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# Perceiving emotions: Cueing social categorization processes and attentional control through facial expressions

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Individuals spontaneously categorise other people on the basis of their gender, ethnicity and age. But what about the emotions they express? In two studies we tested the hypothesis that facial expressions are similar to other social categories in that they can function as contextual cues to control attention. In Experiment 1 we associated expressions of anger and happiness with specific proportions of congruent/incongruent flanker trials. We also created consistent and inconsistent category members within each of these two general contexts. The results demonstrated that participants exhibited a larger congruency effect when presented with faces in the emotional group associated with a high proportion of congruent trials. Notably, this effect transferred to inconsistent members of the group. In Experiment 2 we replicated the effects with faces depicting true and false smiles. Together these findings provide consistent evidence that individuals spontaneously utilise emotions to categorise others and that such categories determine the allocation of attentional control.

*Keywords:* Categorization; Attentional control; Emotion; Social-context-specific proportion congruency effect.

Emotional expressions of others play an important role in people's everyday situations, especially in social interactions (Nachson, 1995). Facial expressions communicate information about the individual and the environment that elicits rapid responses in the observer (Niedenthal & Brauer, 2012). Such responses include inferences about the state of mind of the individual who expresses the emotion and changes in the observer's own behaviour to deal with the situation (Adams, Ambady, Macrae, & Kleck, 2006; Anderson & Thompson, 2004; Hareli & Hess, 2012; Keltner & Kring, 1998; Marsh, Kozak, & Ambady, 2007) Although social psychologists have explored the types of

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information conveyed by facial expressions, less is known about whether and how facial expressions serve to regulate cognitive processing in observers. The present set of experiments was designed to explore whether facial expressions of emotion can cue attentional control similarly to classic social categories such as gender (Fiske & Neuberg, 1990).

## ATTENTIONAL CONTROL AND SOCIAL CATEGORIES

Attentional control can be assessed by the extent to which it moderates performance on interference tasks. In a standard flanker task, for example, the speed with which individuals process a central target is affected by the congruence between the target and surrounding distractors (Eriksen & Eriksen, 1974). Responses indicative of the direction of a target arrow are faster when surrounding arrows point in the same (i.e., congruent) direction compared to the opposite (i.e., incongruent) direction. This is known as the congruency effect (e.g., Stroop, 1935). However, the automatic interference caused by incongruent stimulus displays is modulated by the proportion of incongruent trials presented in the task. Specifically, the congruency effect is attenuated when proportionally more trials contain incongruent stimuli, suggesting that distractor processing is the greatest when the likelihood of congruent trials is high (Gratton, Coles, & Donchin, 1992; Lowe & Mitterer, 1982). This effect is known as the proportion congruency effect (Logan & Zbrodoff, 1979).

In order to address the possibility that awareness of the contingencies is the primary mechanism for attentional control cueing, researchers have examined the impact of stimuli (item-specific control; (Jacoby, Lindsay, & Hessels, 2003) and contexts (context-specific control; (Crump, Gong, & Milliken, 2006) on this effect. Findings from such studies suggest that manipulation of the proportion of congruent trials leads to the development of specific implicit expectancies about the need for control in subsequent trials (Braver, Gray, & Burgess, 2007). However, if the overall proportion of congruency associated with a specific task stimulus is uninformative (i.e., 50% congruent and 50% incongruent), no expectancy is observed.

The role of categorical knowledge in attentional control has been suggested by studies showing that the proportion congruency effect transfers to previously unseen, but categorically related items. Bugg, Jacoby, and Chanani (2011) used a Stroop picture-word task in which participants were instructed to name the word aloud. Four animal words (i.e., bird, cat, dog and fish) and their corresponding pictures were paired and associated with either a high or low proportion of congruency. For example, pictures related to birds and cats were paired with a high proportion of congruent trials (75%), whereas pictures related to dogs and fish were paired with a low proportion of congruent trials (25%). The two sets of stimuli (pictures and words) were allowed to overlap. In an additional block, in which the proportion of congruency was neutral (50%), the same words were paired with pictures of new exemplars from the same (trained) animal categories. Results replicated previous findings by showing a larger congruency effect for items associated with a high than with a low proportion of congruent trials (Crump & Milliken, 2009). This effect occurred not only with the previously presented pictures but also with novel stimuli for which congruency was neutral. These findings indicate that category knowledge allocates attentional control in a flexible and automatic way independently of task demands.

