Attentional and Affective Consequences of Safety Signals in the Presence and Absence of Threat
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ABSTRACT
Improved understanding of fear inhibition processes can inform the etiology and treatment of anxiety disorders. Safety signals can reduce fear to threat, but the mechanism for this reduction remains unclear; they may acquire attentional salience and affective properties (e.g., relief) independent of the threat. Alternatively, safety signals may remain motivationally neutral except when presented during simultaneous threat.

This study examined the fear-reducing effects of safety signals. Participants viewed a series of red and green words from two semantic categories: animals and body parts. Shocks were administered following red words (CUE+). No shocks followed green words (CUE-). Words from one category were defined as Safety Signals; no shocks were administered on CUE+ trials for these words. Words from the other, control category did not alter shock administration. Threat (CUE+ vs. CUE-) and SS (Safety vs. Control) were fully crossed. Startle response and ERPs were recorded.

Startle response was increased during CUE+ vs. CUE-. Safety signals reduced startle response during CUE-, but safety signals had no effect on startle response during CUE-. ERP analyses (P2, P3) suggested that participants parsed threat and safety signals information in parallel. These analyses did not indicate motivated attention associated with safety signals in the absence of threat. Overall, these results confirm that fear can be reduced by safety signals. Additionally, safety signals do not appear to hold any inherent hedonic salience independent of their effect during threat. Instead, safety signals appear to cue participants to engage in relatively effective top-down emotional regulatory processes.

METHOD
Participants: 32 participants (16 female) recruited from the undergraduate community

Cued Threat Task with Safety Signals
- Participants viewed animal and body part words displayed in either red or green ink
- Threat status was established via word color: RED words (CUE+) indicated shock threat; GREEN words (CUE-) indicated no shock threat.
- Safety Signals were indicated via semantic category; e.g., Animal words indicated participant was safe regardless of cue type (SS+), whereas body part words provided no signal of safety (SS-).
- Task: Determine ink color and respond via button press.

S1 750ms 1250ms 250ms 250ms
or
S2

RESULTS – ERP P2 and P3

- Significant main effects of CUE type were observed with increased P2 and P3 on CUE+ trials.
- Significant main effects of Safety Signal were observed with decreased P2 and P3 on SS+ trials.
- The CUE type X Safety Signal interaction was not significant.
- Clear threats (CUE+) attract attention regardless of Safety Signal presence. However, Safety Signals allow participants to disengage attention early in the processing stream.

RESULTS – Startle Response and Response Time

- CUE Type X Safety Signal interaction was significant.
- The simple effect of Safety Signal was significant during CUE+ but not CUE- trials.
- Safety signals inhibit fear during CUE+ trials but do not indicate hedonic value on CUE- trials.

CONCLUSIONS, CLINICAL IMPLICATIONS & FUTURE DIRECTIONS
- Participants can effectively use safety signals that are established by instruction to down-regulate their fear responses to threatening stimuli.
- Early in the processing stream, participants also use safety signals to adaptively disengage their attention in an otherwise ambivalently threatening environment.
- Safety signals do not appear to alter participants’ affective response independent of their modulatory effects during threat.
- These findings highlight the potential utility of treatments involving safety signals as a clinical tool for patients with otherwise poor emotion regulatory ability (e.g., anxiety disorders).
- Future research in this area should examine the effects of safety signals paired with aversive stimuli established via true conditioning (e.g., learning), the time course of affective response (via assessing startle response at earlier time points), and clinically-relevant individual differences.