When does a near-miss sting?

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Abstract

Near misses—missing a desired outcome by a small margin—are more emotionally intense than normal misses, even though the outcomes tend to be no different, and people readily accord near-miss effects when reasoning about others. Yet there are still open questions: what are the distance dimensions along which near misses are judged, and how do people incorporate near misses into more general affective cognition, or reasoning about emotion? In this paper we show that intuitive theories of emotion seem to weigh near-misses even for random events, and this is driven by the semblance of action-outcome contingency. Finally, we incorporate near misses into a more general model of affective cognition, and quantify the psychological cost of a near-miss relative to winning and losing.

Keywords: Near Miss; Counterfactual Distance; Lay Theories; Emotion

"Close only counts in horseshoes and hand grenades" – English Idiom

When Rob achieves a desired outcome, such as winning a soccer match, we intuitively know that he would feel positive. Conversely, when Rob loses, or otherwise fails to achieve an outcome, we can reason that he would feel negative. If he just fails to achieve the outcome by a small margin, a *near-miss*, such as losing a soccer game by a single goal, we intuitively recognize that he actually would feel worse than if he had missed by a larger margin, because the outcome was "so close". Penalty shootouts in soccer provides the most exaggerated of such near-miss scenarios: the losing team often loses because of one missed ball, sometimes an inch shy of escaping the goalkeeper's hands. These details add much more emotional intensity to all agents involved, more so than just a simple loss. Contrary to the above idiom, close counts—*emotionally*.

Such intuitive reasoning about emotions comprise what we call *affective cognition*, or reasoning about emotions and other affective states (some citations xxx, (Ong, Zaki, & Goodman, under review)). ...

Psychologists have long known that near-misses form an integral, but surprisingly not well understood part of affective cognition (Johnson, 1986; Gleicher et al., 1990). Most of this work falls under the broader category of counterfactual thinking (Byrne, 2002; McMullen & Markman, 2002; Medvec & Savitsky, 1997; Roese, 1997). Near-miss counterfactuals are particularly engaging to think about, because these possible worlds almost happened: they were separated from the current world by some small "distance". Consider Kahneman and Tversky (1982)'s classic example of Mr Tees, who missed his plane by 5 minutes, and Mr Crane, who missed his plane by 30 minutes. Both men were delayed due to traffic, but people consistently and reliably judge the person who narrowly missed his plane to feel much worse than the one who missed it by a wider margin. One proposed *causally-relevant* explanation for the near miss effect is that of controllability: Mr Tees could easily think of actions he could have done differently ("if only I woke up ten minutes earlier") that would have led to him catching the plane.

There however, remains many open questions, and we list just three of them here. First, what is the nature of these "counterfactual distances" — the distances that separate the desired-but-unattained counterfactual world from the current world. The answer most commonly proposed by the current literature asserts that people should consider causally-relevant dimensions, like the amount of time one misses a plane by. This would predict that people should not exhibit near miss effects in their lay theory when considering games of chance, or random events, as the causal process that generated the outcomes are based on chance. However, previous work has shown that gamblers persist more after near misses, showing a near-miss effect on motivation even though the outcome of games like slots are independent of the gambler's actions (Kassinove & Schare, 2001; Reid, 1986). In Experiment 1, we show that observers readily judge an agent who "narrowly misses" on a die game (by rolling a number close to the target number) to feel worse than one who misses by a larger amount, even though outcomes on a die game are not ordered like the number line. Observers seem to consider causally-irrelevant dimensions of distance as well, when a causally-relevant dimension does not exist.

Second, how do observers reason using these distance dimensions? Depending on the context, different dimensions of distance should matter to different extents. In Experiment 2, we show that observers are sensitive to information that changes the relevance of different distances in a random card-guessing task, and spontaneously alter their judgments during the task when presented with additional information. (to discuss with Noah more on this point. action-outcome contingency. also rewrite to reduce the "task demand" reaction that readers will have)

Finally, how much does a near-miss cost psychologically? That is, what is the size of the near miss effect relative to the utility of actually winning and losing? In Experiment 3, we build upon a previous model of affective cognition Ong et al. (under review) and explicitly incorporate modeling of near-miss effects into this quantitative model. This allows us to estimate relative effect sizes, and

(Only Experiment 2 is ready so far.).

