

**The role of the conscious self in the Meaning Maintenance Model and other
theories of threat compensation**

by

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ABSTRACT

There are currently a number of competing theories of threat compensation, which attempt to explain why humans affirm schemas and cultural worldviews following events that are distressing, anomalous or unexpected. Central to many of these theories is the role affirmations play in preserving self-identity. The Meaning Maintenance Model is one threat compensation theory that does not require the self to be threatened, in that it claims any violation of expectations is threatening, even those that are not directly related to the self, nor are necessarily consciously perceived. The role of the self as a necessary mediator between the perception of threat and evoked response is empirically tested in three studies. Results show that a subliminal presentation of incoherent word pairs can produce the same type of schema affirmation seen with other explicit and implicit threatening stimuli. Furthering this, the same subliminal threat also produces changes in behaviour that are not consciously directed, in this case by increasing implicit learning ability and working memory.

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1 INTRODUCTION

The Meaning Maintenance Model (MMM) argues that humans have a need for the world to be meaningful, that is, for elements in the world to be related in comprehensible ways. When someone's meaning is threatened, which can occur through any violation of an expected relationship, they compensate by addressing the threat directly, affirming an alternative framework or abstracting a new one. The MMM has been proposed as a model that can offer coherence to the large threat-compensation literature by providing a common foundation to how people process and respond to threats. For example, cognitive dissonance (Festinger, 1962), terror management theory (Rosenblatt et al., 1989), system-justification theory (John, Banaji & Nosek, 2004), self-affirmation theory (Sherman & Cohen, 2006), and uncertainty theories (Kay, et al., 2009; McGregor, et al., 2008) can be construed as specific instantiations of different threats that may be perceived and responded to through the same or similar cognitive processes (see Heine et al., 2006; Proulx & Heine, 2006).

To date, research through the MMM has focused on expanding the scope of these related theories, revealing the inter-connectedness of different domains of threats, and how they can lead to convergent compensatory behaviours. The current studies take a different approach, by focusing on the role of self-awareness in mediating the perception and response to meaning threats. Throughout the field, a number of theories have suggested that the uniqueness of the human experience

can lead to emotional and mental distress not experienced by other animals. Self-affirmation theory for instance, argues that humans have a need to see themselves as good, virtuous and successful (Sherman & Cohen, 2006), while Terror Management Theory has argued that humans needed to handle the unique problem of being able to envision their own future death (Greenberg, Solomon, & Pyszczynski, 1997). While the MMM agrees that threats to the self are disturbing, it argues that any perceived violation of expectations can produce the unpleasant arousal that motivates compensatory behaviours. Thus, while humans are sensitive to self-threats, they are also sensitive to environmental changes that are not directly related to the self, even to the point of not being consciously perceived. The current studies test this part of theory by exploring whether non-consciously perceived anomalies can produce not only changes in deliberate behaviour, but changes in non-conscious behaviour as well.

1.1 Review of the MMM

1.1.1 Meaning Making

The Meaning Maintenance Model (MMM) maintains that people engage with their world through meaning frameworks: that is, they are only able to understand events and themselves through mental representations of expected associations. Arguably, it is possible that all organisms operate through the use of mental relationships. Whether you're a human or a horse, you still need to connect your internal drives to the external world, you need to know what to eat and who can provide you protection, among other examples. However, unlike most other animals, humans have relatively few innate expectations for the world. Unlike the foal that enters the world ready to run, humans

have a prolonged developmental period where information is slowly absorbed and incorporated. While this extended development allows a human to adapt to its unique environment (Burghardt, 2005; Dunbar, 2006), it means that every human must go through the process of forging relationships between the self, the world and other people that allow for actions with adaptive results (Heine, Proulx, & Vohs, 2006). Even play, which is experienced as enjoyable, seems to largely be in the service of testing new behavioural scripts, or mastering new tasks (Burghardt, 2005; Pellegrini, Dupuis, & Smith, 2007). Development is not the focus of this paper, but it is worth noting that for portions of every human life, most of one's time is dedicated to meaning making. During this time, one is fully engaged with the task of understanding one's own identity, what goals are worthy to pursue and how to be successful at pursuing them.

At some point though, we get it. We may not understand *the* world, but we understand *our* world; who we are, what we want, and the daily tasks involved in achieving our goals. Having acquired the unique information about our physical and cultural environment, we can finally begin running. Importantly, from this perspective meaning is in the service of action. Given people's dependence on these meaning frameworks and the error-prone nature of learning, it is both likely that they will encounter information that does not fit with their frameworks, and problematic when such an event occurs – such information leads to the experience of meaninglessness.

1.1.2 Meaning threats

At a proximal level, the MMM argues that any violation of expectations (meaning threat) produces unpleasant arousal. This arousal is not consciously accessible, though some evidence suggests it motivates a general desire for less

uncertainty or more structure (Whitson & Galinsky, 2008) . When people feel meaningless they strive to regain a sense of meaning through a variety of strategies. They may *assimilate* the incongruous element such that it fits with their existing meaning framework, or they may *accommodate* their meaning framework such that the incongruous element is no longer an anomaly. These two responses were first explored in the meaning and development literature (e.g., Kuhn, 1996/1962; Piaget, 1960; Park & Folkman, 1997) and could be understood as a shifting to “learning mode”. However, because both assimilation and accommodation may require considerable cognitive resources, people may not always have the wherewithal to make sense of an encountered anomaly. In these situations, the MMM proposes that people often respond to meaning threats in one of two ways. One solution is to *affirm* their commitment to an alternative meaning framework, which allows them to regain a sense of meaning by focusing their attention on something that remains meaningful. For example, when participants encounter the unexpected while reading a surreal story by Franz Kafka, they come to identify more with their culture (Proulx & Heine, 2009). If an alternative meaning framework is not readily available, people may *abstract* a novel meaning framework. For example, when considering how their behavior is sometimes so contradictory that their self appears to be disunified, people are better able to learn novel patterns (Proulx & Heine, 2009).

