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Authors
Khooshabeh, Peter
de Melo, Celso
Volkman, Brooks
et al.

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Negotiation Strategies with Incongruent Facial Expressions of Emotion Cause Cardiovascular Threat

Peter Khooshabeh (khooshabeh@ict.usc.edu) [1, 3]
Celso de Melo (demelo@usc.edu) [2]
Brooks Volkman (volkman@psych.ucsb.edu) [1]
Jonathan Gratch (gratch@ict.usc.edu) [3]
Jim Blascovich (blascovi@psych.ucsb.edu) [1]
Peter J. Carnevale (carnevale@usc.edu) [2]

[1]Department of Psychological and Brain Sciences, University of California, Santa Barbara, CA 93106 USA
[2]Marshall School of Business, University of Southern California, Los Angeles, CA 90089
[3]Institute for Creative Technologies, University of Southern California, Los Angeles, CA 90094

Abstract

Affect is important in motivated performance situations such as negotiation. Longstanding theories of emotion suggest that facial expressions provide enough information to perceive another person's internal affective state. Alternatively, the *contextual emotion* hypothesis posits that situational factors bias the perception of emotion in others' facial displays. This hypothesis predicts that individuals will have different perceptions of the same facial expression depending upon the context in which the expression is displayed. In this study, cardiovascular indexes of motivational states (i.e., challenge vs. threat) were recorded while players engaged in a multi-issue negotiation where the opposing negotiator (confederate) displayed emotional facial expressions (angry vs. happy); the confederate's negotiation strategy (cooperative vs. competitive) was factorially crossed with his facial expression. During the game, participants' eye fixations and cardiovascular responses, indexing task engagement and challenge/threat motivation, were recorded. Results indicated that participants playing confederates with incongruent facial expressions (e.g., cooperative strategy, angry face) exhibited a greater threat response, which arises due to increased uncertainty. Eye fixations also suggest that participants look at the face more in order to acquire information to reconcile their uncertainty in the incongruent condition. Taken together, these results suggest that context matters in the perception of emotion.

Keywords: facial expressions, negotiation, context in emotion

Introduction

Negotiation is relatively common in personal and professional settings. A child might ask a parent whether she can leave the dinner table. The parent might sternly command the child to finish her vegetables and the child could make a counter offer to finish the peas but not the broccoli. This could ensue into a strategic and emotionally charged social interaction.

Emotion is an important human factor in motivated performance situations (i.e., those that are self-relevant and therefore task engaging and require instrumental cognitive responses; Blascovich, 2008). Such interactions are rarely affectively neutral; that is, they are associated with interactants' positive or negative emotional states. Clearly, negotiations represent motivated performance situations to interested partners. And, experimental negotiation tasks are no exception, including those involving real human players (Van Kleef, De Dreu, & Manstead, 2004) and digital agents (i.e., player representations driven by computer algorithms, de Melo, Carnevale, & Gratch, 2011).

The current work examines individuals' motivational responses, using physiological indexes, to emotionally expressive virtual characters in a multi-issue negotiation task. Specifically, we focus on the question of how situational context affects emotion perception from facial expressions. In person-to-agent negotiation tasks, experimenters often insert communicative cues such as agent facial expressions intended to strategically manipulate user's emotions. Agents that show emotion have now been used in several domains such as education, entertainment, training, therapy and commerce (for a review see Beale & Creed, 2009). In a multi-issue negotiation task, de Melo and colleagues (2011) reported that participants made more concessions to a virtual human that displayed an angry facial expression compared to a happy facial expression.

Most research on the effects of virtual characters' emotional facial expressions has relied on subjective responses from participants (e.g., Beale & Creed, 2009). However, given the evidence that emotion is processed via non-conscious pathways, perhaps more so than conscious pathways (Tamietto & De Gelder, 2010), validated physiological measures related to affect should provide confirmation of the operation of non-conscious emotional processes involved in motivated performance tasks such as negotiation (Blascovich & Mendes, 2010).

Psychophysiological Measurement of Motivational States

Psychophysiological research is now a well-established technique to infer peoples' affective reactions to various situations (Blascovich, Vanman, Mendes, & Dickerson,

Figure 1: The angry (left) and happy (right) facial expressions displayed by the virtual confederate.

2011). However, a lot of research involving peripheral physiological markers has been based on unitary physiological responses such as heart rate variability (Rienerman-Jones, Cosenzo, & Nicholson, 2010) or electrodermal activity (Meehan, Insko, Whitton, & Brooks, 2002) mostly as indexes for workload and stress.