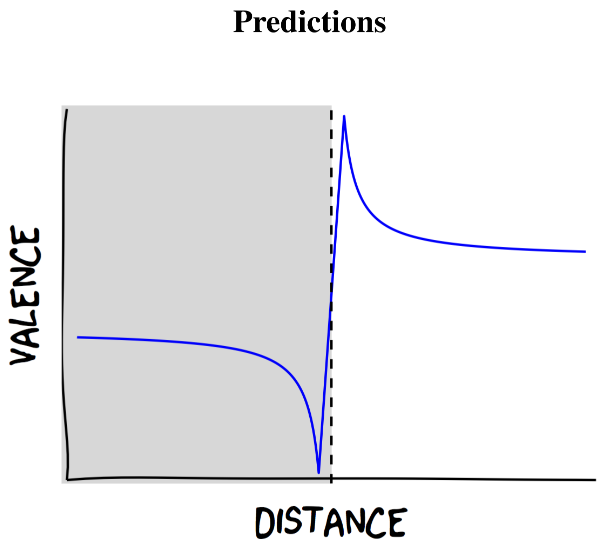

Figure 1: Prediction. A plot of emotional valence against "distance" to the counterfactual world, where the unshaded region represents the desired outcome, and the shaded region, the "miss" region. Near misses and near hits are predicted to be non-linear variations of valence at small distances to the miss-hit boundary.

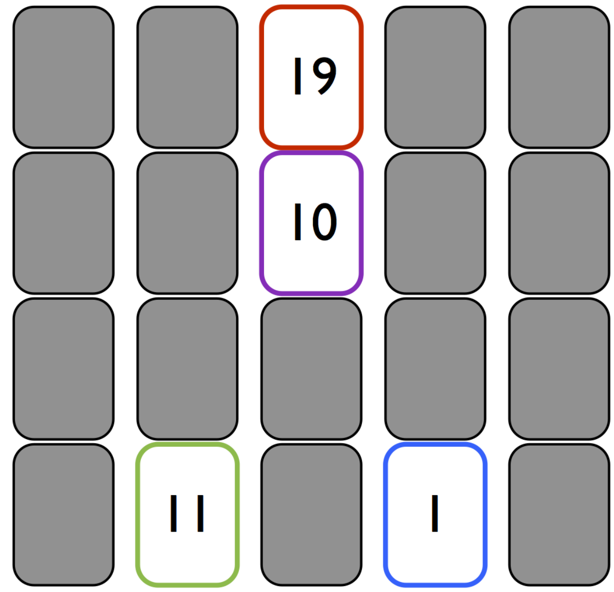

Figure 2: Expt 2 Paradigm. The target card, 10, is outlined in purple. 19 (red), is **Proximal**ly close, 11 (green) is **Numerical**ly close, while 1 (blue) is **Far** on both proximity and numerosity.

Experiment 2: Changing the relevant dimensions

We designed Experiment 2 to dissociate closeness effects along different dimensions. Using a card guessing task, we manipulated the task-relevance of both the positions of the cards or the numbers written on the cards, and showed that only near-miss effects along the task relevant-dimension are incorporated into observers' lay theory of emotion.

Participants. We recruited 300 participants through Amazon's Mechanical Turk, and assigned them to one of three conditions: Single-Trial-Position (N=100), Two-Trial-Position (N=100), Single-Trial-Number (N=100).

Procedures. In the Single-Trial-Position (ST-Pos) condition, participants saw a 5x4 array of cards face down. They were told that two characters were playing a game: the cards were numbered 1-20, and they had to pick the number 10 to win. After the characters picked their cards, the winning number 10 is revealed (see Fig. 2) There were three possible characters (of which participants only saw two): Scott, who picked 19 (proximally-close), Frank, who picked 11 (numerically-close), and David, who picked 1 (far). Participants rated the emotions of the two characters they saw, before answering a forced-choice question "Who felt worse?", with the option to say "Both felt equally bad." In total there are 3 possible pairings ("Proximal vs. Numerical", "Proximal vs. Far", and "Numerical vs. Far"), which are all between subject manipulations. Each participant only saw one trial.