1.1.3 Schema affirmation

When times are tough, stick with what you know. In response to experiencing the unexpected, people generally adhere to and reinforce opinions, world-views and behaviours that are firmly held and still intact. Currently, most

threat-compensation theories argue for this, claiming that in response to threat we affirm a world-view or schema, taking a view we already believe and affirming it further. Thus, while Americans already dislike anti-Americans, have strong views on abortion and are implicitly racist, feeling threatened aggravates these views and pushes them into the extremes (Kay, Gaucher, McGregor, & Nash, 2009; McGregor, Gailliot, Vasquez, & Nash, 2007; McGregor, Zanna, Holmes, & Spencer, 2001). This has the effect of framing compensatory behaviours as zealously charged versions of regular behaviour and is used to suggest that displays of extremism and religiosity, like those in the U.S. following the 9/11 attacks, are the result of a population experiencing threat (Das, Bushman, Bezemer, Kerkhof, & Vermeulen, 2009; Jonas & Fischer, 2006). The MMM generally agrees with these theories regarding compensation, but disagrees on the limited range of stimuli that can cause the threat. For instance, if social rejection (McGregor, Haji, & Kang, 2008), being reminded of one's death and being surprised by a visual anomaly (Proulx & Heine, 2008) can all produce similar compensatory behaviours, it is at least possible that the experiences are being processed in a similar way.

Evidence for schema affirmation reveal that a wide range of behaviours are produced following different types of threat, but most fall into the general category of adherence to cultural world-views or internalized behavioural scripts. Following threat, participants are hesitant to violate a norm (Greenberg, Porteus, Simon, Pyszczynski, & Solomon, 1995), prefer in-groups (Lau, Kay, & Spencer, 2008), avoid out-groups (Navarrete, 2005), are less risky if they are dispositionally cautious and more risky if they are by trait risk inclined (Ben-Ari, Florian, & Mikulincer, 1999),

punish norm-violators more strongly (Proulx & Heine, 2008), commit to an opinion that they held but were ambivalent about (McGregor, et al., 2001), prefer prestigious products (Heine, Harihara, & Niiya, 2002), are more likely to commit to tasks that they believe are important (McGregor, et al., 2007), prefer more social contact if they have a fearful attachment temperament but less contact if they have an avoidant attachment (Hart, Shaver, & Goldenberg, 2005), believe more people agree with their decisions (McGregor, Nail, Marigold, & Kang, 2005), prefer mates that are more culturally normative (Landau, et al., 2006), and feel *guiltier* if they were engaging in creative thought either just before or after a meaning threat (Arndt, Greenberg, Solomon, Pyszczynski, & Schimel, 1999) but will increase espoused openness to new ideas if they're told that creativity is valued in their culture (Routledge & Arndt, 2009). The last finding suggests that schema affirmation is not experienced in a mental vacuum, but incorporates the expectations of others into the threatened individual's actions. Creative thought seems to be unpleasant under threat, possibly because it involves being open to revising schemas, but despite this, people claim they are more open to new ideas if they think this is culturally valued. A more direct example of this is found after mortality salience, where participants are either more or less likely to agree to use sun-screen based on a magazine article telling them whether most people think light or dark skin is attractive (Cox, et al., 2009). This manipulation even worked on participants already at a beach, suggesting that participants are not just zealously defending their view, but are still sensitive to the preferences of others. The question of why we affirm schemas, then, has not yet been fully unpacked, as it isn't

clear whether we are affirming beliefs more strongly, or changing our behaviour to appear more normal, or typical.

1.1.4 Schema abstraction

The MMM argues that schema abstraction occurs when neither learning (in the form of assimilation or accommodation) nor affirmation can take place. Schema abstraction involves heightened motivation and ability to identify new mental relationships. Thus far, evidence suggests that the increased motivation is strong enough to lead to illusory pattern detection (Whitson & Galinsky, 2008), though it may also lead to greater ability to detect patterns when they actually exist (Proulx & Heine, 2009). The result of this can take the literal form of identifying new patterns, such as images in static, but also extends to a readiness to see behavioural patterns, such as suspecting a conspiracy based on unrelated events.

Galinsky & Liljenquist (2005) have suggested that abstraction underlies the connection between anomaly and conspiracy theories. When an event of low-probability occurs, people generally (and rightly) assume that the event was likely not random and may have implications for them. Depending on the scope and complexity of the event, this may lead to reasonable suspicions, such as a hated co-worker getting you fired, to the somewhat less reasonable, such as the U.S. government destroying the World Trade Towers to force their own country into war. Unlikely events, by their nature, can be meaning threats in that they are often unexpected and their consequences unplanned for.

The fact that people are more prone to mistakenly see patterns under threat is expected. If threat signals identify some kind of change, then increasing one's sensitivity is on average a "good bet" that there is a new relationship to be uncovered. That this leads to errors is just another example of how human heuristics can be fooled but may be ecologically useful, as in the case of frequency or conjunction fallacies (Cosmides & Tooby, 1996; Tooby & Cosmides).

Whereas schema affirmation is supported by all threat compensation theories in some form, schema abstraction, the motivation and heightened ability to forge new mental relationships, is less recognized. Thus, schema abstraction may be a useful tool in making unique predictions regarding consequences of threats, such as system threats, or mortality salience that their respective theories would not have made.

1.2 The role of misattribution of arousal in compensatory behaviour

We are always paying attention, even when we're not. Whether we catch our name in a noisy room or are woken by a door opening (but not a car passing in the street), there are many examples of how our unconscious processes perceive more than what we are focused on. In the same way that our name is a special "key" that diverts our attention, perceiving events that violate expectations may alert our conscious attention that something has changed. There is already evidence showing that violations that are not consciously recognized (Proulx & Heine, 2008) or are presented subliminally (Arndt, Greenberg, Pyszczynski, & Solomon, 1997) can still

be perceived and produce compensatory behaviour. Going beyond mere perception, in one study participants with high trait anxiety were more likely to complete word stems using subliminally primed threatening words (e.g. terror, defeat, punish) over neutral words (e.g. celery, bridge), suggesting we are capable of biasing even non-conscious processing in favour of certain stimuli, long before the stimulus enters conscious focus (Li, Paller, & Zinbarg, 2008). However, just because we perceive an anomaly and experience arousal, does not mean we are capable of consciously identifying the source of that arousal. Failure to consciously identify problematic stimuli may in part explain the need to affirm schemas.