Motivational research suggests that relying on unitary indexes can mask important processes. For example, the physiological indexes specified by the bio-psychosocial model (BPS; Blascovich, 2008) of challenge and threat provide a much more informative index of task motivation. Briefly, the BPS model is based on the neuroendocrine underpinnings (i.e., Dienstbier, 1989) of cardiovascular responses involving the sympathetic-adrenal-medullary (SAM) axis as well as the hypothalamic pituitary-adrenal-cortical (HPA) axis.

Psychologically, challenge motivation occurs when an individual's consciously and unconsciously evaluated resources outweigh evaluated task demands. Threat occurs when resources are evaluated as not meeting task demands. Both states involve the activation of the SAM axis, while only the threat state involves both the axes.

Accordingly, activation of common SAM axis sympathetic neural and adrenal medullary endocrine processes affect cardiovascular responses underlying both challenge and threat including increased heart rate (HR) and increased ventricular contractility (VC; i.e., decreased pre-ejection period or "PEP"), and task engagement. However, cardiac output (CO) and total peripheral resistance (TPR) differ depending on motivational state. A challenge state results in decreased TPR and an increase in CO, whereas a threat state leads little or no change or a decrease in CO and little or no change or an increase in TPR (Blascovich & Mendes, 2010).

There is evidence that individuals' explicit responses in experimental tasks are not always congruent with underlying physiological markers (e.g., Blascovich, Mendes, Hunter, Lickel, & Kowai-Bell, 2001). By utilizing the physiological markers specified by the BPS model of challenge and threat, one can identify motivational responses to a stimulus that are not typically accessible to a participant during a motivated performance situation.

Theoretical Motivation and Research Questions

Previous work on cognition and emotion perception proposes that context matters when people decode others' emotions (Barrett, Mesquita, & Gendron, 2011; Lanzetta & Englis, 1989; Singer et al., 2006). In their review of the literature, Barrett and colleagues point out how the visual scene in a stimulus can give rise to different interpretations of an emotional state conveyed by a facial expression. A scowling face can convey anger or disgust depending on the body posture with which it is paired. Individuals' patterns of behavior can also serve as context cues that affect emotional processing.

Two similar individuals can give rise to different emotional responses in their interaction partners based on their behaviors and actions. For example, Singer and colleagues (2006) led participants to believe that confederate players in a Prisoner's Dilemma game were fair or not based on the confederates' game investment strategy. Experimenters then randomly cued participants that either the (fair/unfair) confederate or the participant herself would receive a painful shock. Participants exhibited more empathic neural activity (fronto-insular and anterior cingular cortex) when they observed a fair player receive a shock compared to the unfair player (Singer et al., 2006). This is compelling because the only difference between the individuals was the contextual information of their game playing strategy.

On the basis of this research (i.e., Barrett et al., 2011; Singer et al., 2006), we can infer that different contexts can shape the perception of emotion as well as give rise to different neurophysiological responses to facial expressions. In particular, it is possible that an experimental confederate that employs a fair strategy will be perceived differently as a function of whether the individual smiles or scowls. Similarly, a fair individual that smiles might be perceived differently compared to an unfair smiling individual. In this study, we utilized virtual humans as research confederates in order to manipulate their facial expressions and negotiation strategies while keeping other aspects of the interaction under experimental control.

The research question driving this work was: Do differences in virtual humans' emotional facial expressions coupled with their behavioral strategies in a negotiation task affect neuropsychological processes related to motivation and affect?

The *contextual emotion* hypothesis suggests that if the confederate's negotiation strategy affects perceptual process

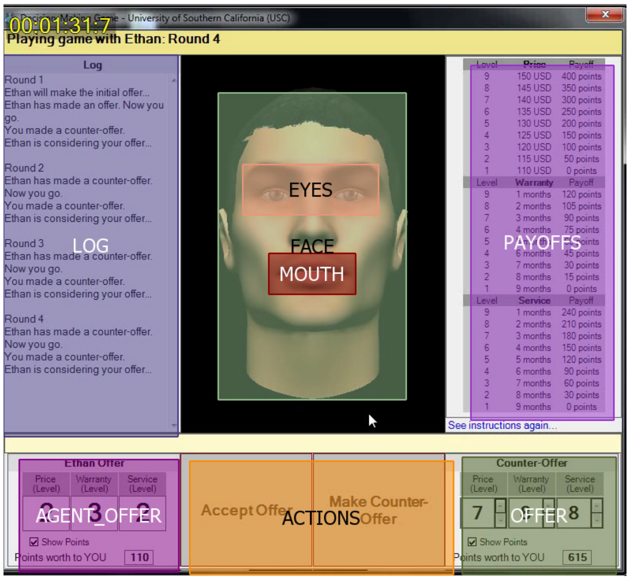

Figure 2: The multi issue bargaining negotiation task interface with areas of interest.

of facial expressions, then individuals will show different responses to the same facial expression depending on context. Specifically, individuals will have a different cardiovascular response to angry faces when paired with a tough strategy compared to angry faces paired with soft strategies.

