Part XVII

Free Talk Session 10

BUKIMI NO TANI: THE EFFECTS OF REGULTORY FOCI ON RESPONSE THRESHOLD AND ITS EFFECTS ON COGNITIVE AND AFFECTIVE UNCERTAINTY

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Abstract

The uncanny valley (UCV) reflects a region along the perceptual continuum used to discriminate human and nonhuman objects and entities associated with uncertainty and negative affect. Recent studies have explored cognitive and affective components of UCV phenomenon. While cognitive uncertainty appears to be a function of categorical representations, stimulus training frequency appears to be the main determinant of affective uncertainty. Studies have also observed that discrimination performance can be changed by manipulating participants' regulatory foci. For instance, whereas promotion focus emphasizes gains (attain 95% accuracy), prevention focus emphasizes losses (avoid 5% errors). These studies have demonstrated that participants with a promotion focus outperform those with a prevention focus. In the current study, we manipulated stimulus training frequency along a continuum following promotion- or prevention-focus instructions. We found that the instructional manipulation altered participants' response threshold such that a promotion focus increased stimulus identification accuracy across the stimulus continuum.

Recently, researchers have begun to explore the possible bases for phenomena referred to as the Uncanny Valley, or bukimi no tani (UCV; Mori, 1970). Some researchers have suggested that there might be specialized cognitive mechanisms that are responsible for these effects (e.g., Macdorman, 2005). Alternative, general learning mechanisms (e.g., categorization; e.g., Cheetham, Suter, & Jancke, 2014) and frequency-based sensitization (e.g., Burliegh & Schoenherr, 2015) might offer a more parsimonious alternative.

The present study investigates whether knowledge of the internal structure of a category is related to affective responses associated with uncertainty and can instead offer a more general account of UCV. Specifically, we examine whether novel face-like category exemplars (i.e., extrapolation items) are associated with greater negative affect, supporting familiarity-based preference (Park et al., 2010). We additionally examined whether these effects were stimulus-specific or were instead the result of a shift in participants' response threshold. We explored this possibility by presenting participants with promotion or prevention processing instructions (e.g., Higgins, 1997) as previous studies have suggested that these instruction change a participants response threshold.

Perceptual Sensitization, Category Learning, and Uncertainty

Categorization research has focused on a number of different learning mechanisms and representations. A broad class of models assumes that individuals use the similarity of old and new exemplars to determine the category membership of novel items (for a review see, Goldstone et al., 2012). When presented with a novel stimulus, participants compare it to existing prototypes (averages), exemplars (instances), or category boundaries (decision criterion) stored in memory. Importantly, all of these models assume that the region between categories is associated with uncertainty due to the similarity of a stimulus with neighboring prototypes, exemplars, or category boundaries. However, participants likely maintain multiple representations (e.g., category boundary and exemplars). This assumption is supported by numerous studies (e.g., Pisoni & Tash, 1974; Paul et al., 2011) with subjective ratings of exemplar typicality (Miller & Volatis, 1989), certainty (Paul et al., 2011), or both (Schoenherr & Logan, 2013) revealing dissociable knowledge of category structure and category members.

Alternative models have examined factors that affect the inclusion of novel exemplars within an existing category. Drawing from the literature on Regulatory Focus Theory (RFT; Higgins, 1997) and loss and gain framing (Tversky & Kahneman, 1981), Novelty Categorization Theory (NCT; Förster et al., 2010) predicts that participants are more likely to include a new item in an old category when it is processed in the context of a promotion focus (i.e., emphasising accuracy) rather than a prevention focus (i.e., emphasising error avoidance) by changing the response threshold. For instance, participants should be more accurate when told to be correct (promote the inclusion of novel items) rather than to avoid errors (prevent the inclusion of novel items) due to general desire to explore novel features of our environment and tendency toward loss aversion, respectively. Moreover, as NCT suggests that processing focus affects the inclusion or exclusion of novel exemplars, it predicts item-specific effects rather than overall changes in preference and performance.