The MMM argues that the expected unexpected is not particularly threatening (Proulx, Heine, & Vohs, 2008). When one is able to identify a likely cause of their arousal, we would expect the experience of threat to be reduced, or the response directed at the anomaly, at least. Thus, if a plausible source is identified, this should be sufficient to turn off the “threat,” or at least reduce motivation to produce unrelated compensatory behaviour. This may explain why such unrelated threats and responses become linked: If you can’t identify what has made you feel uneasy, your best bet is whatever your attention has been guided to. The evidence thus far does suggest that misattribution of arousal plays an important role in mediating threats, as giving participants an explanation for their arousal (Proulx & Heine, 2008) or allowing them to contemplate how the manipulation made them feel (Pyszczynski, Greenberg, Solomon, Sideris, & Stubing, 1993) seems to eliminate the effect. For explicit threats, it is somewhat counter-intuitive to suspect that misattribution is a critical component in compensation. For instance, it

is difficult to believe that people reading absurd literature, or talking about their own death mistakenly misattribute their arousal to an entirely unrelated experience. However, the fact that longer delays between the manipulation and dependant variable produce stronger responses (Burke, Martens, & Faucher, 2010) lend some support to this hypothesis, suggesting that it is easier to misattribute arousal when the cause is not the current focus of attention. This is not an unusual finding with humans, who also confuse arousal between danger and sexual attraction (Dutton & Aron, 1974), sexual arousal and aggression (Zillmann, Katcher, & Milavsky, 1972), arousal caused by unrelated forms of goal-conflict (Eisenberger & Lieberman, 2004) and pain caused by social or physical sources (DeWall, et al.).

1.3 The role of conscious awareness in fluid compensation

Throughout the literature, there is disagreement regarding whether self-awareness is a core mediating component in fluid compensation. Although it is widely accepted that the arousal produced by various threats is not consciously accessible, many argue that the source of the arousal is related to a problem originating in the self. For instance, terror management theory argues that the source of arousal is due to the uniquely human ability to perceive the self both in the present and future, where it will die (Greenberg, et al., 1997). Likewise, self-affirmation theory holds that humans have a need to perceive themselves as morally good or successful from the perspective of their culture and attempt to affirm unrelated but valuable parts of their identity when one component fails (Sherman &

Cohen, 2006). The evidence reviewed here suggests that the self can but does not need to be involved in either the perception of or response to threat.

Although a conscious threat to the self can produce deliberate, compensatory action in an unrelated domain, subliminal or non-conscious threats can also motivate these deliberate compensatory actions. In these cases, it has been argued that concepts that are primed non-consciously still reach awareness and can thus influence deliberate behaviour. Although in many cases participants do not know why their behaviour has changed, the measure is some form of deliberate action, such as a self-reported opinion, or explicit behaviour such as adhering to a norm. There have been very few studies that use an implicit or non-conscious measure as the dependant variable, which would help solve this dilemma. Part of the reason for this is likely not that the question of implicit behaviour is uninteresting, but that it is difficult to develop a measure that does not include self-reflection. One such measure that has been recently used is the implicit grammar task (Dienes & Scott, 2005), which reveals learning that occurs without intentional effort.

2 The present research

In the current studies, we directly address the question of whether the conscious self is a necessary component of meaning maintenance. In study 1, we ask whether compensatory behaviour will follow a prime designed to elicit confusion, or the subjective experience that something anomalous has occurred, while not directly priming concepts that are associated with unpleasant arousal (e.g.

“death” or “uncertainty”). In study 2, we directly test whether self-awareness is a necessary component of meaning maintenance by pairing the same subliminal prime with an implicit measure of schema abstraction. In study 3, working memory as a response to meaning threats is explored as a potential explanation for the increase in schema affirmation or abstraction.

2.1 Study 1: Subliminal meaning threats and explicit schema affirmation

In study 1 we attempt to design a subliminal prime that, instead of priming a concept that individuals find confusing or disturbing, would itself produce the experience of confusion. Thus, there should be no opportunity for self-reflection of a concept that people find threatening (such as death, or failure), only the arousal that is presumably caused by these disturbing concepts. The hypothesis was that this prime would produce an increase in schema affirmation compared to the control, as has been seen in past studies. We included a third condition where participants complete a mortality salience prime, to compare our pattern of results with a reliable threat.

2.1.1 Study 1 methods

Participants

97 participants (36 women, 55 men, 6 unreported) were recruited from a Vancouver-area beach. Their average age was 30.1 years (range 18-49). The sample was diverse, with 60% born in North America, 4% in China, 3% in Israel, 3% in Brazil, 24% from various other countries, and 6 % unreported.

Procedure

Participants were seated in front of a 15-inch laptop with a 60hz refresh rate. All components of the study were completed on the computer. Participants first completed the subliminal word task (described below) or mortality salience manipulation, followed by the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and social judgment survey.

Subliminal Word Task. Participants were told they would see a series of words flashed on the screen and that they should sort the words into “pleasant” or “unpleasant” categories by pressing p or q respectively. For each word, a cross was presented for 1000ms, followed by the word for 356ms, a 42ms “gap” and finally a static block that remained until the participant selected a category. The sorting task and static block were used as a forward and backward mask to hide the presentation of the subliminal word primes, presented within the 42 ms gap. Both control and experimental conditions completed 60 trials. The first 20 trials were the same for both conditions, where the gap contained a mix of either no subliminal stimuli or coherent word pairs. In trials 21-30 the gap contained coherent and meaningful hyphenated word pairs (e.g., quickly-running, juicy-blueberry) in the control condition, and the same words recombined into incoherent and meaningless pairs in the experimental condition (e.g., quickly-blueberry, juicy-sewing; see Appendix A). This process was repeated for trials 31-60 with different words. The incoherent word-pairs were predicted to violate expectations by activating syntactic (e.g. car-throw) or semantic (e.g. smiling-box) violations. Although consciously perceiving these violations is not disturbing per se, participants would not

have the opportunity to identify or address the arousal when caused by a subliminal presentation.

Although Bargh & Chartrand (2000) have suggested that foveally presented stimuli should not be present for more than 15ms to be considered subliminal, they acknowledge that the greater concern is whether participants are able to identify having seen the stimuli in a post-test awareness check. We were concerned that the complex nature of our stimuli (word pairs consisting of up to 17 characters) might be missed entirely with too short a presentation window. As Arndt, et al. (1997) were successful in subliminally priming “death” with a 42ms exposure, we decided to use this length.

Mortality salience. This manipulation was taken directly from Arndt, et al. (1997).

Participants completed 60 trials and received either blank gaps or coherent word pairs during 40 trials, as in the other two conditions. Instead of seeing incoherent word pairs, participants were flashed the word “death” for the critical trials.

Social Judgment Survey. Participants read a hypothetical arrest report about a prostitute and were asked to set the amount of the bail, between \$0-\$999. This identical measure has been used in several meaning-threat and mortality salience studies (e.g. Proulx & Heine, 2008; Proulx et al., in press; Rosenblatt et al., 1989). We predicted that the amount of bail would be set higher for participants completing the incoherent word-pair prime or mortality salience, as it provides an opportunity to affirm an unrelated schema following an anomalous event.