Van Kleef and colleagues have argued that if partners in a social interaction lack information about the other's needs, desires, and goals, then emotional displays help people make sense of situations (Van Kleef, De Dreu, & Manstead, 2010). It follows then that people will tend to look more at emotionally significant facial features when there is uncertainty in social interactions. Therefore, with respect to the eye tracking measure, the *contextual emotion hypothesis* predicts that individuals will fixate more on diagnostic facial features when the confederate's negotiation strategy is incongruent with his facial expression.

An alternative hypothesis suggests that emotion perception is driven purely by the structural features of a face alone. This hypothesis predicts that individuals will show heightened threat responses to angry faces compared to happy faces—regardless of the confederate's strategy with which they are coupled—and there should be more eye fixations on threatening faces (Mogg, Garner, & Bradley, 2007; Tracy & Robins, 2008).

Method

Participants, Design, Materials, Apparatus

Eighty participants were recruited from university undergraduate psychology courses. Participants played a multi-issue bargaining task (Van Kleef, De Dreu, & Manstead, 2004). The task involves a scenario in which participants act as mobile phone sellers and have to negotiate over three issues: a price, length of service contract, and warranty duration with the virtual human (see Figure 2, Payoffs). Each issue had a level that denoted its worth to the participants. Given that the participant was the seller, she would get the most points by selling the mobile phones for the highest price ($150, level 9) in order to gain 400 points; the shortest warranty period (1 month, level 9) corresponding to 120 points; and the shortest service contract (1 month, level 9) corresponding to 240 points. Participant's maximum score was therefore 760 points.

The confederate was an intelligent agent that displayed emotional facial expressions to convey anger or happiness. The study employed a 2 X 2 fully-crossed factorial between-subjects experimental design. The two factors were the virtual human's emotional facial expression (happy or angry) crossed with his negotiation strategy (tough or soft). When the virtual human used a tough strategy (competitive), he made small concessions from his initial offer compared to the larger concessions he made using a soft (i.e., cooperative) strategy.

Both the soft and tough negotiating confederates made the initial offer to the participant, which was ***level 1*** of price ($110, zero points to the participant), ***level 2*** of warranty period (8 months, 15 points to the participant), and ***level 1*** of length of service contract (9 months, zero points to the participant). From this 1-2-1 initial offer by the confederate, the soft and tough agent followed different counter offer policies. In both cases, the confederate's offer was not contingent on the participant's counter offers (see Table 1).

Table 1: Progression of Soft and Tough Negotiation offers through the six round task

Round	Soft	Tough
2	1-2-3	1-2-2
3	1-4-3	1-3-2
4	3-4-3	2-3-2
5	3-4-5	2-3-3
6	5-4-5	3-3-3

While participants interacted with the virtual character during the negotiation game, various measures related to their cardiovascular states were recorded. Electrocardiographic (EKG) and impedance cardiographic (ZKG) signals were recorded continuously with a Biopac MP150 system, using a standard lead II electrode configuration (for EKG) and a tetrapolar aluminum-mylar tape electrode system (for ZKG); blood pressure was continuously recorded using an automated blood pressure device. The automated blood pressure recorded readings via a cuff placed around the participants' wrists and fingers of their non-dominant left hand. The EKG and ZKG signals were scored using an interactive software program that produces ensemble-averaged values for heart rate (HR), preejection period (PEP). Additionally, cardiac output (CO) was calculated from stroke volume (SV) recordings via impedance and heart rate; and total peripheral resistance (TPR) was calculated using impedance and blood pressure readings as a measure of vascular activity.

An SMI RED eye tracker was used with 60Hz sampling rate and a 17" flat screen monitor. The eye tracking camera was positioned to the monitor and as such was unobtrusive to the participants during the task.

Procedure

Participants completed a health screening questionnaire and informed consent was obtained prior to their participation. No one refused to participate. Female research assistants proceeded to apply the necessary sensors for physiological recording including impedance tape electrodes, EKG spot electrodes and blood pressure sensors. A five point calibration was used to ensure proper eye tracking measurement.

