The Role of Affective Realism and Interoceptive Accuracy in Choice

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Summary We will assess the role of affect in constructing preference and influencing choice. Participants will report their preference for one of two landscape pictures while affective images are presented concurrently and suppressed from awareness. We predict that participants will tend to prefer the landscape paired with the more positive affective image, and we will explore whether this effect is moderated by individual differences in sensitivity to internal bodily sensations.
Keywords · affective realism · interoceptive accuracy · choice · continuous flash suppression
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Introduction Affect exerts a powerful influence on perception, and evidence suggests that it does not merely bias the *post-hoc* judgement of the stimulus, but is a key ingredient in constructing the actual perception of that stimulus in real time—a phenomenon known as affective realism (Siegel et al., 2018; Wormwood et al., 2018). To date, studies of affective realism have focused on the role of affect in shaping perceptions of individual stimuli. In the present study, we aim to investigate if affective realism also plays a role in constructing preference and influencing choice among competing alternatives. Specifically, we will ask participants to report their preference for one of two landscape pictures while affective images are presented concurrently and suppressed from reportable awareness.

Aims This study aims to assess the extent to which affective information presented suppressed from awareness is involved in preference construction and choice; and to explore whether individual differences in interoceptive accuracy can explain who is more/less likely to use affect cues to inform their preferences and choice.

Methods 150 participants will complete 180 trials of a landscape choice task. We will employ continuous flash suppression (CFS; Tsuchiya & Koch, 2005), in which flashing images are presented to one eye (and seen) while static, low contrast images are presented to the other eye (and suppressed from reportable awareness). We will use CFS to suppress images of affective faces from reportable awareness (see Fig. 1). On any given trial, one landscape will be presented with a more positive affective face than the other (smiling v. scowling, smiling v. neutral, or neutral v. scowling, depending on condition). We will ask participants to report their preference for one of two landscape pictures on a Likert scale, and we will use the responses to assess both preference (as a continuous outcome) and choice (as a dichotomized version of this scale). We will assess cardiac interoceptive accuracy via a Heartbeat Detection Task (modified Whitehead task; Whitehead et al., 1977).

Proposed Analysis & Predicted Results Data will be analyzed using general linear mixed models with trials nested within participants. Separate models will predict preference for and choice of the landscape image presented with the more positive suppressed stimulus on each trial. We predict that landscapes paired with the more positive suppressed stimulus will be preferred more and chosen more frequently. We will then assess whether the strength of the effect of incidental affective information on preference and choice is moderated by individual differences in participants' sensitivity to their heartbeats.

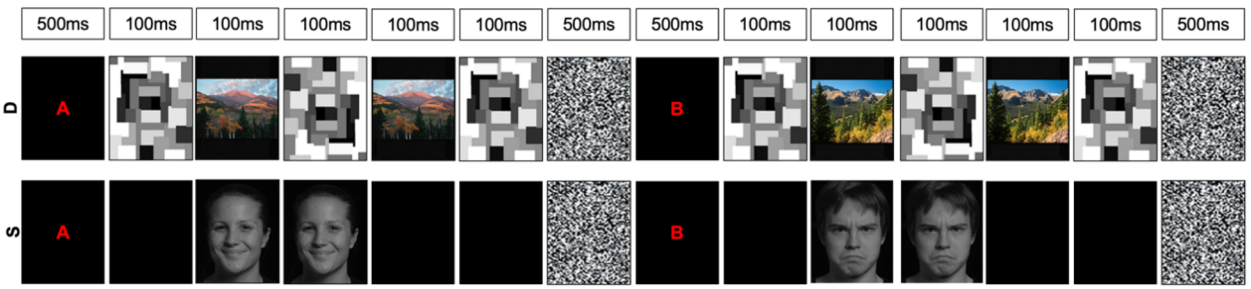

Figure 1: Trial structure. The top row in each panel (labeled D) represents images shown to the dominant eye, which are consciously perceived. The bottom row (labelled S) represents images shown to the non-dominant eye, which are suppressed from awareness.

We will also test if the extent to which participants integrate incidental affective information into their choices is influenced by their interoceptive accuracy (i.e., their objective accuracy in detecting internal bodily sensations; Garfinkel et al., 2015). Interoceptive sensations from the body are thought to be key ingredients in how the brain constructs perceptions of the world (Chanes & Barrett, 2016), and are associated with the subjective experience of affective feelings (see, e.g., Barrett & Bliss-Moreau, 2009). Thus, we anticipate that individuals who are more accurate (v. less accurate) at detecting signals from the body may utilize incidental affective information differently when constructing preferences and choosing between alternatives.