2.1.2 Results and discussion

As a manipulation check, we asked participants at the end of the study to identify how many words were presented at once for each trial. 37 (38% of the sample) correctly

identified that 2 had been presented. However, only 1 participant in either the coherent or incoherent word prime condition was actually able to list one of the subliminally presented words. In the mortality salience condition, ten participants were able to list the word “death” suggesting that this manipulation was not uniformly successful at presenting the stimulus outside of conscious awareness.

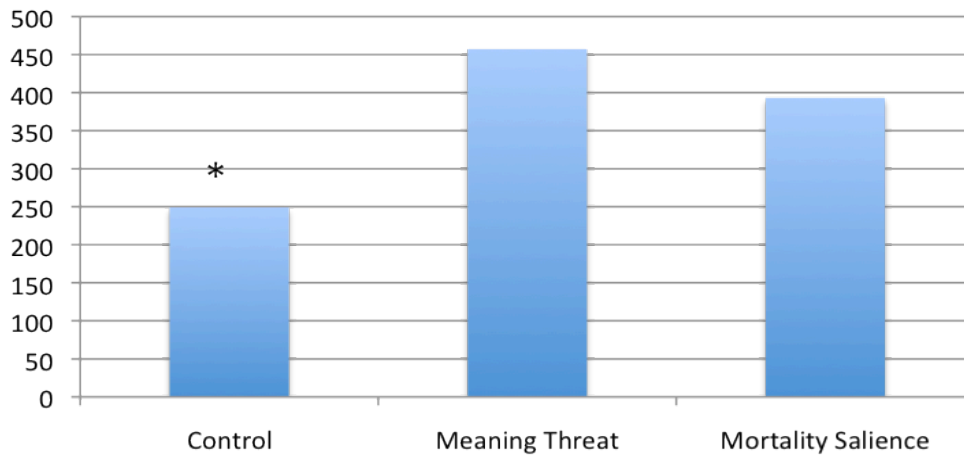
As is typical of meaning threat studies, there were no differences across conditions in either positive ($F_{(2,94)}=1.44, ns$) or negative ($F < 1$) affect.

Distributions of responses on the bail bond were not normal, so the dependent variable was \log_e transformed¹. A one-way ANOVA was used to test our predictions. The model yielded a significant effect between conditions ($F_{(2, 95)}=8.86, p < .01$; See Figure 1). Dunn-Bonferroni adjusted comparisons were used to test individual differences, in order to maintain a family-wise type 1 error rate at .05. These comparisons revealed a significant difference between the control and meaningless words condition ($p < .01, d=1.05$) as well as control and mortality salience ($p = .014, d=.61$). The mortality salience and meaningless words conditions did not differ from one another ($p > .5$)². Although our mortality salience prime was noticed by at least some of the participants, it still managed to produce the predicted effect.

¹ When we compared our results to a non-parametric analysis, we found an inconsistent pattern of significance, indicating that the ANOVA was not robust to the distribution in our data set.

² This pattern of significance using \log_e transformed values was consistent with bootstrapping at 10,000 repetitions.

Figure 2.1 Bond value set for prostitute



Analyses were conducted on \log_e transformed means.

As predicted, we found that a subliminally presented prime can produce an experience of meaninglessness, without directly priming a troubling experience, such as mortality salience. This is a replication of Proulx & Heine (2008), who found that when participants fail to consciously notice that their experimenter has switched with another individual, they affirm unrelated schemas. As with their study, we show that events that are neither consciously perceived nor related to existential concerns, such as mortality or identity, can still produce schema affirmation. However, this study still involves a deliberate action that is at least partially under the control of conscious attention. In study 2, we extend this effect by showing that it can affect cognitive processes that are not at all under conscious control.

2.2 Study 2: Subliminal meaning threats and implicit learning

2.2.1 Study 2 methods

Participants

135 participants (95 women, 38 men, 2 unreported) took part in the study. Two were removed for not following instructions, leaving 66 participants in the meaningful prime condition (control) and 67 in the meaningless prime condition (experimental). Participants were born in North America (53%), China (23%) Korea (7%) and other (17%) countries. Mean age was 20 years (range 18-44).

Procedure

Participants were seated in front of a laptop with a 15-inch screen and a 60hz refresh rate. All components of the study except for the implicit learning task were completed on the computer. Participants first completed the subliminal word task, followed by the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and an implicit learning task.

Implicit learning task. This measure was taken directly from Dienes & Scott (2005) and has been used following unrelated, explicit meaning threats (Proulx & Heine, 2009). Participants were given a sheet of 45 “Training” letter strings (e.g., VTVTRVTM) and are instructed only to copy them verbatim. They are then given another sheet of 60 “Test” letter strings with the following instructions:

The strings of letters you just copied contained a strict pattern. Some of the letter strings below follow the same pattern. Some of these letter strings do not. Please place a checkmark beside the letter strings you believe follow the same pattern as the letter strings you just copied.

Because the participants were not told that there would be recall test, any learning that took place was caused by mere exposure to the training strings. Thus, if the threatened

group outperforms the control condition, this is evidence implicit learning strategies have been affected without the participant's awareness.

2.2.2 Results and discussion

As a manipulation check, participants were asked how many words they had seen presented at once during the sorting task. Although over half the participants (53%) correctly identified that two words has been presented, none of them were able to list any of the words presented.

Again, there were no significant differences in either positive or negative affect (both $t_s < 1$) between conditions, as measured by the PANAS.

Of the 60 items in the test strings, 30 of them matched the implicit pattern and 30 did not. Two measures were used to assess participants' learning of the artificial grammar: Absolute Success and Accuracy. Absolute Success is a score representing how successful the participant was at detecting patterns overall, which is calculated by subtracting the number of false alarms from the number of hits. This provides a score ranging from -30 to +30, with participants scoring highest if they were both motivated to find patterns (by selecting many strings) and accurate in the strings they selected. Although this measure produces a "real" success score, it confounds motivation and accuracy, where a highly accurate but unmotivated individual would score fairly low. The second measurement approach, Accuracy, divides hits by the number of total attempts (hits + false alarms) and measures how accurate a participant was when they selected a pattern, regardless of how many "test" strings they selected. Both of these are measures of learning, and have different tradeoffs associated with them (Wagner, 1993), but both are predicted to be higher following subliminal exposure to meaningless words.