Next, the participant sat comfortably at rest for five minutes prior to receiving any task instructions. Finally, the participants were instructed to play 1 practice round to learn the user interface, during which the virtual human was not visible. Next, the criterion negotiation game commenced for 6 rounds. Afterwards, participants completed surveys that recorded their subjective and open-ended responses to the virtual human.

Results

Negotiation Task

Performance on the negotiation task was calculated based on how much the participants conceded to the virtual confederate over the six rounds. Each issue in the negotiation was summed at each round to compute a demand score. The best outcome for the participant would have been a demand score of 760 points. The final performance measure was the difference between the first and last round demand scores. If participants conceded more over the six rounds, this difference score would be higher. A univariate ANOVA with two factors (1. emotion: happy or angry; 2. strategy: tough or soft) showed no main effects or interactions (all *p*'s > 0.5, see Table 2 for means).

Table 2: Mean demand score difference from the first and last round (SD). A score of zero indicates no concession.

	Angry	Happy	
Soft	150.2 (223)	129.4 (217)	140.6 (217)
Tough	113.3 (155)	142.5 (193)	127.6 (173)
	131.8 (190)	136.3 (202)	133 (195)

Cardiovascular Physiological Indexes

We predicted that individuals interacting with the virtual confederate would exhibit task engagement, and that those interacting with an incongruent virtual confederate (e.g., soft strategy but angry face) would experience threat.

Task Engagement

According to the Biopsychosocial Model, task engagement is indexed by increases from baseline in sympathetically driven cardiovascular responses. As is common in this research, we calculated changes from baseline in preejection period (PEP), a purely sympathetically driven cardiovascular measure (Tomaka, Blascovich, Kelsey, & Leitten, 1993).

We established average baseline values of HR and PEP by averaging baseline minutes 4 and 5 for each of these measures. PEP decreased during the task (M = 133.3 ms, SD = 15.76) compared to the baseline (M = 135.8 ms, SD = 16.06), as predicted, two-tailed paired samples *t*-test, $t(78) = 3.31$, $p = .001$.

Challenge and Threat

Total Peripheral Resistance (TPR) scores were computed by subtracting TPR during baseline from TPR during the negotiation task. A univariate ANOVA did not show a main effect of either strategy or emotion (both F's < 1). There was also no interaction, $F(1, 62) = 1.47$, $p = .23$.

Cardiac output (CO) reactivity scores were computed by subtracting CO during baseline from CO during the negotiation task. A univariate ANOVA, controlling for baseline CO, with two factors showed no main effects of emotion or strategy (F's < 1). There was an interaction between emotion and strategy, $F(1, 76) = 8.34$, $p = 0.005$, $\eta_p^2 = .098$.

Using a Bonferroni adjustment, simple effects analyses revealed that participants in the soft strategy condition significantly differed from each other, $F(1, 77) = 5.34$, $p = 0.024$, $\eta_p^2 = .065$. Participants who interacted with the virtual confederate that displayed an angry facial expression while using a soft (more conceding) strategy had further reduced cardiac output compared to those participants in the soft-happy condition (see Figure 3).

Eye Tracking

BeGaze eye tracking analysis (SMI) software was used to construct areas of interest (AOI) on different components of the task interface as well as the virtual confederate's facial regions.

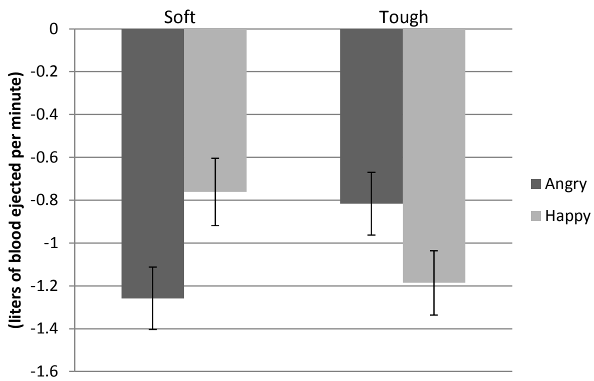

Figure 3: Cardiac output reactivity scores in the two virtual human strategy and facial expression conditions.

A multivariate ANOVA was conducted with the eight AOI (see Figure 2). The MANOVA showed a significant difference among the different AOI, $F(7, 504) = 77.06$, $p < 0.001$, $\eta_p^2 = .517$. As Figure 4 shows, participants fixated on the offer section of the game interface the longest percentage of time throughout the task. However, the results suggest people also spend considerable time looking at the face. In fact, the percentage of time fixated on the total face—aggregate of eyes, mouth, and remainder of the face—did not differ from the time fixated on the offer, $t(72) = .54$, $p = .6$.