While NCT finds some empirical support (Gillebaart et al., 2012) there are several issues. First, in contrast to category learning paradigms wherein participants are presented with feedback to determine category membership, participants in Gillebaart et al. (2012) were presented with a single set of stimuli without feedback. While this does conform to a mere exposure paradigm (Bornstein, 1989), it only requires that participants encode individual exemplars (e.g., absolute identification) rather than acquire the relational structure of a category, thereby implicitly assuming participants acquire exemplar-based representations. Second, NCT does not distinguish between response uncertainty due to category membership and uncertainty associated with affect or preference. Yet there is evidence that individuals have access to both stimulus-based and category-based information (Miller & Volatis, 1989) and can retain multiple kinds of representations (Smith & Minda, 1999), which suggests that categorization and affective responses are determined by dissociable mechanisms (Burleigh & Schoenherr, 2015).

Categorization models can be used to understand and predict affective responses to stimuli. For instance, the ease with which a stimulus can be categorized predicts positive affect (Reber, Winkielman & Schwarz, 1998), and conversely that a lack of processing fluency predicts negative affect (Yamada, Kawabe & Ihaya, 2013). Negative affect might also occur when stimuli activate multiple, competing stimulus representations (e.g., Burleigh, Schoenherr, & Lacroix, 2013). Thus, stimuli located at the category boundary where there is the greatest uncertainty and categorization difficulty might be associated with more negative affect than more prototypical stimuli. Several recent studies have investigated this possibility, finding mixed results (Burleigh & Schoenherr, 2015; Cheetham, Suter & Jancke, 2015). Further examination is required to determine the relationship between cognitive and affective uncertainty responses.

Thus, in contrast to NCT, affective responses might reflect a different set of processes outside of categorization (Burleigh & Schoenherr, 2015). In addition to categorization processes, Burleigh and Schoenherr (2015) suggest that participants' affective responses are determined by stimulus frequency independently of category structure. While affective responses can become associated with categorical knowledge, during early stages of learning this can lead to dissociations. Thus, by manipulating participants' processing foci, we should observe a general increase in categorization performance when participants employ a promotion (vs. prevention) focus, as a result of observing the similarity between a novel item and the category representation stored in long-term memory. In contrast, early stages of processing that are dependent on frequency which determine affect should be unaffected by processing foci.

The present study examines whether basic category learning processes can account for the results of experiments examining UCV. We additionally sought to examine claims made by researchers that regulatory foci could alter the response threshold. However, in contrast to other studies (Gillebaart et al., 2012), we used a categorization paradigm. Participants were also required to rate exemplar eeriness (i.e., negative affect) and exemplar typicality.

Method

Participants. Participants were 116 undergraduate students ($M_{age} = 20.16$). They received 0.5% credit toward their final grade.

Stimuli. There were 15 creature stimuli, 7 for each creature category, and 1 at the boundary. Creatures were nonhuman entities with humanoid properties selected from a larger stimulus set used in a previous study (Figure 1; see also, Burleigh & Schoenherr, 2015).

Procedure. Participants first received an instructional manipulation. They were instructed to maintain a 95% level of accuracy (promotion focus) or to avoid making 5% errors (prevention focus). Following the instruction, they began the experimental phase, which consisted of 8 blocks of training, 2 transfer blocks, and 1 typicality rating task. Presentation frequencies for each three training set in training and transfer phases are presented in Table 1.

During training, participants were first presented with a screen with the word 'Ready?' After pressing the spacebar, a screen with a fixation point (+) was presented

Fig. 1. Sample stimuli from two graded categories used in the study.

Table 1. Stimulus presentation frequency for equal frequency distribution (EFD) and unequal frequency distributions (UFD) used in training and the equal frequency transfer blocks.

	Stimulus															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
EFD	0	0	4	4	4	4	4	0	4	4	4	4	4	0	0	40
UFD	0	0	8	6	4	2	0	0	0	2	4	6	8	0	0	40
Transfer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	30

for 500 ms. The fixation screen was replaced by a randomly selected stimulus for 750 ms. The stimulus was then replaced with a prompt that indicate the response keys ('C-species' (C) or 'M-Species' (M)), which remained on the screen until the participant selected a response. As previous studies (Burleigh & Schoenherr, 2015) revealed that participants quickly reached asymptote, participants received feedback on only 50% of the trials to increase presentation frequency while allowing for learning of the category structure (for a similar method in a categorization task, see Ziori & Dienes, 2008).