The mean values for each dependant variable are reported in Table 2.1. Distributions for each of the dependant variables were positively skewed, so the data were \log_e transformed, which reduced, but did not completely eliminate the skew³. Participants in the meaningless prime condition scored significantly higher in both the measures of Accuracy (Welch's $t_{(131)} = 2.18, p < .05, d = .38$) and Absolute Success (Welch's $t_{(131)} = 2.06, p < .05, d = .36$), compared to those in the meaningful prime condition, largely replicating the pattern found with explicit meaning threats (Proulx & Heine, 2009). That is, exposure to the subliminal meaningless word pairings led participants to learn new patterns better.

Table 2.1 Pattern Learning Following Subliminal Word-Pair Presentations

	Control	Meaning Threat
Absolute Success (H-F)	5.9	7.5
Accuracy (H/(H+F))	.68	.74

Conditions are significantly different at $p < .05$.

Analyses were conducted on \log_e transformed means.

This is the first study to show that meaning threats that are not consciously perceived can shift cognition without requiring conscious attention or effort. Although other studies show that individuals will increase their effort on a task following threat

³ Results were re-analyzed using bootstrapping at 10,000 repetitions. The pattern of significance was the same, indicating the results are robust to the remaining violation of normality.

(Jamieson & Harkins, 2009; Pettit & Lount Jr, 2009) this is the first to show a change in task ability unrelated to effort or conscious motivation.

The MMM argues that schema abstraction occurs in the service of reducing arousal and that this does not require conscious awareness of that arousal or of the abstraction efforts. However, this still leaves the question of what does change to increase ability in abstraction. Although effort may increase in general following threats, participants were unaware that they were engaged in a learning task.

In study 3, we explore whether increased working memory may account for greater ability in pattern detection. If, following a meaning threat, individuals experience a cognitive re-allocation of resources such that working memory is temporarily boosted, then this could explain heightened retention of information, even without the individual's conscious effort.

There is some evidence to suggest that information which is organized in a counter-intuitive or incoherent layout, provides better opportunity for learning when someone is familiar with the type of information they are learning about (e.g. biology) (Kintsch, 1994; McNamara, Kintsch, Songer, & Kintsch, 1996). This effect does not occur for topics unfamiliar to the reader, though one could argue that a new knowledge domain is, in itself, enough to arouse a person's sense of novelty. Although this is an example of increased learning associated with the anomalous stimuli, other work has shown that any material associated with the anomalous event is more securely stored and better recalled up to a week later (Norenzayan, Atran, Faulkner, & Schaller, 2006). In this study, the authors found that a few counter-intuitive word pairs inter-mixed with a list of regular word pairs allowed for greater overall memory of the list a week later,

compared to an entirely intuitive list or one populated with almost all counter-intuitive pairs. This suggests that anomalous information is more difficult to remember (as memory of the highly counter-intuitive list was mostly degraded), but that it encourages a change in processing that increases the likelihood of remembering anything at that time. The authors argue that this bias has real-world effects, and show that folk tales that contain 2 or 3 counter-intuitive elements are identified as more likely to be remembered.

If anomalous stimuli can increase overall memory in a particular task, it is possible that any stimuli presented temporally close enough to the anomaly also has a greater chance of being remembered. Although no study has shown that unrelated tasks benefit from anomaly, one anecdotal example is flashbulb memories. When momentous and unusual events happen, people not only remember the details of the event, but also store a great deal of information about their own circumstances when they heard the news, much of which is unrelated to the main information. Although considerable debate has arisen since the phenomenon was first identified (R. Brown & Kulik, 1977) regarding how these memories are formed, current models and data suggest that surprise, though not necessarily emotional intensity, contribute to the development of flashbulb memories (Luminet & Curci, 2009). This is generally what might be predicted for a real-world instance of meaning maintenance, where anomalous and surprising events lead to an impactful change in cognition (e.g. greater memory).

2.3 Study 3: Subliminal meaning threats and working memory

2.3.1 Study 3 methods

Participants

106 participants (86 women, 20 men) took part. One was removed before analysis on suspicion of entering data randomly. Mean age was 19.9 years (range 16 – 53). 48% were born in Canada, 25% in China, 8% in Taiwan and 4% in Korea, with the remaining 15% from other countries.

Procedure

The procedure was exactly the same as study 2, with a measure of working memory used as the dependant variable. The measure was taken from study 3 in (Schmader & Johns, 2003). Participants are given a word to remember, followed by a distracter where they count the number vowels in a sentence. After a number of words are presented, they are asked to recall as many as they can. Words are recalled in sets of 4 for the first four blocks and sets of 5 for the remaining 8 blocks.

2.3.2 Results and discussion

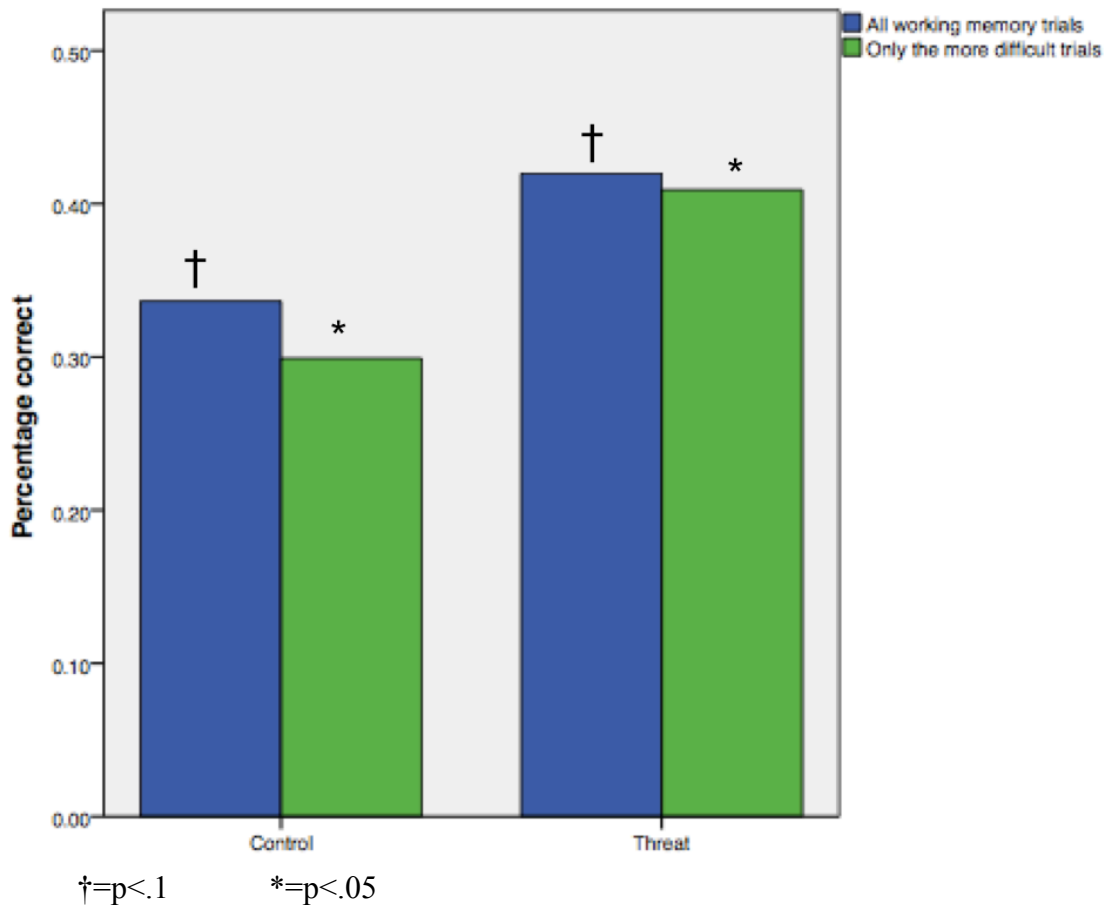
35 participants (33%) listed the correct number of words flashed, which would be expected by chance. However, 5 of those were able to list at least one of the subliminal words. There was no difference between conditions for either positive or negative affect ($t < 1$).

