I did not want the scenario to contain any words that were strongly associated to the target (e.g., "happy" and "sad"), as it has been well documented that strongly associative words produce priming effects. To demonstrate that this was not the case, forward associative strength from the words in the scenario to the abstract target were obtained from the University of South Florida Free Association Norms (Nelson et al., 1998). Of the 48 scenarios, only four contained words with nonzero forward associative strengths to the targets, and these were very low (*range* = .001 - .034). Thus, any obtained priming from the scenario to the target abstract concept could not be explained by associative relations.

Target Word Norming Study

The purpose of this study was to obtain scores for the abstract targets on several dimensions that have been shown to influence tasks involving abstract (and concrete) concepts. Of interest were concreteness, imageability, familiarity, context availability, emotional arousal, and emotional valence.

Concreteness captures the extent to which a concept is abstract or concrete on a scale from 1 (abstract) – 7 (concrete) whereas imageability refers to the ease with which a person can come up with an image for a particular concept on a scale from 1 (difficult) – 7 (very easily). Imageability and concreteness are highly correlated, and often are used interchangeably. Context availability reflects how easily people can come up with a context for a given concept on a scale from 1 (difficult) to 7 (very easily). Familiarity refers to how familiar people believe a particular concept to be on a scale from 1 (not familiar) to 7 (very familiar). Valence refers to how negative or positive a given concept is, ranging from 1 (negative) – 9 (positive) with 5 being neutral. Similarly, arousal ratings capture how arousing people find a given concept to be on a scale from 1 (low arousal) to

9 (high arousal) with 5 being neutral. All of these scales express means multiplied by 100, so if an average score is 6.34 for example, it is reported as 634.

Norming the target concepts was important for several reasons. First, it was necessary to verify that they were indeed abstract. Previous research has classified abstract concepts as those with concreteness and imageability scores less than 400 (Paivio, 1986; Schwanenflugel & Shoben, 1983; Schwanenflugel, Harnishfeger, & Stowe, 1988; Wiemar-Hastings & Xu, 2005), so this standard was followed. I also wanted concepts to be relatively familiar, as it is difficult to obtain priming to concepts that people do not use or understand. Finally, these ratings were critical for equating the groups that were compared in Experiment 2.

Method

Participants

Forty undergraduate students from the University of Western Ontario participated for course credit.

Materials

All 48 target abstract concepts were rated alongside appropriate fillers on the dimensions of concreteness, imageability, familarity, context availability, emotional arousal, and emotional valence in an online survey (full instructions for all dimensions can be found in Appendix C). Appropriate fillers were used to anchor scores within each dimension. To illustrate, when participants rated concreteness, words with high and low concreteness according to the MRC Psycholinguistic database were included. Due to the length of the survey with all dimensions included, it was divided into two separate surveys. In one, participants rated concreteness, imageability and familarity, and in the other, context availability, valence, and arousal were rated.

Procedure

Participants completed the norming study by signing on to a web-site. The instructions informed them that they were to rate various words according to different sets of instructions. Responses were collected from 20 participants per survey. The entire task took approximately half an hour.

Results

Mean ratings and standard errors on each dimension for the 48 target abstract concepts are presented in Table 1. The statistics for all of the stimuli were computed in the following way. For targets with values from existing databases (Altarriba, Bauer, & Benvenuto, 1999; Bird, Howard, & Franklin, 2000; Coltheart, 1981; Cortese & Fudgett, 2004; Morrow & Duffy, 2005; Stadthagen-Gonzalez & Davis, 2006; Wilson, 1988), scores were averaged using those databases. For items that had not been normed previously, the values were taken from this study. Of relevance for Experiment 1, all items had concreteness and imageability scores less than 400. Thus, they are classified as "abstract." The scores on all variables were further used in Experiment 2, and are discussed in more detail at that time.

Experiment 1: Situational Priming

Experiment 1 tested the hypothesis that situational information does indeed activate related abstract concepts. Specifically, it was predicted that participants would be faster to recognize an abstract word when it was preceded by, or primed by, a related as opposed to an unrelated scenario. For any theory in which situational information is central to the representation of abstract concepts, establishing a priming effect from

Table 1. Means and SEs for Target Concepts in Experiment 1.

Variable	*M*	*SE*
Concreteness	300	4
Imageability	388	9
Familiarity	567	5
Valence	423	29
Arousal	528	15
Context Availability	459	11

situations to abstract concepts is fundamental. Because no experiments of this type have been conducted previously, and because it might take some time for abstract concepts to be activated by situations, I conducted the experiment using a 0 ms interval between the acoustic offset of the situation and the onset of the visually-presented target word (Experiment 1a), as well as a 500 ms interval (Experiment 1b).

Experiment 1a

Method

Participants

Forty-four undergraduate students at the University of Western Ontario participated for compensation of $15.

Materials

The 48 situation-word combinations were split into two rotation groups (24 per group). Within each rotation group, scenarios and targets were shuffled to create unrelated pairings. Two lists were constructed, with each containing 24 related situation-concept pairs from one rotation group, and 24 unrelated situation-concept pairs from the other (and vice versa). In addition, 24 unrelated situation-word pairs created by the experimenter were included, for a total of 72 word targets overall. Thus, the relatedness proportion was .33 (i.e., the proportion of word targets preceded by related situations). Previous research has demonstrated that relatedness proportion can moderate priming effects, such that priming is facilitated as the proportion of related prime-target pairs increases (Stolz & Neely, 1995). According to Neely (1991), a relatedness proportion of less than .33 is deemed low. The remaining 50% (72) of the items were situations paired with pronounceable nonwords (e.g., “pluish”). Prior to the experiment, participants completed 18 practice trials. Proportions of target types were identical to those used in the experiment itself. In total, the experiment consisted of 144 trials.

Procedure

Participants listened to the situations over headphones, following which a lexical decision was performed. The letter strings (i.e., words and nonwords) were displayed using E-Prime v2.1 on a PC with a 15-inch colour monitor. Letter strings were displayed in 24 Arial font and centered on a white screen. Participants made responses using a Psychological Software Tools serial-response box (Model 200A), which provided millisecond accuracy.

Participants were instructed to listen to the scenarios, and then decide as quickly as possible while maintaining accuracy whether or not the presented stimulus was an English word by pressing a button for "yes," or a button for "no." They used their dominant hand for "yes" responses. Each trial began with a fixation cross (+), which remained on the screen during the entire acoustically-presented situation. Immediately at the offset of the last word, a letter string was presented. The letter string remained on the screen until participants made their response. Following a 500 ms interval, a simple comprehension question regarding the previous scenario was displayed on the screen. Participants were asked to answer "yes," if it was true, or "no" if it was false using the same buttons. Comprehension questions were included to ensure that participants were paying attention to the scenarios, and were not intended to be difficult. The entire task took approximately 45 minutes.