During transfer, participants did not receive any feedback. Participants categorized the stimulus (old items from training and new extrapolations or boundary-adjacent items), and then rated its eeriness on a scale of 1 "not at all" to 7 "extremely". After two transfer blocks, participants completed a final block wherein they rated stimulus typicality, on a scale of 1 (highly typical of the category) to 5 (highly atypical of the category). Typicality values were reverse coded for analyses. As we did not want to increase frequency of extrapolation items, thereby affecting eeriness ratings, all participants were presented with affective ratings first followed by typicality ratings.

Results and Discussion

Repeated measures analyses of variance (ANOVA) were conducted after collapsing across response key counter-balancing and category set (e.g., alien or reptile). Adjacent blocks were grouped together (e.g., Block 1 and 2). Analyses included between-subjects measures of Regulatory Focus (Promotion/ Prevention) and Training Frequency (Equal/ Unequal) as well as within-subjects measures of Training Phase (1-4) and stimulus (8). Analyses of transfer stimuli were also collapsed, but included the complete stimulus continuum (15).

Training Categorization Accuracy. With categorization performance, there was a significant main effect of Training Phase, $F(3, 336) = 48.87, MSE = .060, p < .001, \eta_p^2 = .030$, indicating that performance improved over the course of training. We also observed a significant effect of stimulus location, $F(7, 784) = 4.82, MSE = .066, p = .004, \eta_p^2 = .041$, replicating past findings that performance increased monotonically with distance from the category boundary.

Transfer Categorization Accuracy. While the effect of regulatory focus was absent in our analysis of training accuracy, we observed a main effect of regulatory focus in the analysis of transfer categorization accuracy, $F(14, 1302) = 6.93, MSE = .090, p < .001, \eta_p^2 = .70$. A main effect of stimulus was also obtained, $F(1, 93) = 212.48, MSE = .073, p = .010, \eta_p^2 = .069$. Figure 2 indicates transfer accuracy was lowest around the cat-

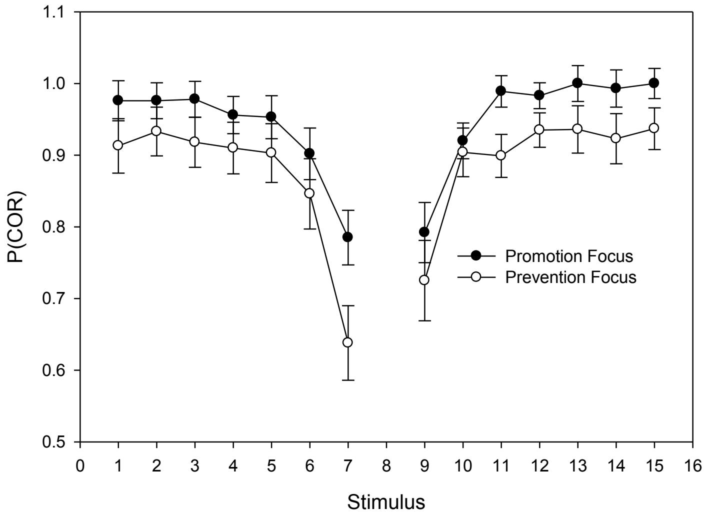

Fig. 2. Transfer block categorization accuracy in equal- and unequal-frequency conditions. Error bars represent standard error of the mean.

egory boundary but increased as a function of distance away from the category boundary. Contrary to NCT, performance in the promotion focus condition ($M = .88, SE = .017$) was generally higher than in the prevention focus condition ($M = .81, SE = .019$) with no stimulus-specific effects evidenced.