Working memory was analyzed by counting the number of blocks where participants correctly recalled all of the words, producing a score between 0 to 12 and converted to percent. Over the whole measure, there was a trending effect towards increased working memory in the threat condition, $t_{104} = 1.68$, $p < .1$, $d = .33$. However,

when we removed the first four, easier blocks, the threatened group was shown to have significantly better working memory, $t_{104}=1.97, p=.05, d=.38$ (See figure 2.2).

As predicted, working memory increased for participants who experienced a meaning threat, which was more apparent for the more difficult trials in the measure. Although success at this task likely could be improved with effort, there was no explicit threat that should have motivated participants to do so. Thus, it would appear that meaning threats can increase both implicit learning and short-term retention of information.

Figure 2.2 Percentage of correct trials on the working memory task



3 General Discussion

In study 1, a subliminally presented incoherent statement produced the same compensatory schema affirmation as an explicit mortality salience prime, replicating the effects in Proulx & Heine (2008). In study 2, the same subliminal prime produced cognitive changes that are not under conscious control, leading to an increase in implicit pattern detection. Finally, study 3 found that meaning threats cause an increase in working memory, possibly identifying the means by which implicit pattern detection can improve. These studies combine to suggest that meaning threats that are perceived outside conscious awareness can not only impact conscious behaviour, but also change cognitive processes that are not under conscious control.

The results in this paper fit with the MMM, but present problems for theories of threat compensation that require the self to be a necessary component of threat perception and response. For instance, Terror Management Theory cannot explain why threats should increase implicit learning or working memory. Likewise, self-affirmation theory, which requires a direct attack on the coherence of the self, would have to struggle to explain how non-conscious experiences can create behaviours that resemble the response to a self threat (as in study 1) but also changes in cognition that avoid the self entirely, as in study 2.

While more explicit threats can produce these responses, the studies here suggest that there is a low-level system involved in processing a number of different frustrating or unexpected experiences. Furthermore, the ability for subliminal primes to produce both implicit and explicit effects, supports the hypothesis that one cognitive system is involved for both peripheral “nuisance” threats and more relevant threats, such as failure feedback.

Future studies should begin to explore what elements of this process are in fact, similar, and where specific threats have a unique influence. For example, consider stereotype threat. Although in the current study, the threat was found to increase working memory, there is a large body of evidence showing that experiencing stereotype threat decreases working memory, affecting both domain relevant and irrelevant tasks (Schmader, Johns, & Forbes, 2008). Stereotype threat is viewed as emerging from the conflict of holding negative group stereotypes that conflict with one's self-identity (e.g. women are bad at math, and I'm a woman but I'm good at math). This should, by the definition of the MMM be a violation of expectations, but produces results opposite of what was found here. As there is still considerable debate regarding whether a core motive exists at all, questions of this type have yet to be explored.

3.1 Limitations

3.1.1 Methodological limitations

One methodological limitation is the “subliminal” status of the prime, with up to 53% participants in one study identifying the subliminal stimulus, noticeably higher than the 33% expected by chance. Although the exposure time is longer than 15ms limit that Bargh & Chartrand (2000) recommends for foveal presentation of stimuli, the task that participants engaged in as the forward mask is more complicated than typical subliminal presentation paradigms. Arndt et al. (1997) were successful in subliminally priming words using a similarly engaging task, suggesting that foveal presentation can be increased if the participant is experiencing some distraction. Furthermore, it is not strictly necessary that participants are unaware that additional stimuli are being presented, only that they fail to consciously perceive the content, which appeared to be the case in

these studies. Ideally, future modifications of the paradigm would aim to produce a consistently low awareness of the subliminal presentation, to avoid any concerns on this issue.

3.1.2 Limitations of theoretical implications

I have suggested that working memory may be the means by which implicit learning is improved, but this is as of yet an untested assumption. Another possibility is that general arousal is increasing vigilance, which may underlie both effects. Research has shown that making people moderately aroused or stressed increases general perceptual and motor function (Lambourne & Tomporowski, 2010; Stefanucci & Storbeck, 2009). The results of study 3 somewhat support this. The control group declined in success over time, while the experimental group remained consistent throughout the task. If participants are more attentive in general, this may increase success on any kind of perceptual task requiring focus over a period of time. One possible way to test this would be to compare the success of threatened groups to those who have received a mild stimulant, such as caffeine. If participants who receive a familiar stimulant perform equally well to those who experience a meaning threat, it would suggest that increased schema abstraction is the result of any arousal, and not specific to arousal associated with meaning threats. This paradigm would also make it possible to test whether schema abstraction and affirmation are both in the service of reducing unexplained arousal. If they are, we would expect both to occur when participants consume a stimulant but are told it is a placebo, while neither should occur if they are aware they've consumed an arousal-causing drug. However, another possibility is that any arousal increases implicit learning through vigilance or working memory,

while affirmation only occurs if one experiences unexplained arousal. In this case, we would expect that all participants show abstraction, but only those who can't explain their arousal would show affirmation.