Although categorization processes occur in a range of contexts in which individuals have high levels of perceptual expertise, categorization of social stimuli is ubiquitous (Brewer, 1988; Cuddy, Fiske, & Glick, 2004; Kawakami, Dion, & Dovidio, 1998; Nelson, 2005). Human faces in particular are important cues for attentional control because they provide valuable information about potential interaction partners (Johnson & Morton, 1991). For example, in two separate experiments using a modified flanker task, we demonstrated that participants spontaneously use the gender of faces as a context to flexibly control attention (Canadas, Rodriguez-Bailon, Milliken, & Lupianez, 2013). Specifically, participants in these studies were presented with an image of a face and a stimulus array consisting of five arrows above or below the face on each trial. The faces served as the context for the stimulus arrays. In the congruent conditions, all five arrows pointed in the same direction. In the incongruent conditions, the central arrow and the four flanking distractors pointed in opposite directions. Participants were instructed to respond as quickly and accurately as possible to the direction of the central arrow by pressing the appropriate key. Critically, a given context (e.g., male faces) was associated with a high proportion of congruent trials, whereas the other context (e.g., female faces) was associated with a low proportion of congruent trials. As expected, reduced interference effects were found when the arrows appeared in a context (i.e., male or female faces) associated with a low proportion of congruent stimulus arrays, indicating that the social category cued the increased allocation of control in this context (Crump, et al., 2006).

The consistency of faces within the group was also manipulated in these studies. In particular, one face in each category was associated with the same proportion of congruency as the alternative category. For instance, a single female face was paired with the proportion of congruency associated with male faces or a single male face was paired with the proportion of congruency associated with female faces. Furthermore, in one of the experiments we included an additional block of trials in which novel faces of men and women were paired with an unbiased proportion of congruency (50%). The results provided evidence that the proportion congruency effects related to 'consistent category faces' transferred to both the inconsistent category faces (i.e., the male face associated with the proportion of congruency of the female faces and the female face associated with the proportion of congruency of the male faces) and the unbiased novel faces. These transfer effects indicate that participants deployed more attentional control when presented with faces from the category associated with a low proportion versus high proportion of congruent trials regardless of the proportion of congruency associated with a specific face.

Moreover, subsequent research indicates that participants' motivation to pay attention to individual vs. category-related features of faces (Canadas et al., 2013), expertise (Tanaka, 2001; Tanaka & Taylor, 1991) and familiarity (Canadas, Lupiañez, Niedenthal, Rychlowska, & Rodríguez-Bailón, in preparation) can moderate the extent to which social categories or individual faces influence the allocation of attentional control. Together these results suggest that although general categorization processes underlie person perception, such processes can be influenced by perceiver-related factors (Fiske & Neuberg, 1990; Hugenberg, Young, Bernstein, & Sacco, 2010).

## The present research

The primary goal of the present research was to explore whether other social information conveyed by human faces also serves as contextual cues for attentional control. While previous research has demonstrated that immediately evident visual cues related to socially relevant groups such as race/ethnicity, gender and age spontaneously cue categorization processes (Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000) and serve as signals for attentional control (Canadas et al., 2013), we investigated whether emotional cues function in the same way. In particular, in two experiments we examined the impact of emotional facial expressions on attentional control.