Design

Decision latencies were analyzed using two-way analyses of variance. Of interest was comparing the target abstract concepts when they were preceded by a related versus an unrelated situation. Relatedness was within participants (F_1) and within items (F_2). List was included as a between-participants dummy variable and item rotation group as a between-items dummy variable to stabilize variance that may have resulted from rotating participants and items over the two lists (Pollatsek & Well, 1995). The square root of the number of errors for each condition was also analyzed (Myers, 1979).

Prior to analyses, decision latencies longer than three standard deviations above the grand mean were replaced by this value (1.3% of trials). Trials in which a lexical decision error was committed were excluded from decision latency analyses. Four participants had mean decision latencies greater than three standard deviations above the mean for critical trials, and were thus excluded from the analyses.

Results

Lexical decision latencies were 49 ms shorter when preceded by a related (M = 719 ms, SE = 74 ms) versus an unrelated situation (M =768 ms, SE = 81 ms), $F_1(1, 38) = 15.54$, $p < .001$, $F_2(1, 46) = 15.15$, $p < .001$. Error rates did not differ significantly between related (M = 1.9%, SE = .001%), and unrelated (M = 2.7%, SE = .002%) conditions, $F_1(1, 38) < 1$, $F_2(1, 46) = 3.36$, $p = .07$. Comprehension question accuracy rates showed that all participants attended to the scenarios (M = 92%, range = 80 - 98%).

Experiment 1b

Method

Participants

Thirty undergraduate students from the University of Western Ontario participated for course credit.

Materials

The stimuli were identical to Experiment 1a.

Procedure

The procedure was identical to Experiment 1a, except the duration of time between the offset of the last word in each acoustically-presented scenario and the onset of the lexical decision target was 500 ms.

Design

Analyses were identical to Experiment 1a. Two participants were omitted for having overall mean decision latencies longer than 3 standard deviations above the grand mean. Decision latencies greater than three standard deviations above the grand mean were replaced with that value (1.6% of trials).

Results and Discussion

Similar to Experiment 1a, lexical decision latencies were 73 ms shorter when preceded by a related (M = 759 ms, SE = 27 ms) versus an unrelated situation (M = 812 ms, SE = 36 ms), $F_1(1, 26) = 14.65$, $p < .002$, $F_2(1, 46) = 13.10$, $p < .002$. Error rates did not differ significantly between the related (M = 1.2%, SE = 0.001%) and unrelated (M = 1.5%, SE = 0.001%) conditions, $F_1(1, 26) < 1$, $F_2(1, 46) = 1.42$, $p = .24$. Comprehension question accuracy was again quite high (M = 93%, range = 67 - 100%).

Acoustically-presented scenario descriptions primed abstract concepts in both Experiments 1a and 1b, an effect that cannot be explained by word association alone because forward associative strength was virtually nonexistent. These results strongly support theories that claim that part of the way in which people learn, use, comprehend, and represent abstract concepts involves information beyond lexical co-occurrence, and rather, extends to a broader situational level. Experiment 1 involved situations that were common for, and relevant to, undergraduates, and that were expressed in terms of normal conversational tone as much as possible. To my knowledge, this is the first demonstration that providing people with situation descriptions activates abstract concepts – a finding that is critical for accounts that claim situational knowledge is important.

With this basic priming effect established, I further examined the relationship between the scenarios and the target concepts they primed to better understand the nature of situational-based priming. While previous research speaks to situational information as being important (Barsalou, 1999, 2003, 2008), this claim is somewhat underspecified. Past research has gained tremendous insight by looking at the types of relationships between concepts that express priming, such as whether they are thematic, or occur together in the same situation, or are members of the same category (McRae, Khalkhali, & Hare, 2012; Lucas, 2000). Logically then, the relationship between the provided information and an abstract concept is likely to be important, but remains unexplored.

To begin, I examined the relationship between the abstract concepts and the situations used to prime them. One obvious category that arose was concepts that referred to internal states, or emotions that the character "you" in the narrative could be feeling. For example, the following situation was used for *relief*:

You're walking home from school when you realize you don't have your laptop. You must have left it at school. You run back and find it exactly where you left it.

Relief in this example specifically refers to the internal state of the protagonist. Conversely, other concepts had less to do with internal states specifically, and more to do with integrating multiple aspects of the situation cohesively. For example, the following situation was used for *ignore:*

You're walking to get some food when you see a homeless man out of the corner of your eye. You do not turn your head. You keep walking.

Ignore in this example incorporates specific actions, an agent performing this act, a patient receiving this act, and the combination of all of these aspects of the situation, but "you" do not feel *ignore* as a coherent singular internal state. These types of concepts are more congruent with Wilson-Mendenhall et al.'s (2011) view that many abstract concepts are relational structures that integrate various aspects of a scenario. For this reason, they were termed *relational*.

Interestingly, the distinction between concepts that relate aspects of a situation and those that refer to internal states is discussed in a recent theory of emotion called the Conceptual Act Theory (Barrett 2006; Wilson-Mendenhall, 2011). According to this theory, as a situation unfolds, information (objects, actions, environmental settings, internal sensations, etc.) projects onto concepts in parallel, all of which compete to categorize the situation at hand. Relational organization, or integration of situational information, occurs first, and then produces an internal state. For example, a situation is recognized as *danger,* which in turn produces *fear.*

While the Conceptual Act Theory is discussed in more detail below, I was curious as to whether this basic distinction would manifest in behavioual differences. The goal of Experiment 2 was to investigate situational priming with these two groups of items, relational and internal state, to determine whether differential priming effects would be obtained. If these types of abstract concepts can be distinguished empirically, it would provide evidence for a situationally-based distinction while further specifying the nature of situational priming more generally.

Experiment 2: Internal State versus Relational

The goal of Experiment 2 was to determine whether situations differentially activate relational and internal state concepts. At least two outcomes were possible. First, if situations must be categorized before internal states are then produced, when the ISI between the situation and the target is 0 ms, there could be priming for relational but not internal state concepts. On the other hand, with a 0 ms ISI, the auditory situation unfolds over three sentences, and so it is perhaps the case that this time interval is sufficient for both types of concepts to be activated, thus producing priming in both conditions.

Experiment 2a

Method

Participants

Forty-two undergraduate students from the University of Western Ontario participated for $10 compensation.