A final limitation is that thus far we have relied on convergent behavioural evidence. While useful in supporting the theory, this reliance has led to various circular arguments in the literature. For instance, one criticism the MMM has levied against terror management theory is that it cannot account for the wide variety of threats that produce compensatory behaviour. The rebuttal to this has been studies showing that some unrelated threats nevertheless do cause higher death thought activation, which they argue mediates the compensatory response (though no one has been able to show mediation on this yet) (Hayes, Schimel, Faucher, & Williams, 2008; Schimel, Hayes, Williams, & Jahrig, 2007; Vess, Routledge, Landau, & Arndt, 2009). One potential counter to this argument is that any anomaly causes a spreading pattern of semantic activation, making all arousal-causing ideas more accessible, but this creates a debate where neither side can be falsified. One solution to this problem likely lies in more attention to cognitive process.

3.2 Future Directions

3.2.1 Neural evidence

One solution to the limitation of convergent validity is to also find convergent neural processing of different types of threats. Cognitive neuroscience has already identified a number of neural events in response to anomalous stimuli. Humans show a mismatch negativity response in as little as 120ms following an anomalous stimuli, such as a tone that is different from tones preceding it (Pulverm, ller & Shtyrov, 2006). This

immediate response is not restricted to impoverished stimuli, as grammatical errors and possibly even semantic violations can evoke this response. For instance, two responses to anomaly that follow shortly after mismatch negativity are the P300 and N400 (C. Brown & Hagoort, 1993). These waves have been shown to appear following unexpected stimuli, such as when the sentence “He took the pizza from the ...” ends in “toothbrush” instead of something semantically expected, like “counter”. Likewise a semantically deviant word in a list of similar words, or a male name in a list of female names can elicit the P300 (Fabiani, Karis, & Donchin, 2007). When this occurs, not only do the unusual stimuli typically evoke a stronger P300, but the relative strength of the P300 response to any word predicts how likely that word will be remembered later on. This effect is at least somewhat similar to the findings of study 3. Although no cognitive study has shown that anomaly leads to enhanced memory on a following task, there is at least evidence that anomaly can boost memory at the moment it is experienced.

There are three benefits to increasing use of the above approach. As mentioned, convergent behavioural evidence can now be supported by convergent neurological evidence. If incoherent word pairs and mortality salience are actually processed through the same system, they should both elicit similar waves (possibly the P300) and the strength of that wave should predict increased schema affirmation. It may also turn out that the P300 predicts only certain types of threat, in which case there may not be any core motive driving these similar behaviours.

This methodology would also help further the question involving the role of conscious self-awareness in the threat response. For instance, the mismatch negativity and P300 have been identified as largely pre-conscious waves, whereas the N400 does

not emerge for completely subliminal stimuli (C. Brown & Hagoort, 1993). Finding the earliest evoked potential that can predict schema affirmation or abstraction can tell us what the sufficient conditions are for threat response.

Finally, accessing the neuroscience literature allows for greater comparison to other non-human animals. It is unlikely that humans have developed unique cognitive machinery for detecting anomaly, and in fact other mammals show the same P300 response to many of the same eliciting stimuli used with humans (Harrison, Buchwald, Kaga, Woolf, & Butcher, 1988; Swick, Pineda, & Foote, 1994). More attention to this area will allow us to identify at what stage of the cognitive event the response becomes unique to humans.

3.2.2 Selection Processes

Another area of research that has yet to receive serious consideration is the selection processes that have led to meaning maintenance. Currently, the MMM argues that humans respond to the arousal caused by an anomaly by either learning about the anomaly, affirming an unrelated schema, or abstracting a new schema. The latter two are not considered functional behaviours, but are entirely a by-product of the cognitive need to reduce distracting arousal and return to the task on hand.

This explanation, while potentially correct, suffers from a theoretical problem similarly found in Terror Management Theory. This theory argues that humans have an instinct to avoid death that became problematic as we developed forethought and could envision our own demise (Greenberg, et al., 1997). To overcome this, we projected our identity onto various symbolic immortal systems, and by affirming these systems, were able to alleviate our existential terror. This approach involves a failure to

apply *a priori* evolutionary thinking. Cognition types increase in frequency if they produce a useable behaviour (such as experiencing food cognitions when the body requires energy), but TMT argues that certain behaviours have increased in frequency to control maladaptive cognitions.

Although it hasn't been stated explicitly, the MMM is viewing the arousal caused by nuisance anomalies as a spandrel of a learning system interacting with a highly complex world. In evolutionary terms, a spandrel is a behaviour or trait that emerges as a result of another trait that has been selected for, such as whiteness in bones being selected for incidentally because of the adaptiveness of their calcium-rich structure. An important difference between these two, is that some spandrels (like bone whiteness) are free to vary in any direction because there is no opportunity for selection. However, meaning maintenance produces visible behavioural changes such as schema affirmation, adherence to norms and so on, which are exposed and thus subject to selection. The argument requires then, that costs imposed by meaning maintenance be outweighed by the benefits of being able to ignore new stimuli that are either not worth one's attention, or beyond the ability of the individual to understand. This perspective also requires an explanation for how individuals decide between learning and maintenance. Currently, the model does not include a clear process for how this decision is arrived at, which is problematic given that individuals are not consciously aware that they find the threats troubling, or that some threats are never consciously perceived.

One alternative to the by-product hypothesis is that meaning maintenance itself has been selected for. Research has shown that participants perceive more

than they are consciously aware of. When we experience uncertainty then, we may lack the cognitive capacity to consciously identify how our expectations have been violated, but still receive a blunt signal warning us that “something” has occurred that wasn’t expected. This signal may motivate us to focus on our environment more than normal, and place us in a state of conservative behaviour, as we have been alerted that our normal ability to predict outcomes has been jeopardized and thus, we cannot predict the consequences of deviating from normative rules.

It is uncontroversial to suggest that the motivation to learn about novel information is itself likely adaptive. Even animals with less capacity to organize complex information spend the effort to explore, when first exposed to novel environments (Russell, McMorland, & MacKay, 2010). Following from this phenomenon, schema abstraction doesn’t seem out of place next to assimilation and accommodation. If it is beneficial to learn about novel events, than redirecting resources to increase the likelihood of successfully learning (through boosted working memory, vigilance, etc.) would follow naturally. The fact that humans show increased abstraction abilities in areas unrelated to the threat may simply be a case of misdirected effort. Foster & Kokoo (2009) have made a similar argument for the role of misattribution in superstitious behaviour, suggesting that as long as there is some correlation between environmental events and the costliness of errors of omission, a bias could evolve that leaves one assuming any precursor to the event was causal. This can be especially problematic when multiple actions precede an event, leading to bundling multiple behaviours with the event, some of which are

superstitious. Again, the reason this occurs with humans is that we can't always tell how events are related, and so need to rely on what is salient.