Conclusions By demonstrating the role of incidental affect in constructing preference and choice, as well as the moderating role of interoceptive accuracy in that relationship, we hope to generate novel evidence to inform theories of how perception and preference are constructed in the context of sensations from the body.

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Reverse engineering emotions during social interactions

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Summary Popular theories of emotion and decision-making argue that negatively arousing emotions—such as anger—motivate antisocial decisions such as punishing norm transgressors. Here we leverage a new methodology to precisely characterize the role of emotions across a variety of social interactions. Results reveal that rather than anger, emotional states such as disappointment, are more associated with decisions to punish across multiple contexts.

Keywords · Emotions · Punishment · Ultimatum Game · Classification · Machine Learning

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Introduction There is good evidence that negative arousing emotions—such as, anger—act as the proximate mechanism motivating antisocial decisions including punishment and defection (Pillutla & Murnighan, 1996). However, the long-standing challenge of precisely quantifying nebulous emotional experiences and the nature in which emotion is traditionally probed, leaves open the possibility that other emotions also shape social decisions. To examine the relationship between emotion and punishment, we combine machine learning algorithms with a measure of emotion that is agnostic to any one specific label or experience.

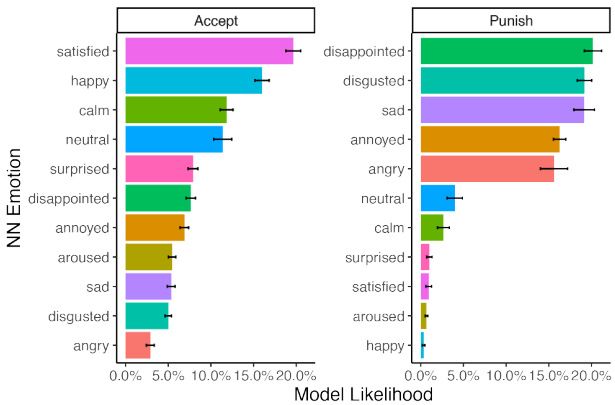

Figure 1: Neural network emotion classifications for accept and punish decisions. Emotion ratings in the UG were assigned a probability of each emotion class by a trained neural network. Error bars reflect 95% CIs.

Aims Compared to candidate emotions such as disappointment or sadness, we test the hypothesis that anger is the most common emotion associated with antisocial decisions.

Methods We embed a novel measurement of emotion (Heffner, Vives, & FeldmanHall, 2021) into the Ultimatum Game, Public Goods Game, and Prisoners' Dilemma (Experiments 1-3). Subjects self-report emotional experiences on a 500-500 pixel valence-arousal grid. Subjects (N = 1,491) report their emotional experiences after receiving offers from a Proposer before deciding to punish (UG) or defect (PGG and PD). Prior to playing in the economic games, subjects completed an emotion classification task in which they use the same emotion grid to classify 11 feeling terms (angry, surprised, happy, etc.; Fig. 1) selected from prior research. To infer an unbiased, subject-driven estimate of what emotion the person was likely feeling after unfair treatment, we train a neural network on this emotion classification data and apply a model to the unlabelled emotional experiences reported during the economic games.

Results Contrary to popular emotion-punishment theories, our results reveal that the top three most likely emotions that best predict decisions to punish and defect are disappointment, disgust, and sadness—in that order (Fig. 1). Anger was identified by the model as the 5th most likely emotion in the UG (significantly lower than sad, disgusted, and disappointed, all *ps* < .001), and the 8th most likely emotion in the PD and PGG. The top three emotions most likely to be associated with a decision to accept was satisfied, happy, and calm (Fig. 1).

Conclusions While prior research argues that feelings of anger play a predominate role in motivating antisocial choices, our data-driven, machine learning approach finds that disappointment is the primary emotion driving punishment and defection. Our results also suggest that emotions driving antisocial decisions are more varied than previously thought. The heterogeneity of the specific emotion labels associated with decisions suggest wide variability in the emotions experienced during an unfair economic exchange. Future research should examine the boundary conditions for when specific emotions, such as anger, are more representative of decisions to punish or defect.