Materials

Of the 48 situation-target pairs from Experiment 1, abstract concepts that referred to internal states and relational components were selected. Thirty-two situation-concept pairs were included (16 relational and 16 internal state). These two item groups were then equated on 13 variables (statistics are presented in Table 2). Importantly, relatedness ratings between the scenario and the target concept did not differ between groups, so it is not the case that one concept type was rated as being more relevant to the situation than the other. The groups also did not differ significantly on lexical variables such as the length of the scenarios, nor the number of letters, phonemes, syllables or frequency of the

Table 2. Means and SEs for Relational and Internal State Concepts and Related Statistics.

	Holistic		Internal		$t(30)$	p-value
Variable	*M*	*SE*	*M*	*SE*		
Situation Rating	6.46	0.05	6.40	0.07	0.71	.48
Situation Words	33.1	2.0	29.0	1.9	1.52	.14
Letters	7.1	0.7	7.4	0.7	0.33	.75
Syllables	2.3	0.3	2.1	0.3	0.48	.64
Phonemes	5.9	2.6	5.9	2.3	0	1.0
ln(BCN Frequency)	7.72	0.36	7.68	0.89	0.10	.92
Concreteness	286	21	295	7	0.41	.68
Imageability	354	29	390	13	1.14	.26
Familiarity	530	36	530	36	0.01	.99
Valence	466	51	364	47	1.47	.15
Absolute Valence	186	18	219	16	1.35	.19
Context Availability	438	31	468	9	0.93	.36

Note: All comparisons were non-significant at $p > .05$.

target words, all of which have been shown to influence lexical decision latencies.

Finally, words rated high on valence and arousal (Kousta et al., 2011), context availability (Schwanenflugel & Shoben, 1983), concreteness and imageability (Paivio, 2007) are typically recognized faster in lexical decision tasks. The internal state and relational concepts did not differ on these dimensions either. Balancing groups on the aforementioned factors ensured that any obtained differences in priming effects were the product of the semantic relationship between the concept and the scenario.

The 32 items were evenly split into two rotation groups. As in Experiment 1, abstract concepts were re-paired with situations in each rotation group to create unrelated pairings. For unrelated items, holistic concepts were paired with internal scenarios and vise versa. Two lists were then created. Each contained the related situation-word pairs from one rotation group, and unrelated situation-word pairs from the other. To verify that unrelated targets were equally unrelated for both groups, 40 participants rated the relatedness between the matched unrelated target and the scenario for all 32 abstract concepts in an identical fashion to the original situation norming study. This was done to ensure that any obtained differences in priming effects would not be due to the unrelated condition being less related to the scenario. Unrelated targets for relational concepts (M = 2.34, SE = 0.17) did not differ in relatedness from internal state concepts (M = 2.40, SE = 0.14), $t(30) = 0.30$, $p = .78$.

Fillers with word targets were created so that 50% of the lexical decision targets were words (n = 64), of which 16 were related targets, 16 were unrelated targets, and 32 were unrelated fillers. Thus, the relatedness proportion was .25. The other 50% of targets (n = 64) were situation-nonword pairs from Experiment 1. Participants completed the same practice trials used in Experiment 1.

Procedure

The procedure was identical to that of Experiment 1.

Design

Decision latencies to lexical decision targets were analyzed using three-way analyses of variance, both by-participants (F_1) and by-items (F_2). Of interest were two factors: relatedness (related versus unrelated) and concept type (relational versus internal state). For the participants analyses (F_1), both relatedness and concept type were within-participants variables, whereas for items analyses (F_2), relatedness was within items but concept type was between items. List and item rotation group again were included in the by-participants and by-items analyses respectively. The square root of the number of errors for each condition was analyzed separately using the same procedure. Decision latencies greater than three standard deviations above the grand mean were replaced with that value (1.6% of trials).

Results and Discussion

Lexical decision latencies and error rates for each condition are presented in Table 3. For decision latencies, the relatedness by concept type interaction was significant by items, $F_2(1, 28) = 5.66$, $p < .05$, and marginally significant by participants, $F_1(1, 40) = 3.50$, $p = .07$. The marginally significant effect by participants likely reflected the high variability in decision latencies across individual participants; variability was lower across items. Planned comparisons evaluating the effect of relatedness for each concept type revealed that relational concepts were recognized 106 ms faster when primed by a related versus an unrelated situation,

Table 3. Mean Decision Latencies (ms) and Percentage of Errors by Condition in Experiment 2a

	Relational		Internal State	
	M	*SE*	*M*	*SE*
Latencies (ms)				
Unrelated	932	51	882	48
Related	826	47	868	52
Priming Effect	106*		14	
Percent Errors				
Unrelated	1.9	0.03	1.6	0.04
Related	2.5	0.06	0.9	0.003
Priming Effect	-0.6		1.1	

Note: * = significant by participants and items

$F_1(1, 77) = 11.43$, $p < .002$, $F_2(1, 28) = 15.87$, $p < .0006$. In contrast, for internal state concepts, there was a non-significant 14 ms difference between the related and unrelated conditions, $F_1(1, 77) < 1$, $F_2(1, 28) < 1$.

Given the apparent differences between relational and internal state concepts in each of the related and unrelated conditions, I also tested the effect of concept type at each level of relatedness. However, the relational and internal state concepts did not differ significantly in the unrelated, $F_1(1, 77) = 3.13$, $p = .08$, $F_2(1, 52) = 2.55$, $p = .12$, or related conditions, $F_1(1, 77) = 2.24$, $p = .14$, $F_2(1, 52) = 2.51$, $p = .23$.

Replicating the effect demonstrated in Experiment 1a and 1b, abstract concepts overall were recognized faster when preceded by a related ($M = 847$ ms, $SE = 47$ ms) versus an unrelated situation ($M = 907$ ms, $SE = 47$ ms), $F_1(1, 40) = 9.28$, $p < .005$, $F_2(1, 28) = 10.42$, $p < .004$. This suggests that the relatedness effect in Experiment 1 was carried largely by the relational abstract concepts. There was no significant overall difference between relational ($M = 879$ ms, $SE = 47$ ms) and internal state concepts ($M = 875$ ms, $SE = 47$ ms), $F_1(1, 40) < 1$, $F_2(1, 28) < 1$. Finally, for error rates, there was no main effect of relatedness, $F_1(1, 40) < 1$, $F_2(1, 28) < 1$, or concept type $F_1(1, 40) < 1$, $F_2(1, 28) < 1$, nor was there a significant interaction between these two factors, $F_1(1, 40) = 1.72$, $p = .25$, $F_2(1, 28) < 1$. Comprehension question accuracy was again quite high ($M = 91.5\%$, range = 81 - 97%).