From this perspective, schema affirmation is the odd one out. One possibility is that schema affirmation is somehow involved in the learning process (possibly by increasing salience of currently held scripts) and that any behaviours are a by-product of this. We know that participants polarize and strengthen their opinions following threat, which could be an by-product of a schema that is more salient than normal. However, there is also evidence that people are more influenced by others after threat, which stands in opposition to a "hardened schema" hypothesis. For instance, after a mortality salience prime, participants were either more or less likely to claim they would use sunscreen, depending on whether a popular fashion magazine endorsed it, even if they completed the study at the beach (presumably ready to start tanning) (Cox, et al., 2009). One alternative to the by-product hypothesis that can account for increased sensitivity to social pressure, is that affirmation benefits the individual by reducing any socially deviant behaviour. If a person believes that something about their environment has changed, the cost and likelihood of an error suddenly become unpredictable, which may have lead to a bias for socially conservative (i.e. normative) behaviour while feeling uncertain. One example of this is found with men who, after a threat, rate their sexual intent as lower and women as less attractive (Landau, et al., 2006) and yet show an increase in desire for children (Wisman & Goldenberg, 2005). Although neither study asked their participants what they thought most other people would have said, it is possible that their expressed opinion is being biased so that one appears more

similar to what they believe the norm is. One set of studies has shown that, following a number of different threats, participants are more likely to claim that most people agree with the opinion they hold (McGregor, et al., 2005).

One important future study would be to assess whether not only social conformity increases following threat, but informational conformity as well. Social conformity involves the motivation to conform because it will reduce punishment from others or increase opportunities for cooperation, whereas informational conformity involves motivation to conform because the model (or group of models) is more likely to be correct than you are. Baron, Vandello, & Brunzman(1996) were able to show that these motivations are different. They found that with easy tasks, participants would conform to confederates who gave an incorrect answer when there was no reward for correctness, apparently motivated to agree with the group even at the cost of being wrong. The opposite pattern emerged when the task was difficult, where participants were more likely to conform when the reward was large, suggesting that they trusted the group consensus more than their own perception. Informational conformity would not involve affirming a schema, but it would show that more attention is being paid to what others think is correct.

In addition to lab work, this question would greatly benefit from being able to show that schema affirmation has real-world consequences. If the effect of meaning threats is largely negligible and limited to artificial lab environments, then a by-product effect becomes more tenable. If, however, affirmation has an appreciable impact on real-world consequences, it is more difficult to claim that

fluid compensation is just a spandrel, as it likely has an impact on fitness and can thus be shaped by selection. Theorists in this area have argued that fluid compensation has a real impact on behavior, such as the increase of both flag sales and church attendance in the United States following the 9/11 terrorist attacks (Crowson, Debacker, & Thoma, 2006; Landau, et al., 2004). In a similar vein, recent analyses of voter behaviour reveals Canadian ridings experiencing a soldier death in Afghanistan were more likely to vote for the Conservative party (which was incumbent at the time) (Loewen & Rubenson, 2010). These behaviours may be the result of rational decision-making, but if it could be shown that meaning maintenance influences behavioural changes of this magnitude, it would suggest that the process is experiencing selection pressure on its outcome, not just its relationship to anxiety.

3.3 Conclusion

Results of three studies show that a subliminally perceived meaning threat can produce both implicit and explicit changes in behaviour, as well as changes in overall cognitive functioning. This work calls into question the core motive driving fluid compensation, specifically whether the self is a necessary part of that core. Future work should explore in more detail how much of this process is similar between threats and how much is unique to specific threats. Additionally, there is room to explore the actual neurological processes involved and stronger theoretical arguments for the selection pressures that have lead to meaning maintenance.

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Appendix A

Words in both conditions	Control cond. words	Meaning-threat words
Hot-lava	Quickly-running	Quickly-blueberry
Snow-man	Careful-sewing	Careful-sweater
Cheese-cake	Juicy-blueberry	Juicy-sewing
Round-table	Pink-sweater	Pink-running
Basket-ball	Car-dent	Car-throw
Belly-dance	Fighting-bravely	Fighting-dent
Tissue-box	Clean-dish	Clean-bravely
Play-list	Fast-throw	Fast-dish
Maple-leaf	Belly-dance	Belly-slowly
Tool-box	Ping-pong	Ping-dance
Young-puppy	Jumping-high	Jumping-pong
Park-bench	Crawling-slowly	Crawling-high
Down-hill	Metal-fork	Role-fork
Fork-lift	Magic-wand	Magic-softly
Bull-frog	Weeping-softly	Weeping-wand
Ping-pong	Role-playing	Metal-playing
Mad-cat	Bull-frog	Bull-left
Air-plane	Tool-box	Tool-politely
Power-chord	Turn-left	Turn-frog
Ham-burger	Smiling-politely	Smiling-box



The University of British Columbia
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CERTIFICATE OF APPROVAL - MINIMAL RISK

PRINCIPAL INVESTIGATOR: Steven J. Heine	INSTITUTION / DEPARTMENT: UBC/Arts/Psychology, Department of	UBC BREB NUMBER: H09-02437
INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:		
<small>Institution</small>	<small>Site</small>	
UBC Other locations where the research will be conducted: N/A	Vancouver (excludes UBC Hospital)	
CO-INVESTIGATOR(S): Jason Martens Daniel Randles		
SPONSORING AGENCIES: N/A		
PROJECT TITLE: Personality and Opinions		

CERTIFICATE EXPIRY DATE: September 29, 2010

DOCUMENTS INCLUDED IN THIS APPROVAL:	DATE APPROVED: September 29, 2009	
<small>Document Name</small>	<small>Version</small>	<small>Date</small>
Protocol:		
Proposal	N/A	September 1, 2009
Consent Forms:		
Consent Form	Version 1	September 1, 2009
Questionnaire, Questionnaire Cover Letter, Tests:		
Working Memory task	N/A	September 1, 2009
Personality questions	N/A	April 1, 2009
Implicit learning 2	N/A	September 1, 2009
Implicit learning 1	N/A	September 1, 2009
Scenario questions	N/A	September 1, 2009
Other Documents:		
Debriefing form	Version 1	September 1, 2009

The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

**Approval is issued on behalf of the Behavioural Research Ethics Board
and signed electronically by one of the following:**

 Dr. M. Judith Lynam, Chair
 Dr. Ken Craig, Chair
 Dr. Jim Rupert, Associate Chair
 Dr. Laurie Ford, Associate Chair
 Dr. Anita Ho, Associate Chair