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How incidental emotions bias economic decisions

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Summary Our aim was to establish a mapping between incidental emotional states (happiness and sadness) and sensitivity to costs (delay, risk, effort) involved in economic choices. Emotional states were induced using text vignettes paired with music extracts and validated by both subjective reports and physiological measures. Computational modelling of economic decisions showed that the valence of emotional states biased choices by increasing the willingness to accept additional costs in order to obtain higher rewards.

Keywords · incidental emotions · valence · decision-making · computational modelling · arousal

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Introduction The idea that emotions can influence our decisions is quite intuitive. An emotional state has a certain duration, allowing it to spill over to proximate decisions, even if they are unrelated to the emotional trigger. For example, momentary incidental happiness may enhance risk taking (Otto, Fleming, & Glimcher, 2016; Vinckier, Rigoux, Oudiette, & Pessiglione, 2018). However, the incidental impact of emotional states on economic decision-making has not been extensively documented.

Aims We systematically tested whether induced happiness or sadness, as compared to a neutral state, might bias economic choices involving trade-offs between monetary reward and 3 types of costs: delay until payment, risk of losing money, or physical effort to exert.

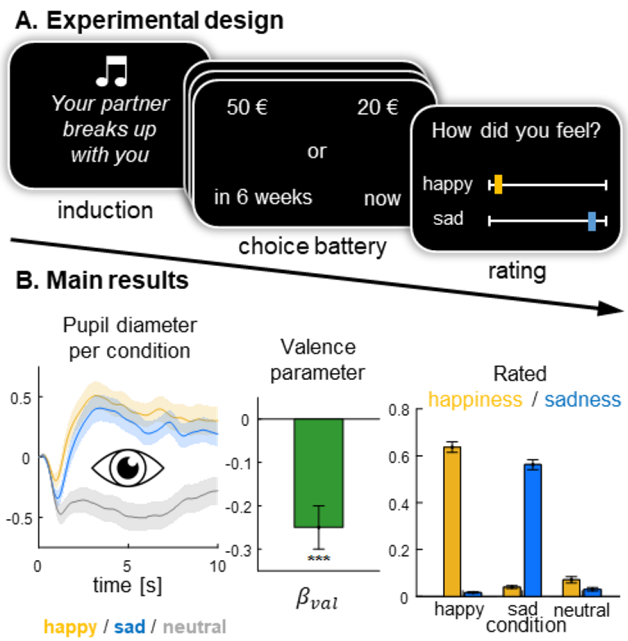

Figure 1: Experimental paradigm and main results.

Methods Participants (n = 94) viewed emotionally-laden text vignettes on a screen, combined with affectively targeted instrumental music for 10s prior to performing a short battery of choices (Fig. 1A). Choices featured economic discounting tasks, where subjects had to choose between a costly, high-reward option, or an uncostly, low-reward option. After the choices, participants rated their emotional state. All the while, we recorded facial EMG of the zygomaticus and corrugator muscles, and multiple physiological measures (pupil dilation, skin conductance, heart rate).

Choice behavior was modelled as a function of decision value *DV* (Eq. 1), which depends on the value difference between the uncostly and the costly option (V_U, V_C) and a bias term that is weighted by valence (Eq. 2). The valence dimension was defined as rated happiness minus rated sadness.

$$P_U = \frac{1}{1 + \exp(-DV)} \quad (1)$$

$$DV = \beta_0 + \beta_1(V_U - V_C) + \boldsymbol{\beta_{val}} Valence \quad (2)$$

Results Ratings (between 0 and 1) showed that participants indeed felt the targeted emotion in the happy or sad condition, and an absence of emotion in the neutral state (Fig. 1B, right). This result was further confirmed by the enhanced pupil dilation during induced emotional versus neutral states (Fig. 1B, left).

The valence-weighted choice bias, common in the model across the three types of economic choices, was significantly negative ($p = 1e\text{-}6$; Fig. 1B, middle), suggesting that it was favouring the costly option.

Conclusions Short emotional episodes can be induced in the lab and characterized by subjective report and physiological arousal. Their affective valence spills over to subsequent economic decisions, in such a manner that a positive emotional state biases us to accept additional costs to obtain higher rewards, while a negative emotional state biases us towards lower rewards that come at no cost. These incidental effects of emotions on choice may be adaptive, depending on the environment. But they may also turn into pathological behaviors, as seen in mood disorders.

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Regret and Relief About Brexit

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Summary This study explores people's Brexit-related regret and relief experiences. The results support a distinction between two types of relief; one experienced at the end of a period of uncertainty (temporal relief), and one experienced when a favourable outcome is obtained (counterfactual relief). The results also indicate that it is possible to experience regret and relief simultaneously.