In Experiment 2a, the type of abstract concept interacted with situation-concept relatedness such that a large significant priming effect was found for relational abstract concepts, whereas a small nonsignificant effect was found for internal states. These results further support the idea that situational knowledge is an important component of abstract concepts. In addition, they show that categorizing abstract concepts in terms of how they correspond to aspects of a situation is a promising theoretical approach, and a potentially fertile avenue of further investigation.

Experiment 2b

According to the Conceptual Act Theory, relational abstract concepts are organizing structures that in turn, produce internal states. One possibility then is that the nonsignificant priming effect for internal state concepts is a matter of timing. That is, at a 0 ms ISI, relational concepts are activated, but internal states are not yet activated to a degree that produces significant priming. Therefore, I investigated whether after a longer ISI, internal state concepts would show similar priming effects to relational concepts. This was evaluated in Experiment 2b by extending the ISI from 0 to 500 ms.

Method

Participants

Forty undergraduate students from the University of Western Ontario participated for course credit.

Materials

The stimuli were identical to Experiment 2a.

Procedure

The procedure was identical to Experiment 2a, except the duration of time between the offset of last word in each acoustically-presented scenario and onset of the lexical decision target was 500 ms.

Design

Analyses were identical to Experiment 2a. Four participants were omitted for having an overall mean decision latency longer than 3 standard deviations above the grand mean. Decision latencies greater than three standard deviations above the grand mean were replaced with that value (1.8% of trials).

Results and Discussion

Lexical decision latencies and error rates for each condition are presented in Table 4. For decision latencies, in contrast to Experiment 2a, the relatedness by concept type interaction was nonsignificant, $F_1(1, 34) = 1.26$, $p = .27$, $F_2(1, 28) < 1$. Planned comparisons were conducted to explore the effect of relatedness at each level of concept type. Replicating Experiment 2a, decision latencies for relational concepts were a significant 53 ms shorter when preceded by a related versus an unrelated situation, $F_1(1, 67) = 4.50$, $p < .04$, $F_2(1, 28) = 6.04$, $p < .03$. Also as in Experiment 2a, there was a nonsignificant relatedness effect (27 ms) for internal state concepts, $F_1(1, 67) = 1.17$, $p = .28$, $F_2(1, 28) = 1.45$, $p = .24$. It is noteworthy that the differences in priming effects was stronger in Experiment 2a, as evidenced by the significant interaction. In Experiment 2b, the interaction was nonsignificant, although the pattern of planned comparisons was the same.

I again compared the effect of concept type for each level of relatedness. Relational and internal state concepts did not differ in the unrelated condition, $F_1(1, 67) < 1$, $F_2(1, 43) < 1$. For related situation-abstract concept pairs, decision latencies for relational concepts were significantly shorter than for internal state concepts by participants, $F_1(1, 67) = 4.29$, $p < .05$, although not by items, $F_2(1, 43) = 1.18$, $p = .28$.

Again replicating the overall situational priming effect, decision latencies for abstract concepts were 40 ms shorter when preceded by a related ($M = 725$ ms, $SE = 30$

Table 4. Mean Decision Latencies (ms) and Percentage of Errors by Condition in Experiment 2b

	Relational		Internal State	
	M	*SE*	*M*	*SE*
Latencies (ms)				
Unrelated	761	35	769	39
Related	708	29	742	33
Priming Effect	53*		27	
Percent Errors				
Unrelated	2.3	0.02	0.1	0.001
Related	1.6	0.01	1.6	0.01
Priming Effect	0.7		-1.5	

Note: * = significant by participants and items ms) versus an unrelated situation (*M* = 765 ms, *SE* = 36 ms), $F_1(1, 34) = 9.26$, $p < .004$, $F_2(1, 28) = 6.54$, $p < .02$. There was no significant difference between relational (M = 734 ms, SE = 31 ms) and internal state concepts (756 ms, SE = 35 ms), $F_1(1, 34) = 3.25$, p = .08, $F_2(1, 28) < 1$. For error rates, there was no main effect of relatedness, $F_1(1, 34) < 1$, $F_2(1, 28) < 1$, nor concept type $F_1(1, 34) < 1$, $F_2(1, 28) < 1$, nor was there a significant interaction between these two factors, $F_1(1, 34) = 1.96$, $p = .17$, $F_2(1, 28) = 1.06$, $p = .31$. Finally, comprehension question accuracy was high (*M* = 89%, range = 80 - 98%).

At two timing intervals, relational concepts demonstrated significant situational priming whereas internal state concepts did not. Thus, it appears as though when grouped separately, only concepts that integrate multiple aspects of the scenario are activated by situation descriptions. One possible explanation of the results obtained in Experiment 2 is that I happened to choose good situational exemplars for relational concepts, but not internal state. Although relatedness ratings did not differ between the two concept types, in the initial relatedness norming study, participants rated a set of concepts that I had chosen based on intuition. Therefore, it is possible that although participants may judge a situation and concept as highly related based on the provided items, there might be concepts that are more highly related, or better exemplars of the situation.

As internal state concepts are subjective internal feelings, perhaps the concepts I provided differ from what people would have actually provided if given the opportunity. To examine this possibility, I conducted a production study in which participants read the situations and then produced concepts that they believed were related.

Forty-four undergraduate students from the University of Western completed an online survey for course credit. They were instructed to read each of the 32 scenarios used in Experiment 2 and provide 2 (minimum) to 5 (maximum) concepts they believed were related or representative of the situation in order of relevance (full instructions can be found in Appendix D).

Responses were rank summed according to the order in they were produced by participants. Therefore, each concept was given a score based on the number of people who reported it according to the following formula: $W = 5a + 4b + 3c + 2d + e$, where *a, b, c, d,* and *e,* refer to the number of participants who provided that response in ranks 1, 2, 3, 4, and 5 respectively. Words that were different forms of the same concept were combined based on the highest rank sum. For example if *relief* had a score of 46 and *relieved* had a score of 24, they were combined as *relief* with a total score of 70.

Interestingly, in direct contrast to the results of Experiment 2, the mean rank sum for internal state concepts ($M = 86$, $SE = 13.6$, *range* = 7 – 171) was significantly higher than for relational concepts ($M = 2.62$, $SE = .85$, *range* = 0 – 9), $t(16) = 6.12$, $p < .001$. For internal state concepts, the target used in Experiment 2 was within the top 5 ranked concepts 81% of the time; for the 16 items, 8 targets were produced as the first ranked, 3 as the second, 1 as the third, and 1 as the fifth. Conversely, for relational concepts, seven out of 32 (44%) were never produced by participants, and thus had rank sums of zero. Of those that were produced, the scores were very low (range excluding zero = 1 – 9).

