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FlashReport

Turn-frogs and careful-sweaters: Non-conscious perception of incongruous word pairings provokes fluid compensation

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ABSTRACT

The meaning maintenance model (MMM) maintains that violations of expectations can elicit compensatory behavior. When anomalies are encountered, people may compensate either by affirming an intact schema or by abstracting new, meaningful connections. Past research has shown that implicitly perceived events can be threatening, and can cause changes to behavior that were not consciously intended. However, no research has yet explored whether fluid compensation responses can occur implicitly, in response to an implicit threat. This paper introduces a novel meaning threat and provides evidence that both threat and response can happen entirely outside conscious awareness. Two studies present participants with subliminally incoherent word pairs (e.g., turn-frog). Study 1 finds that these subliminal presentations enhance the ability to implicitly learn new patterns. Study 2 finds that these same presentations lead to the affirmation of an unrelated moral schema, and to the same extent as a subliminal mortality salience manipulation.

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A rapidly growing body of research, which has been termed the "threat-compensation literature" (Proulx & Heine, in press), is concerned with how people respond when they encounter conflicted beliefs. For example, cognitive dissonance theory has long investigated the responses of people to cognitive inconsistency (Festinger, 1957); terror management theory (e.g., Rosenblatt et al., 1989) explores how people come to terms with thoughts about their mortality; system-justification theory (e.g., John, Banaji, & Nosek, 2004) has documented how people react to thoughts regarding that the system is not just; self-affirmation theory (e.g., Sherman & Cohen, 2006) has explored how people contend with threats to their self-image; and uncertainty management theories (e.g., McGregor, Haji, Nash, & Teper, 2008) question how people behave in the face of uncertainty. Recently, the meaning maintenance model (MMM; Heine, Proulx, & Vohs, 2006) has proposed that the kinds of compensatory responses entailed within the various paradigms of the threat-compensation literature represent specific instantiations of a common threat response system.

The MMM maintains that people engage with the world through meaning frameworks — they are only able to understand events and themselves through mental representations of expected associations. Given people's dependence on these meaning frameworks, it is problematic when they encounter information that is incongruent or contradictory. When a violation of expectation is perceived, unconsciously experienced arousal signals the detection of an anomaly

(Proulx & Heine, 2008; Kay, Moscovitch, & Laurin, in press; Zanna & Cooper, 1974) and individuals are then motivated to regain a sense of meaning through a variety of strategies. When individuals are unwilling or unable to address the threat directly, they may *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 short story, they come to identify more with their culture (Proulx, Heine, & Vohs, 2010). On the other hand, if an alternative meaning framework is not readily available, people may *abstract* a novel meaning framework. For example, when individuals consider their contradictory behaviors they are better able to learn novel, unrelated patterns (Proulx & Heine, 2009).

The MMM has proposed that any violation of expectations is *sufficient* to motivate compensatory action, regardless of the specific type of threat. To date, empirical work on the MMM has focused on exposing the breadth of different threats that can produce convergent effects (e.g., Proulx & Heine, 2008, 2009; Proulx et al., 2010). This paper extends those findings by employing a prime that induces a minimal violation of expectations in the form of a subliminally-perceived semantic inconsistency. Further, this paper investigates the question of whether fluid compensation can both be sparked by a non-conscious threat and responded to by a non-conscious reaction.

People have semantic networks and syntactic rules for each word in their vocabulary, and these render the words meaningful. But what would happen if they encountered pairs of words that did not share any common nodes in their semantic networks, nor could be combined syntactically? For example, consider the word pairing

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"quickly-blueberry." There is no obvious way of creating a relation between these two words and they stand as incongruous. The experience of activating two conflicting semantic networks that cannot be integrated should prime a violation of expectation — what we term a meaning threat (although it is plausible that this kind of semantic violation could alternatively be termed dissonance or uncertainty). According to the MMM, such violations lead to compensatory responses. While previous research has demonstrated the ability of implicit meaning threats to evoke explicit compensation involving conscious judgments (e.g., setting bond for a prostitute; Proulx & Heine, 2008), the MMM also allows for meaning threats to evoke implicit compensation efforts that are not consciously accessible (e.g., enhanced implicit learning; Proulx & Heine, 2009). To date, no study in the threat-compensation literature has demonstrated implicit compensation efforts following from implicitly perceived meaning threats.

We report the results of two studies that explored the effects of such subliminal word presentations. In the first study, we assessed whether an implicit threat (viz., subliminally presented anomalous word pairings) would lead to an implicit compensatory response (viz., the abstraction of novel meaning frameworks), as past studies have found with unrelated, explicit meaning threats (e.g., Proulx & Heine, 2009; Whitson & Galinsky, 2008). In Study 2, we assessed whether the same presentations would also lead people to affirm alternative meaning frameworks, as has been found with other meaning threats (Proulx & Heine, 2008; Proulx et al., 2010; Rosenblatt et al., 1989).