Keywords · Relief · Regret · Brexit · Election·

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Introduction Recently, psychologists and philosophers have proposed a distinction between two types of relief (e.g., Sweeny & Vohs, 2012; Hoerl, 2015). *Counterfactual relief*, akin to the antithesis of regret, is experienced when one's current state is better than an alternative. *Temporal relief*, on the other hand, is experienced when an unpleasant episode is over. However, empirical evidence to support this distinction is sparse.

Aims We sought to explore whether people can feel relief about two distinct aspects of the same events; i. that a period of uncertainty is over (temporal relief), and ii. that the outcome was better than an alternative (counterfactual relief). We hypothesised that it is possible to feel temporal relief when an outcome has manifested after a period of uncertainty, even if the outcome itself is regrettable. We expected those who obtained a desirable outcome to feel both temporal and counterfactual relief.

Methods The day after Britain legally left the European Union, 347 EU referendum voters (66.6% Remainers, 33.3% Leavers) were asked to rate the extent to which they felt regretful, relieved, triumphant, excited, disappointed, and fearful about the fact that i) the current stage of Brexit was over, and ii) that the outcome was to leave the EU. Participants rated each of the six emotions using a 100-point visual analogue scale ranging from *Not at all* to *Extremely*.

Results Leavers felt more relief than Remainers about both the decision to leave the EU; $t(369) = 19.0$, $p < .001$, $d = 2.09$, $BF_{10} = 5.33e^{52}$, and the current stage of Brexit being over; $t(369) = 11.6$, $p < .001$, $d = 1.27$, $BF_{10} = 1.89e^{23}$. Conversely, Remainers felt more regret than Leavers about both the decision to leave the EU; $t(369) = 15.8$, $p < .001$, $d = 1.73$, $BF_{10} = 3.54e^{39}$ and the current stage of Brexit being over; $t(369) = 14.2$, $p < .001$, $d = 1.57$, $BF_{10} = 3.00e^{33}$. Unlike Leavers, a significant interaction between emotion and question was observed in Remainers, $F(1, 246) = 91.5$, $p < .001$, $\eta_p^2 = .27$. Paired samples *t*-tests indicated that Remainers felt much more relieved about the current stage of Brexit being over ($M = 35.9$), than they did about the decision to leave the EU ($M = 15.4$), $t(246) = 10.5$, $p < .001$, $d = .67$, $BF_{10} = 1.81e^{18}$. Finally, Remainers felt more regret than relief about both the current stage of Brexit being over and the decision to leave the EU, $t(246) = 10.9$, $p < .001$, $d = .69$, $BF_{10} = 5.52e^{19}$ and $t(246) = 20.1$, $p < .001$, $d = 1.28$, $BF_{10} = 2.59e^{50}$, respectively.

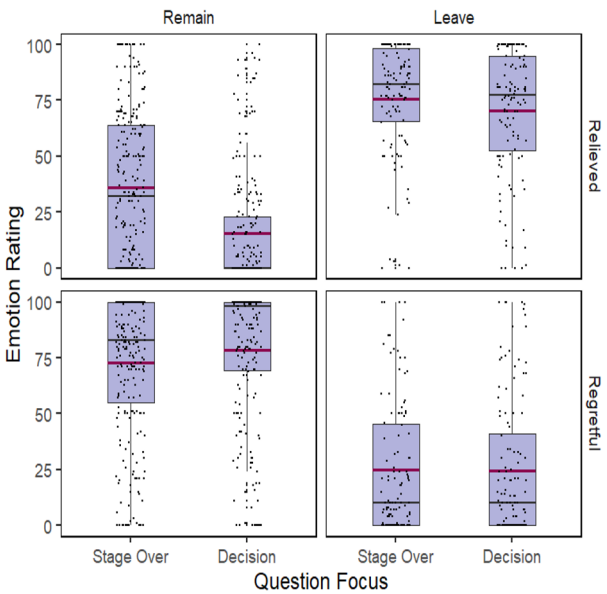

Figure 1. Distribution of individual emotion ratings by voter group and emotion. Red lines indicate mean.

Conclusions In addition to strong regret, 'Remainers' experienced little relief about the decision to leave, but stronger relief that a decision had been made. Results suggest that there are at least two different triggering conditions for relief. The results indicate a role for anticipated relief in voting behaviour.

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