Affective and Typicality Ratings. Within affective ratings, there were significant main effects of Training Frequency, $F(1, 109) = 7.51, MSE = 20.51, p = .007, \eta_p^2 = .064$, and Stimulus Location, $F(14, 1526) = 4.26, MSE = 14.14, p = .024, \eta_p^2 = .038$. These findings are inconsistent with NCT. Figure 3 indicates that eeriness was highest for stimuli located at the extremes of the continuum, and did not increase for boundary-adjacent stimuli. Given the assumptions of NCT, differences in affect for stimuli near the boundary in the Unequal Frequency condition would be expected (cf. Burliegh & Schoenherr, 2015). Moreover, Regulatory Focus did not change affective ratings, $F(1, 109) = .153, p = .70$.

With typicality, there was only a significant effect of stimulus location, $F(14, 1484) = 7.13, MSE = 3.11, p < .001, \eta_p^2 = .063$. Figure 3 suggests that participants have knowledge of exemplars that define the category structure: exemplars located at the category boundary were rated least typical, and typicality increased with distance from the boundary. A correlational analaysis revealed that eeriness ratings were neither strongly correlated with accuracy ($r = -.034, p > .05$) nor with typicality ($r = .118, p > .05$), while typicality was negatively correlated with accuracy ($r = -.445, p < .01$).

Conclusions

The results of our experiment support the assertion that instructional manipulations can change regulatory foci and alter response accuracy by changing participant's response threshold. Specifically, we observed that participants performed better in the promotion focus condition (95% correct) relative to the prevention focus condition (avoidance of 5% errors). This suggests that the instructional manipulations changed their response

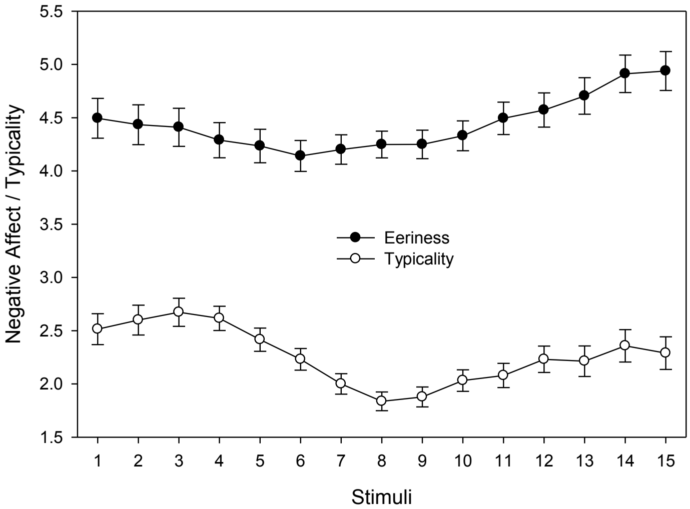

Fig. 3. Transfer block categorization accuracy in equal- and unequal-frequency conditions. Error bars represent standard error of the mean.

threshold. However, unlike the prediction of NCT, we did not observe item-specific effects. Namely, regulatory foci did not affect identification of individual exemplars or ratings of affect or typicality. However, exemplar training frequency altered affective responses, with the greatest negative affect observed for novel extrapolation stimuli. Importantly, these items were also assigned high typicality ratings and were responded to accurately. This suggests that affective ratings and categorical knowledge were dissociable. Consequently, while the Uncanny-Valley-like phenomena (bukimi no tani) appear to exist, general categorization mechanisms offer a more parsimonious explanation.

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THE EFFECT OF FACIAL ATTRACTIVENESS ON FACE PERCEPTION UNDER BINOCULAR RIVALRY

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In the present study, the effect of facial attractiveness on face perception under binocular rivalry was examined. Two male or two female faces, which had different attractiveness, were simultaneously presented on a display and fused by a mirror stereoscope. Ten female participants observed two male faces (male-face group) and the other ten females observed two female faces (female-face group). The participants kept pressing a key corresponding to each face while they were perceiving one of the two for ten seconds. Results showed that, in male-face condition, the more attractive faces were perceived much longer and dominant in perception rather than the less attractive faces. In female-face condition, the less attractive faces were perceived much longer and dominant in perception rather than the more attractive faces. These results suggest that facial attractiveness affects the face perception of the same and opposite sex.