Overall, participants predominantly produced internal state concepts. Of all 32 scenarios, the top 5 words were exclusively internal state for 28 of them. For the remaining scenarios, 3 contained 4 internal state words and 1 relational concept, and 1 contained 3 internal state words and 2 relational concepts. Thus, when participants were given the scenario descriptions and asked to provide related concepts, they tended to provide concepts referring to emotions they would be feeling in the situation, but rarely reported relational concepts. Furthermore, the initially chosen target was included in the top-five ranked responses 81% of the time for internal state concepts. Relational concepts, on the other hand, were either not reported, or reported rarely, as reflected by their low rank sums.

Thus, when given the opportunity to provide related concepts with an unspecified amount of time to do so, people strongly tended to produce internal state concepts as opposed to relational concepts. Furthermore, these were fairly congruent with the internal state concepts used in Experiment 2 – and at very least, much more so than relational concepts. Therefore, it is not the case that the internal state concepts I initially selected were poor situational exemplars. If anything, it is the other way around, as the relational concepts were hardly reported at all.

A puzzling aspect of these findings is that in both Experiments 2a and 2b, internal state concepts, despite being salient as measured by the production and rating studies, did not show significant situational priming effects, whereas relational concepts, which were rarely reported, did. Though the priming effect for internal state concepts was not zero in either case, and was more pronounced with a longer timing interval, it failed to reach significance.

One possible explanation for these results involves semantic specificity and the variability of subjective internal states more generally. As a situation unfolds, it is categorized conceptually. That is, actions, objects, agents, patients, and so forth project onto concepts in parallel; this conceptualization process involves memory representations (similar situations experienced in the past) merging with the presented information

(Wilson-Mendenhall et al., 2011). From a theoretical standpoint, this is akin to accounts of discourse processing that emphasize a broader situation model that is built upon and updated with incoming information**.** Working memory is inherently linked to situation models such that relevant components of the unfolding situation must be maintained and updated to achieve a cohesive, comprehensible representation (Radvansky & Copeland, 2001).

As incoming information is categorized, and a situation model is built, internal states tied to concepts are presumably activated as part of this process. Yet arguably, they are not activated in a consistent fashion across individuals. To illustrate, consider the following scenario description:

You have recently entered a chess tournament through school. You are an experienced chess player and your first match is against a classmate who you have previously competed against and lost the title of defending champion to. Since then, you've been practicing and feel confident that this will be a close match.

According to the production study, the top ranked responses were *nervous, confident, excited, anxious,* and *determined*. That is, while some people conceptualized the situation as one in which they feel confident and excited, others were nervous and anxious. Likewise, consider the following scenario:

You just finished writing a test. It took you only half an hour. You barely studied but knew almost all of the answers.

Again, participants provided internal state concepts, the top six being *relieved, happy, nervous, confident, excited,* and *scared*. A similar trend exists such that some participants reported feelings of relief, happiness, and excitement, where others, presumably believing that even an easy test is problematic when one did not study, felt nervous and scared.

Because internal state concepts are subjective, they differ from individual to individual. This no doubt introduces variability, such that same internal state concept could be activated or primed for one person but not the next. Another way to think about the issue at hand concerns how the semantics of a given abstract concept can move from objective (external) to subjective (internal) content. Relational concepts appear to be more objective. Concepts such as *competition* are less debatable situationally; a chess tournament is an instance of competition. But internal state concepts are subjective emotions that are not necessarily fixed. How one feels about a competition depends on various factors and experiences that could lead one to feel *excited* and *confident* or *nervous* and *scared*.

If this is correct, it is not the case that situational content does not activate internal state concepts. Rather, the variability in the internal state concepts that are activated by a given scenario obscures a uniform priming effect for them, introducing variability that leads to a null effect. If one could tailor the internal state concepts felt by each individual on a person-by-person basis, presumably significant priming could be obtained.

General Discussion

Abstract concepts have puzzled researchers for decades. How we understand concepts that do not have explicit physical properties, and what the semantic structure of such concepts could possibly be if we cannot directly experience them, is a challenge for theories of conceptual knowledge. Dual Coding Theory (Paivio, 1986, 2007) states that abstract concepts are represented primarily through the verbal system via words that co-occur together in language. In essence, we understand the concept *idea* as a cumulative set of relations among *thought, light, concept,* etc. However, it has been recognized that this account is not comprehensive, based on fMRI data that shows contradictory profiles of activation (Rodriguez-Ferreiro et al., 2009), results from patient studies and healthy individuals that produce exceptions (Newton and Barry, 1997; Pexman et al., 2007), and the fact that word associates to abstract concepts are often abstract themselves.

In Perceptual Symbol Systems theory (Barsalou, 1999), all concepts loosely organize information and are represented using the same modality-specific areas involved in perception and action. That is, people understand concepts through partial simulations using relevant brain areas that encode information about a given concept learned through continued experience. While abstract concepts do not have prototypic modality-specific features (i.e., visual and haptic properties such as texture, colour, and shape, or motor properties), they are understood through simulations of entire situations that have been stored in memory.

While this idea has been relatively unexplored, support is offered by Ghio and Tettamanti (2010) who demonstrated that passively viewing an abstract sentence leads to left-hemisphere language areas being more functionally coupled with areas thought to be involved in coding contextual information and monitoring introspective states (areas in the retrosplenial cortex). The retrosplenial cortex has a well-established role in episodic memory (see Vann, Aggleton & Maguire, 2009, for review). Thus, when people are provided with abstract sentences, there appears to be activation of areas that encode contextual and internal state information.

The current set of Experiments examined the same process in reverse. Instead of providing people with a concept and looking at the types of information that are important, the content believed to be important was provided to examine whether the concept of interest is activated. While situational information has been claimed to underlie the conceptual representation of abstract concepts (Barsalou, 1999, 2003, 2008; Wilson-Mendenhall et al., 2011) the current experiments were the first to establish that abstract concepts are activated by situational information – a finding that is crucially important for such theories. Across all experiments, abstract concepts were recognized faster when preceded by a related as opposed to an unrelated scenario. In addition, this effect was replicated in Experiment 2 with fewer items, further speaking to its robustness.

On the surface at least, Experiment 2 indicates that situational information does not activate all types of abstract concepts. When abstract concepts are grouped into relational and internal states, the former showed significant priming but the latter did not. However, I believe this does not reflect situational knowledge as being unimportant for internal state concepts, but rather speaks to their inherent variability across individuals.