Study 1

Participants

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

Procedure

Participants were seated in front of a laptop with a 15-inch screen and a 60 Hz refresh rate and completed the subliminal word task, followed by the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and the implicit learning task.

Subliminal word task

Participants were told that they would see a series of words 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 1000 ms, followed by the word for 356 ms, a 42 ms "gap" and finally a static block that remained until the participant selected a category. The sorting task and static block were used as forward and backward masks to hide the subliminal word primes, presented within the 42 ms gap. Participants 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., turn-left, bull-frog) in the meaningful words condition, and the same words recombined into incoherent and meaningless pairs in the meaningless words condition (e.g., turn-frog, bull-left; see Appendix A). This process was repeated for trials 31–60 with different words.

Implicit learning task

This measure was taken directly from Dienes and Scott (2005). Participants were given a sheet of 45 "Training" letter strings (e.g.,

Table 1

Pattern learning following subliminal word pair presentations.

	Meaningful words	Meaningless words
Absolute Success (H − F)	5.9[*]	7.5[*]
Accuracy (H/(H + F))	.68[*]	.74[*]
Motivation	21	18.7

Analyses were conducted on $\log_e$ transformed means.
[*] Conditions are significantly different at $p < .05$.

VTVTRVTM) and were instructed only to copy them verbatim. They were then given another sheet of 60 "Test" letter strings and were told that some of the test letter strings contained the same pattern that characterized the training letter strings. Participants were told to guess which test strings shared the same pattern as the training strings.

Results

As a manipulation check, participants were asked if they had seen one, two, or three words presented at a time during the sorting task,. Although over half the participants (53%) correctly identified that two words has been presented ($t_{(131)} = 4.7$, $p < .01$, compared against 33% for guessing), none of them were able to list any of the words presented. Given that many participants appeared to notice the prime, we tested if reaction times were different for trials with no prime, a coherent word pair or incoherent word pair. There were no differences (all $ps > .20$).

As is typical of meaning-threat studies, there were no significant differences in either positive or negative affect (both $ts < 1$) between conditions, as measured by the PANAS. This demonstrates that the conditions did not manipulate consciously accessible affect.

Participants' learning of the artificial grammar was measured by the three variables of Absolute Success, Accuracy, and Motivation. Absolute Success is a score representing one's success at detecting patterns. It was calculated by subtracting the number of false alarms from the number of hits. Accuracy divides hits by the number of total attempts (hits + false alarms) and measures the accuracy of the selected patterns, regardless of how many "test" strings they selected. Both of these are measures of learning, and have different tradeoffs associated with them (Wagner, 1993), and both are predicted to be higher following subliminal exposure to meaningless words. Motivation, operationalized as the total of all strings selected, was also expected to increase.

The means for each dependent variable are reported in Table 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 skew.[1] Participants in the meaningless words condition scored significantly higher on both 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 words condition, replicating the pattern found with explicit meaning threats (Proulx & Heine, 2009). That is, exposure to the subliminal meaningless word pairs led participants to learn new patterns better. Contrary to expectations, motivation, did not increase (Welch's $t < 1$). It is not clear why the meaningless words affected learning but not motivation.

We sought to replicate and extend these findings in Study 2. First, we wished to assess whether responses to the meaningless primes would be evident for an entirely different kind of compensation: affirmation of a committed moral belief. Second, we aimed to see whether our incoherent word primes were sufficient to yield similar

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[1] Results were re-analyzed using bootstrapping at 10,000 repetitions. The pattern of significance did not change, indicating that the results are robust to the violation of normality.

responses as mortality salience, to see whether effects following from different meaning threats are similar. Mortality salience has been construed as a meaning threat (for discussion see Proulx & Heine, 2006, in press) in that thoughts about one's impending death cannot be easily integrated into the daily thoughts of the typical undergraduate participant in terror management studies. It is noteworthy that typical mortality salience effects do not emerge with elderly people (e.g., Maxfield et al., 2007; Taubman-Ben-Ari & Findler, 2005) who arguably have integrated such thoughts into their worldviews. Third, because mortality salience effects tend to be more pronounced among undergraduates than other samples (Burke, Martens, & Faucher, 2010), we employed a community sample in Study 2 to increase the generalizability of our findings.

Study 2

Participants

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

Procedure

All adults were approached on the path beside the beach and offered refreshments for a ten-minute study. Participants completed the subliminal word task, the PANAS, and a social judgment survey, on the same laptops from Study 1.

Subliminal word task

The meaningful words and meaningless words conditions were identical to Study 1. In addition, we included a mortality salience condition, in which the word "death" was flashed subliminally (see Arndt, Greenberg, Pyszczynski, & Solomon, 1997).