Mouth AOI

The main differentiating facial feature for the angry and happy expressions was the mouth area. Past work indicates

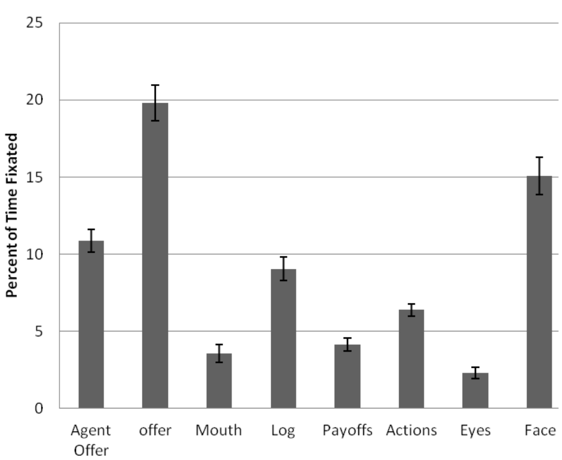

Figure 4: Percentage of time during the whole negotiation fixated on different areas of interest.

that individuals from samples similar to ours tend to fixate more on the mouth region (Blais, Jack, Scheepers, Fiset, & Caldara, 2008; Jack, Blais, Scheepers, Schyns, & Caldara, 2009). Thus, we conducted an ANOVA with the two factors

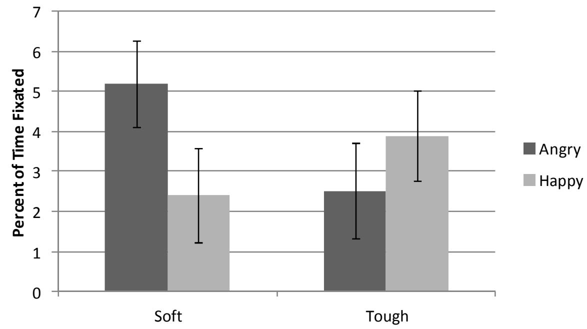

Figure 5: Percentage of time on the mouth as a function of the confederate's emotion and strategy.

of strategy and emotion on the percentage of time fixated on the mouth AOI.

There was no main effect of strategy or emotion, F's < 1. There was a marginal interaction of strategy and emotion, $F(1, 68) = 3.281$, $p = .074$, $\eta_p^2 = .046$. As Figure 5 shows, participants in the soft-angry condition tended to fixate the mouth for a longer time compared to participants in the soft-happy condition.

Discussion

Virtual human confederates in a negotiation game caused a threat motivational response (reduced cardiac output) when their facial expressions were not congruent with their strategies. Specifically, participants had lower cardiac output when the virtual human negotiated using a soft strategy but displayed an angry facial expression. Additionally, despite not reaching significance, similar effects occurred when participants engaged with a tough agent that showed happy facial expressions. This incongruence could cause more uncertainty, which is related to increases in task demands (Tomaka et al., 1993).

Eye tracking results provide converging evidence. Participants in the incongruent strategy and emotion condition (e.g., soft-angry) tended to fixate on the most diagnostic facial region longer compared to participants in the congruent condition (e.g., soft-happy). This result suggests that participants tended to fixate longer at the mouth in order to try to gain potential cues to reconcile their uncertainty from the conflicting strategy and emotion coupling.

These results are compatible with the suggestion that people look at others' facial expressions in an attempt to reduce inherent uncertainty that occurs in social decision making situations with counterparts that might have different priorities and objectives (Van Kleef et al., 2010). Our results show specific psychophysiological evidence for this process, especially when there is an incongruence between the counterpart's strategy and the facial displays.

These results are also in line with other research which suggests that context matters when people decode others' emotions (Barrett et al., 2011; Lanzetta & Englis, 1989; Singer et al., 2006; Szczurek, Monin, & Gross, 2012). An identical angry facial expression gave rise to different motivational states depending on the strategic context in which it was displayed during the negotiation task.

Finally, the results can have practical implications for the design of human-computer interaction systems. This work suggests that cardiovascular measures are sensitive at detecting incongruence and uncertainty in human users and suggests that affecting the context in which emotions are shown (for instance, in virtual humans) can lead to concomitant changes to the user's challenge/threat motivational state.

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