Internal State Concepts

According to recent insights on emotion concept processing referred to as the Conceptual Act Theory (Barrett et al., 2006; Wilson-Mendenhall et al., 2011), as a situation unfolds, agents, objects, actions, mental states, and so forth project onto concepts in parallel and compete for categorization. It is claimed that the situation is categorized first, and it is this categorization that produces an internal state. In effect, one must conceptualize *danger* (relational) before one feels *fear* (internal).

The correspondence, however, between how one conceptualizes a situation and the internal state it produces is arguably not one-to-one. While in some cases it may be more specific (e.g., *danger* likely produces *fear*), in others it is not (e.g., *competition* may produce *excitement* and *confidence* for some, and *nervousness* for others). In other words, it may be consistent that people recognize and conceptualize a scenario that involves playing a game with an opponent as *competition,* but the subjective internal state concept(s) that are activated are less consistent. Regarding priming experiments, if the target word is an internal state such as *confidence,* presumably it would only be primed for those who experience competition with confidence, or have experienced good outcomes from competitions in the past. And indeed, research has long recognized that people conceptualize situations differently. The link between the conceptual system and the internal states it drives has long been the basis of various psychological disorders such as phobias, and their treatment more generally (see Butler, et al., 2006, for review).

Categorization

Experiment 2 also highlights that the categorization of abstract concepts is an important venue for future research. Currently, there are no widely accepted categories of abstract concepts beyond the so-called emotion words. While it has been demonstrated that emotion words (words rated highly on valence and arousal) are special, such that when other factors are controlled for, they actually elicit *shorter* reaction times in behavioural studies than concrete concepts (Kousta et al., 2011), overall, abstract concepts are typically treated as belonging to one ubiquitous category. Presumably this is because they do not lend themselves well to categorization, or at any rate, much less so than concrete nouns, which have long been differentiated.

Experiment 2 suggests this is a worthwhile venture. Further, future attempts should go beyond sorting concepts in isolation using scales from rated dimensions. If I had taken this approach in Experiment 2, both relational and internal state concepts would belong to the same category, as they were matched on all available variables – including valence and arousal. Yet, it is clear that semantically they are very different and they led to different behavioural effects.

If abstract concepts are represented by situations, it is perhaps more informative to group them based on the content they express. This type of approach has been used successfully to understand concrete concept categories by having people generate their features (Cree & McRae, 2003; Garrard et al., 2001; McRae et al., 2005; Vinson &Vigliocco, 2008). Analogously, treating situational content as features may produce insight into ways to how they can be grouped, and further, how these groups differ.

The Role of Language

The current thesis emphasizes the importance of real-world situational knowledge in representing abstract concepts. And indeed, the Conceptual Act Theory that motivated Experiment 2 does not refer to linguistic descriptions of scenarios but real-life experiences of them. However, I did not actually provide people with situational experiences but linguistic descriptions. It would be inaccurate to claim these are the precisely the same thing. However, the embodied nature of language suggests they do share parallels. People simulate experiences through words, and do so vividly. For example, Dils and Boroditsky (2010) demonstrated that when people are listening to motion language, the mental images they produce are vivid enough to evoke the motion after effect (MAE), an illusion that produces direction-selective adaptation in the visual system.

One advantage of using linguistically-described scenarios is that information can be included that could not be otherwise, such as the agent's mental state, motives, and recent experiences. To illustrate, consider the situation, "In order to lose weight you've started a diet. You're out for dinner and plan to order a salad. But you can't take your eyes of their double-chocolate-fudge cake." It would be incredibly challenging if not impossible to provide an experience (through movies or pictures) that would fully set up the situation and instill the agent's motives. Nonetheless, it would be informative and important for future research to use non-linguistic primes such as pictures or videos to test whether abstract concepts are activated when they are primed with such stimuli.

It is also true that emphasis was placed on moving away from a purely linguistic context towards one that incorporates real-world experience. I would like to point out that I do not in any way advocate for an impoverished role of language in the representation of abstract concepts. Rather, my intention was to emphasize that while concepts do not exist in a vacuum, neither does language.

Language and experience occur in parallel. However, for abstract concepts, the linguistic environment has been viewed as primary, although it is undeniable that we use abstract concepts in scenarios we experience to describe and make sense of the world around us. This is an important consideration that has been overlooked in many cases, one that is at the core of Perceptual Symbol Systems theory (Barsalou, 1999), and one I believe should play a larger role in the future. Recent research has demonstrated that combining experiential data (information obtained from direct experience) and linguistic-based data (information obtained from language) adds computational power as compared to using either in isolation or independently (Andrews, Vigliocco, & Vinson, 2009). In essence, a more realistic way to look at how the semantics of a given concept are learned emphasizes the role of language *and* experience, as these two are interdependent during learning.

Conclusion

Overall, it is clear that theories emphasizing the importance of situational information in abstract concept representation are in need of continued research. The present experiments demonstrated that situational knowledge is connected to abstract concepts, so this preliminary finding holds promise to better understand them in the future. At any rate, it is clear that a new approach is warranted; comparing small selected subsets of abstract and concrete concepts has demonstrated that they do, indeed, differ, but has not led to a complete understanding of why, nor have these experiments provided a compelling explanation for what exactly the representational content of abstract concepts might be.

Categorization has been extremely useful in understanding concrete concepts. For example, animals and tools show different, but relatively consistent patterns of activation across the cortex (Martin, 2007). These findings have provided insight into how we process and categorize them as well as why certain semantic deficits occur as a result of brain damage or degeneration (McRae & Cree, 2001; Lambon Ralph, Lowe, & Rogers, 2007). However, such an approach has not been taken regarding abstract concepts. Often, they are selected from databases with little regard as to key ways in which they differ semantically. It may not be surprising then, that fMRI results have been so inconsistent. If concrete concepts were treated as a single group for experimental purposes, similar inconsistencies would emerge. If we begin to view abstract concepts as relational structures that integrate or individuate aspects of situational information, it becomes clear that there are differences between them in terms of the type of information that is important and necessary.

One such distinction made in the present experiment was between internal state and relational concepts. While it is clear that *relational* is a very broad category, it is an initial one upon which future research should build. It is plausible that some types of relations are more important for certain concepts than others (e.g., the distinction between agent and patient may be critical for *advice* or *ignore* but not *truth*). Further, to the extent that a concept refers to an internally experienced event, one should expect the external content that produces said internal state to be more variable across individual and subjectively dependent on experience.

Finally, and importantly, the current research highlights the need for incorporating more realistic, context-driven paradigms for all concepts. As noted by Santos et al. (2011), shallow processing tasks that use single word presentation at rapid timing intervals may not reflect conceptual processing in real life, and may produce very different effects than more naturalistic paradigms. This is especially the case for abstract concepts for which meaning is largely dependent on situational context.

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Appendix A

Instructions for situation relatedness norming study.