Social judgment survey

Participants read a hypothetical arrest report about a prostitute and were asked to set the amount of the bail, between $0 and $999. This identical measure has been used in several meaning-threat studies (Proulx & Heine, 2008; Proulx et al., 2010; Rosenblatt et al., 1989). The rationale for expecting participants to increase the bond value following a threat, is that sex for money is both at odds with commonly held views of relationships in North American culture and is against the law. Thus, increasing the penalty provides an opportunity to affirm what most of our participants already believe: namely that prostitution is wrong.

Results

38% of participants identified the correct number of words presented, which is not different from chance ($p = .30$). As before, there were no differences in reaction time across conditions (all $ps > .30$), and 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 transformed as in Study 1.[2] A one-way ANOVA yielded a significant effect between conditions ($F_{(2,95)} = 8.86$, $p < .01$; see Fig. 1). Dunn–Bonferroni adjusted comparisons revealed significantly higher bonds for meaningless words than meaningful words ($p < .01$, $d = 1.05$) and for mortality salience than meaningful words
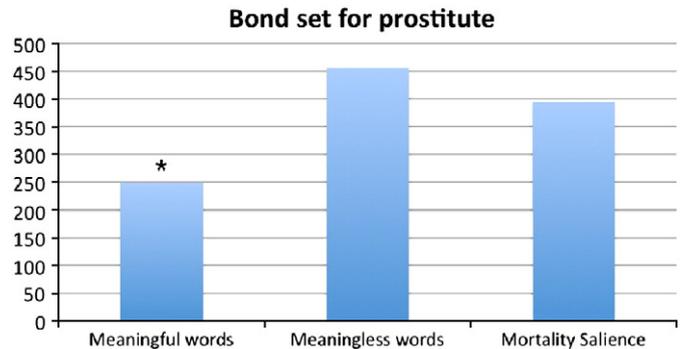

Fig. 1. Bonds set by different conditions. Analyses were conducted on log_e transformed means.

($p = .01$, $d = .61$). The mortality salience and meaningless words conditions did not differ from one another ($p > .15$).[3]

General discussion

Implicitly encountering a pair of incoherent words is sufficient to prompt people to implicitly abstract novel meaning frameworks, or explicitly affirm alternative ones. In Study 1, the meaningless words led to an increase in participants' implicit learning of novel patterns. These results largely correspond to those that follow from explicit meaning threats, such as self-unity threats (Proulx & Heine, 2009) and personal control threats (Whitson & Galinsky, 2008), although we unexpectedly failed to find increased motivation to detect patterns, as in the other studies. They also constitute the first example of an implicit threat eliciting implicit threat-compensation efforts. This demonstrates that conscious awareness is not necessary in the fluid compensation process. It is possible that people are implicitly noticing and fluidly compensating for meaning threats that they encounter in their day-to-day activities, without ever being aware that anything has transpired.

In Study 2, the utility of the subliminal word pairing threats was further demonstrated with a community sample (the first MMM study to include a non-student sample) and extended the effects to an unrelated compensation strategy: the affirmation of moral beliefs. Further, the effect of the incongruous word pairs was demonstrated to be commensurate with those obtained by a subliminal mortality salience prime (replicating past work; Proulx & Heine, 2008; Proulx et al., 2010), which raises the possibility that compensation efforts following from these two threats share a common mechanism. However, it is certainly possible that the two conditions yielded similar results for other reasons; to make a strong case that meaninglessness and mortality salience are similar threats it is necessary to identify an underlying common mechanism — something that has yet to be empirically demonstrated.

There is some concern whether the word primes could be termed fully subliminal for all participants, as people "guessed" better than chance regarding the number of words that were shown to them in Study 1 (no such effect emerged for Study 2). However, no one was able to report identifying the primes, and reaction times suggest that it did not have an effect on the explicit task, indicating that the content of the primes did not reach conscious awareness.

Finally, it is useful to note that this paradigm can be conducted with a simple computer script and without participants ever being aware that anything untoward has passed. This is a far more

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[2] Comparing our results with a non-parametric analysis reveals an inconsistent pattern of significance, indicating that the ANOVA was not robust to the untransformed distribution in our data set.

[3] This pattern of significance using log_e transformed values was consistent with bootstrapping at 10,000 repetitions.

manageable way to threaten meaning than the cumbersome kinds of meaning threats that have been used in past studies (e.g., a changing experimenter; Proulx & Heine, 2008; or exposures to absurd stories, but only when those stories are unexpected by the readers; Proulx et al., 2010). This new and straightforward method for threatening meaning should open the door for research on a number of important future questions regarding how people respond to meaning threats, such as neural correlates of meaning threats, the boundary conditions for meaning affirmation responses, and novel compensation processes yet to be identified.

Acknowledgments

Appendix A

Words in both conditions	Meaningful word pairs	Meaningless word pairs
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

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