The Two-Trial-Position (TT-Pos) condition was similar to the ST-Pos condition, except that after characters picked their cards but before the winning card is revealed, participants make one set of emotion attributions and one forced-choice on who felt worse. Following this, the winning number 10 is revealed, and then participants make another set of attributions.

In the Single-Trial-Number (ST-Num) condition, we changed the rules of the game. There were 19 blank cards, and a target card (circled in purple). Characters were assigned a blank card and had to guess what the number was behind the target card, writing their answers on their assigned blank card. Thus, in the Position conditions, the number of the goal was known (10) while the position was unknown, characters picked a position and were assigned a number (based on their choice); in this Number condition, the position of the goal was known, but the number was unknown, and characters were assigned a position and picked a number. Importantly, the visual description that participants saw is similar to the Position conditions. Thus, after characters wrote their guesses, the winning number behind the purple card is revealed (to be 10). Participants then attributed emotions to the two characters.

Predictions. We predicted that in the Single-Trial-Position condition, proximity would be judged to be a more relevant dimension of closeness than numerousity, and so the proximally-close character would be judged to feel worse than the numerically-close character, although the numerically-close character would, to a lesser extent, be judged to feel worse than the character who chose the numerically and proximally far card. In the Single-Trial-Number condition, on the other hand, proximity is irrelevant, and so we predicted that the numerically close character would be judged to feel the worst, and there would be no difference between the proximally close character and the far character.

The Two-Trial-Position condition has an interesting twist. Prior to finding out the position of the winning card, position is still a more relevant dimension than numerosity, but not knowing the position of the winning card makes it impossible to judge closeness based on proximal distance. Observers should judge based on numerosity. At this point, there would be no difference between the proximally close and the far characters, and we predicted that the numerically close character will be judged to feel the worse of them all (similar to ST-Num). However, after finding out the position of the winning card, proximal closeness becomes much more relevant, and we expect to see the proximally close character being judged the worst (similar to ST-Pos).

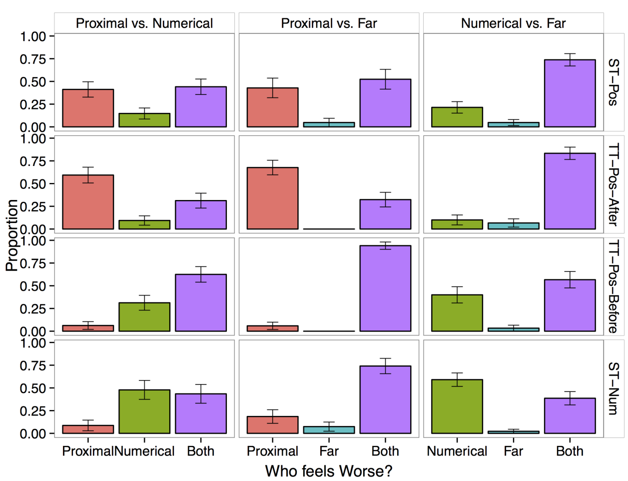

Figure 3: Expt 2 Results. Proportions of forced choice response. Note that the DV is "Who feels Worse?" Error bars indicate standard errors. Top row: Single-Trial-Position. 2nd row: Two-Trial-Position, after card is revealed. 3rd row: Two-Trial-Position, before card is revealed. Last row: Single-Trial-Number.

Results. Results for emotion attribution.

The results for the forced-choice ratings are in Fig. 3. In line with our predictions, we find that in the ST-Pos and TT-Pos (after the card was revealed) conditions, the proximally-close character was judged to feel the worst (TODO XXX STATS), and to a much smaller extent, the numerically-close character was judged to feel worse than the far character (TODO XXX STATS). In contrast, in the ST-Num and TT-Pos (before the card was revealed) conditions, the numerically close character is judged to feel worst (TODO XXX STATS).

Experiment 3

Experiment 3 involved a meta-analysis of three prior experiments that were designed to examine the features underlying affective cognition in a gambling paradigm.