"This questionnaire requires you to read 3-sentence situations and rate various concepts based on how applicable they are to those situations, using a scale from 1 – 7. Concepts that are very relevant to the situation (i.e., you would experience this concept in the situation or use it to describe the situation) should be given a **high rating (say, 6 or 7).** Concepts that are not relevant in the situation (i.e., you would not experience this concept in the situation or use it to describe the situation) should be given a **low rating (say 1 or 2).** Please try to use the entire scale. That is, please do not rate everything as either 1 or 7."

Appendix B

Situations and abstract concepts targets used in Experiments 1 and 2. The first 16 items were the relational items, and the second 16 were the internal state items in Experiment 2. The final 16 items were used in Experiment 1 only. All items were used in Experiment 1.

Number	Situation	Target
Relational Items for Experiment 2 (1 – 16)		
1.	School has been really difficult and stressful this year. You feel like maybe you should just give up and you want someone to talk to. You pick up your cell phone and call your best friend	advice
2.	Everyday for lunch you go to subway. You order a 6” cold cut with lettuce, tomato, and mayo. You also get a small diet coke.	habit
3.	You’re walking to get some food when you see a homeless man out of the corner of your eye. You don’t turn your head. You keep walking.	ignore
4.	You’ve just gone grocery shopping and have your arms full of bags. You’re entering your apartment building and someone stops to hold the door for you. They offer to help you carry your bags.	polite
5.	Your younger sister spills milk all over the kitchen floor. Your parents walk in and see the mess and your sister says she didn’t touch the milk. Your parents assumed it was you.	blame
6.	You have recently entered a chess tournament through school. You are an experienced chess player and your first match is against a classmate who you have previously competed against and lost the title of defending champion to. Since then, you’ve been practicing and feel confident that this will be a close match.	competition

7.	You just finished writing a test. It took you only half an hour. You barely studied but knew almost all of the answers.	easy
8.	You and Quinn have known each other since childhood. You often get together to chat, to study and to go shopping. After graduation, you decide to go to the same university.	friendship
9.	You reach in your pocket as you're walking to class and find a dollar. You're holding it but it slips from your hand. It rolls down into the gutter.	gone
10.	You and one of your family members got in a big fight last week. You haven't been talking much since then. When they call and ask you for a ride to an appointment, you refuse to drive them.	grudge
11.	Your youngest son now wants to walk to the bus stop by himself. You're reluctant but you decide to let him, just once. You watch from the front window as he carefully crosses the street and realize that he's old enough to do this on his own.	independence
12.	You are working on a paper in the library. The fire alarm goes off and everyone has to evacuate the building. It turns out that there was no fire, but the whole procedure took about a half an hour.	interruption
13.	It's Friday and a friend asks you to go downtown. You decide to join. You still have lots of work to do, but you've worked really hard all week.	justify
14.	You've lost your phone. The funny thing is you just had it 10 minutes ago. You've retraced your steps but can't find it anywhere.	missing

15.	Your roommate just got a new puppy. But she works all day and is hardly ever home. The puppy doesn’t get walked or fed enough and doesn’t seem very healthy.	neglect
16.	As a kid, you had a bad experience with a dog and you were bitten. You’ve never liked dogs since. When dogs approach you, you retreat and your heart starts to race.	phobia

Internal State Items for Experiment 2 (17 – 32)		
17.	Your favourite show starts again next week. It’s been off the air for way too long. Next Wednesday seems like a long way away.	anticipation
18.	You’re in line for the bank. You realize your ex is standing in front of you. You make eye contact a few times but don’t say anything.	awkward
19.	You’re taking the bus back home. You check the time. Your phone’s dying, you have nothing to read, and you’re not even tired.	boredom
20.	You’re studying for a test. The textbook says one thing on the topic. However, the professor’s notes say another.	confused
21.	You come home from work crying since you’ve had a really bad day. Nothing you do seems to be working out the way you want it to. You fall asleep crying and can’t seem to get out of bed the next morning.	depressed
22.	You and your significant other had a messy breakup. They’ve been ignoring you. You decide to call them several times leaving multiple messages.	desperate
23.	You just went out on a date with someone you have really strong feelings for. Everything went really well. But, it’s been a week and you haven’t heard anything from them.	disappointed

24.	You've applied to your dream job a week ago but haven't heard back. You decide to call them. You just need to know either way.	eager
25.	It's Monday morning and you want a coffee from Tim Horton's. You don't bother changing your dirty pajamas. When you arrive, you see your boss.	embarrassed
26.	You are walking through a neighbourhood that you don't often go through. It's a run-down neighbourhood with graffiti and boarded-up houses and abandoned cars. You notice that a man seems to be following you, he's starting to walk faster and you are the only two people on the street.	fear
27.	You're sitting at your computer trying to write an essay. You've been working on it for hours but can't seem to get the words out. You keep rewriting the same three sentences.	frustrated
28.	You're working on a group project with another student. She's really nice and does almost all of the work. Later you find out you received 15% higher than she did.	guilt
29.	After many job applications, you have an interview. The position is highly desirable. It's a bit of a long shot, but maybe you'll get the job.	hope
30.	You've just woken up. It's Saturday morning and you have an exam at 10:00 a.m. However, you roll over to look at your clock and see that it's 10:15.	panic
31.	You're walking home when you realize you don't have your laptop. You must have left it at school. You run back and find it exactly where you left it.	relief
32.	Your community soccer team needs a goalie so you try out. You're excited about the prospect of playing. You get an email and your name isn't on the list.	upset

Items used in Experiment 1 Only (33 – 48)		
33.	A friend invites you to his cottage. You hate heights, but a rite of passage is cliff jumping into the lake. You're standing on the ledge and take the jump.	brave
34.	A friend talks you into trying rock climbing. The two of you arrive and you find yourself staring up from the bottom of the wall. It's a lot larger and steeper than you thought it would be.	challenge
35.	It's your first time babysitting for a neighbour. Everything's going well until you check on the baby you put to bed an hour ago. She's not there.	crisis
36.	You are surfing for the first time. You decided to go alone. Today, the waves are very big and the tides are strong.	danger
37.	You have a job at Wendy's, but you're looking for other work. You are not very happy at Wendy's. You would like to do something more challenging and something that you are more interested in.	dissatisfaction
38.	You're working hard to finish a paper you've been writing. Your phone keeps vibrating. You can see it flashing out of the corner of your eye.	distracted
39.	This morning, your parents left for a weekend getaway. You've just woken up from sleeping in. The place is all yours.	freedom
40.	You were laid off from work two weeks ago. You haven't told your spouse because you're scared that the news will devastate them. You decide that tomorrow you will tell them what happened.	hesitation

41.	You don't have anything to do today. You sleep in, then lie in bed for a while when you finally wake up. You get up slowly, eat breakfast, and decide not to get dressed all day.	lazy
42.	A friend invites you to a card party. But when you arrive, you don't know the game they're playing. You find yourself sitting on a chair in the back of the room.	lonely
43.	Last month you were offered a great job. Instead of taking it, you decided to wait. Now you work at McDonalds.	regret
44.	Your little cousin is really annoying. She's always kicking you and calling you names. You take her stuffed animal and hide it.	revenge
45.	You are riding your bike home and get caught in a thunderstorm. The thunder is booming and the lightning struck a tree not that far away. You reach your home without getting hurt and you dry off and stand inside to watch the end of the storm.	safety
46.	It's your anniversary. You have a feeling that your partner of 3 years has forgotten. When you arrive home, there's dinner on the table.	surprise
47.	In order to lose weight, you've started a diet. You're out for dinner and plan to order a salad. But you can't take your eyes off their double chocolate fudge cake.	temptation
48.	You've put a lot of effort into a group project for class. However, one of your members plagiarizes. Nevertheless, your professor gives you all a zero.	unfair

Appendix C

Instructions for Target Norming Study.

Concreteness

“This questionnaire requires you to read words referring to various concepts and rate them based on how concrete or abstract you find them to be. To illustrate, any word that refers to objects, materials, or persons should receive a high concreteness rating. In contrast, any word that refers to an abstract concept that cannot be experienced by the senses should receive a high abstractness rating. For example, "turtle," should be given a relatively high rating (say, 6 or 7), "chance" may be given a lower rating (say, 2 or 3), and "small" may be rated somewhere in the middle (say, 4). Larger numbers indicate more concrete, whereas smaller numbers indicate more abstract. Please try to use the entire scale and indicate your response by filling in the appropriate bubble.”
*Instructions taken from Paivio (1986).

Imageability

“This questionnaire requires you to read words referring to various concepts and rate them based on how imageable you find them to be. Any word which, in your estimation, very quickly and easily arouses a mental image (i.e., a mental picture, or sound, or other sensory experience) should be given a high imagery rating. In contrast, any word that arouses a mental image with difficulty or not at all should be given a low imagery rating. Larger numbers indicate more imageable concepts, whereas smaller numbers indicate less imageable concepts. For example, "circumstance," may be given a relatively low rating (say, 2 or 3), whereas "puppy" should be given a relatively high rating (say, 6 or 7). "Evolution," may be given a rating somewhere in between (say, 4). Please try to use the entire scale and indicate your response by filling in the appropriate bubble.”
*Instructions taken from Paivio (1986).

Context Availability

“Words differ on how easy it is to come up with a particular context or circumstance in which you might experience them. It is easy to think of a context for the word “baseball” and “emotion” but much harder to think of a context for the word “method” or “essence.”

Rate the following words on the ease with which you can think of a context for each word on a scale from 1 to 7, where 1 means “very hard to think of a context,” and 7 means “very easy to think of a context.” In the above examples, it is easy to think of a context for the word “baseball” and “emotion” (I immediately think of the context of the World Series for “baseball,” and perhaps the context of falling in love for “emotion”). Therefore, these words might receive a rating of 6 or 7. In contrast, it is rather difficult to think of a context for the words “method” or “essence”. Although after some thought, I may be able to come up with an appropriate context, but because it was more difficult, these words might receive ratings of 1 or 2. Please try and use the full range of the scale.” *Instructions taken from Schwanenflugel and Shoben (1986).

Familiarity

“This questionnaire requires you to rate words based on how familiar you are with the concept or idea that the word refers to on a scale from 1 to 7. Concepts that you are very familiar with should receive a high rating (6 or 7) whereas concepts that you are not very familiar with should receive a low rating (1 or 2). Concepts you are somewhat familiar with should be rated in the mid-range (4 or 5). Please try to use the entire range of the scale.”

Valence

“The purpose of this questionnaire is to investigate emotion, and concerns how people respond to different types of words. Please rate the following concepts based on how positive (happy) or negative (sad) you find them to be on a scale from 1 to 9. At one extreme of this scale, you are happy, pleased, satisfied, contented, or hopeful. When you feel completely happy, you should indicate this by using the right-most bubble. The other end of the scale is when you feel completely unhappy, annoyed, unsatisfied, or depressed. You can indicate feeling completely unhappy by using the left-most bubble. You can also indicate intermediate feelings of pleasure, by using any of the other bubbles. If you feel completely neutral, neither happy nor sad, use the middle bubble (5). This permits you to make more finely graded ratings of how you feel in reaction to each word. Please try to use the entire range of the scale.”

*Instructions substantially modified from Lang (1980)

Arousal

“The purpose of this questionnaire is is to investigate emotion, and concerns how people respond to different types of words. In the last questionnaire you were asked to rate words based on how positive or negative they are. This time, please rate the following concepts based on arousal. At one extreme of this scale you are stimulated, excited, frenzied, jittery, wide-awake, or aroused. When you feel completely aroused, use the right-most bubble. If the word makes you feel completely relaxed, calm, sluggish, dull, sleepy, or unaroused, use the left-most bubble. You can represent intermediate levels of excitedness or calmness by using any of the other bubbles. If you are not excited nor at all calm (neutral), use the middle bubble (5). This permits you to make more finely graded ratings of how you feel in reaction to each word. There are a total of 9 possible bubbles along the rating scale so that you can indicate the extent to which you believe the concepts to be low or high arousal. Please try to use the entire range of the scale.”

*Instructions heavily modified from Lang (1980).

Appendix D

Instructions for Production Study

The purpose of this experiment is to find out what people think about situations of various types.

You will read a number of 3-sentence descriptions of situations. For each one, please immerse yourself in the situation, and then provide 2 (minimum) to 5 (maximum) words that you feel describe the situation in the order you deem most relevant.

We would like you to provide words that refer to the emotions or feelings or thoughts of the people that are in each situation, or that sum up the situation as a whole.

Here's an example situation that may elicit the following responses:
"You're waiting in line for a ride at Canada's Wonderland. Your heart starts to race, your hands are shaking, and your knees feel weak. You debate whether or not you should turn back."

1. Nervous

2. Coward

3. Scared

4. Confused

5. Dilemma

Please note that we do NOT want you to provide names of things or types of people, or the physical activities that may be involved in the situation.

So, for the above example, please do NOT provide responses like "roller coaster", "child", "flee", or "scream".

When you are ready to begin, please progress to the next page.

You may use the same words in multiple situations if you believe they apply.

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