Participants and procedures. 690 participants were recruited across 3 different experiments previously reported in Ong et al. (under review). The basic trial involves watching a character spin a wheel and win the amount on the wheel (Fig. 4). Participants then attributed emotions (*happy*, *sad*, *anger*, *surprise*, *disgust*, *fear*, *content* and *disappointment*) to the character after the outcome on the wheel, using 9 point Likert scales. Each participant saw 10 trials, and the payoff and probability structure of the wheels were varied systematically to decorrelate the amount won with the expected value of the wheel. The first experiment only had these basic wheel trials: the second and third had these basic wheel trials intermixed with emotion attribution trials given other stimuli (faces and utterances) instead of wheels. We extracted data from the subset of wheel trials from the second and third experiment, and the entire first experiment, to amass a dataset of 3048 observations from 690 participants to conduct a meta-analysis on.

These experiments were initially designed to test how different features of the situation, namely the amount won and the prediction error, affected participants' attribution of emotion to the character. Yet, because we randomized the position on which the spinner lands, these experiments incidentally provided a valuable dataset to test for a near-miss effect.

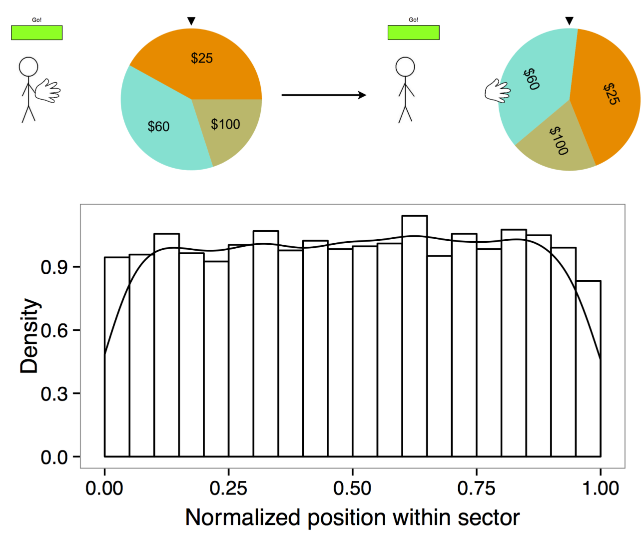

Figure 4: Top: Paradigm for the meta analysis reported in Expt 3. Participants attribute emotions to an agent after the outcome of a spin. After this spin, the agent won $60 (as indicated by the black pointer), but almost won a lower amount. Bottom: Histogram of the normalized position the wheel landed within the sector in the dataset.

Prior model. The model we built in Ong et al. (under review) incorporated three important factors, the amount won, the prediction error (PE), and the absolute value of the prediction error. That is, the emotion attributed to the agent after event X was:

$$E(X) = b_0 + b_1 \text{win}(X) + b_2 \text{PE}(X) + b_3 \text{absPE}(X) + \varepsilon \quad (1)$$

which was a linear combination of *win*, *PE* and *absPE*. The absolute value of the PE was added to test for nonlinear effects, namely, loss aversion, whereby agents will be more sensitive to negative PE values than to positive PE values. More discussion can be found in the paper, but this was the starting point for the following model.

Adding Near Miss to the model. Next, we proceeded to define a near miss distance. We started with the normalized ending position of where the spinner landed, which ranged from 0 to 1, with 0 indicating the boundary with the sector it would have landed in if the wheel spun less, and 1, the boundary with the sector it would have landed in if the wheel spun more (the wheels spun clockwise). We then calculated a "distance from the edge" which ranged from 0 to 0.5, with 0 being the boundary edge. We then took a reciprocal transform $(1/x)$ to introduce a non-linearity that favors smaller distances, and finally multiplied that with the difference in payment amounts from the current sector to the next nearer sector. This last component was to account for the difference in utility in the two payouts. Hence, we had:

$$NM(X) = \frac{1}{\text{distanceToEdge}(X)} * \Delta\text{Payoffs}(X) \quad (2)$$

which we added to the model in Eqn. 1.

Meta analysis results. Model: Happy win = 4.046032e-02, t = 7.0800461 PE = 3.574020e-02, t = 5.8587292 absPE = -1.488921e-02, t = -2.8340726 NM = -3.490640e-05, t = -2.7963737

Discussion

Acknowledgments

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