Recent theorising suggests that emotional expressions are crucial for social interactions because they facilitate and promote communication between peers and signal appropriate behaviour (Harmon-Jones & Sigelman, 2001; Van Kleef, 2009). These theorists propose that because emotional expressions are perceived to be informative in social situations, people rapidly perceive and use them in order to understand and react to others. Just like social categories such as Blacks and Whites can trigger approach and avoidance orientations (Kawakami, Phills, Steele, & Dovidio, 2007; Phills, Kawakami, Tabi, Nadolny, & Inzlicht, 2011), emotional expressions can determine such immediate responses (Harmon-Jones & Sigelman, 2001). Notably, while the majority of research investigating categorical processing by social psychologists has been related to relatively stable characteristics such as race/ethnicity, gender, socio-economic status and age, emotions may to some extent be assumed to be more context-dependent and variable. Even though these visible cues may be perceived to be less predictive of underlying personality traits, because of their importance in person perception (Hareli & Hess, 2012), they have the potential to spontaneously prompt categorical processing. In the present research we investigated whether facial expression related to anger, happiness and true and false smiles serve as cues of attentional control and result in categorical responding to even inconsistent members.

Specifically, in this research we associated facial expressions of emotion with a particular proportion of congruency in flanker task stimulus arrays. In Experiment 1, we examined whether two distinct emotions with opposing valence served as contexts for the allocation of attentional control and produce a proportion congruency effect similar to the one associated with more stable social categories such as gender. In Experiment 2, we investigated whether the proportion congruency effect occurs when subtle differences in affective expressions are used as context. Specifically, in Experiment 1 we examined responses to happy versus angry faces and in Experiment 2 we examined responses to Duchenne versus non-Duchenne smiles. Although these latter emotions related to true and false smiles have overlapping and disparate structural features (Ekman & Friesen, 1982; Frank, Ekman, & Friesen, 1993), research has demonstrated that people are adept at identifying and differentiating between these smiles (Ambadar, Cohn, & Reed, 2009; Hess & Kleck, 1994; Krumhuber, Manstead, Cosker, Marshall, & Rosin, 2009; Maringer, Krumhuber, Fischer, & Niedenthal, 2011; Miles & Johnston, 2007) probably because of the divergent social meaning associated with them (Niedenthal, Mermillod, Maringer, & Hess, 2010).

We predicted that both displays of distinct emotions (happy vs. angry) and of more subtle differences in emotions (true vs. false smiles) would cue social categorization processes and thereby determine the allocation of attentional resources. Specifically, for both studies, we predicted higher congruency effects for emotional expressions associated with a high proportion of congruency than for expressions associated with a low proportion of congruency. We also expected to find similar congruency effects for all faces expressing the same emotion regardless of whether a particular face was consistent or inconsistent with the congruency proportion for that emotion. Specifically, we hypothesised that participants' responses would be determined by the congruency proportions associated with the emotional categories (i.e., happy vs. angry or true vs. false smiles) rather than by congruency proportions associated with the face identity. Together the results from Experiments 1 and 2 have the potential to provide novel support for the spontaneous categorization of faces by emotion impacting on the allocation of attentional control.

## EXPERIMENT 1

In Experiment 1 we associated different emotional contexts (i.e., happy vs. angry faces) with different proportions of congruent trials in a flanker task. For half of the participants, angry faces were associated with a high proportion of congruent trials and happy faces were associated with a low proportion of congruent trials. For the other half of the participants, these proportions were reversed. We expected that, for both facial expressions, the congruency effect (i.e., the difference in reaction times for incongruent minus congruent faces) would be higher for the emotional context associated with a high than low proportion of congruent trials. In addition, we created consistent and inconsistent category members within each of these two contexts. Specifically, consistent category members were made up of three face identities related to one emotional expression (e.g., angry) and associated with the same proportion of congruent trials (e.g., high). Inconsistent category members, alternatively, was a single face identity related to the same emotional expression (e.g., angry), but associated with the proportion of congruency (e.g., low) that was typical of the opposing emotional category (e.g., happy). In our first experiment, we used angry and happy expressions for several reasons. First, the expression of happiness and anger involve the contraction of different facial muscles (Ekman, Friesen, & Hager, 2002). Second, these emotions also differ in valence. Evidence suggests that different brain regions are involved in processing individual emotions and/or facial expressions with different valences. Finally, analyses of self-reports have confirmed that such emotions are negatively correlated (e.g., Bonanno & Keltner, 2004; Ekman, Friesen, & Ancoli, 1980) and generate contradictory impressions (Willis & Todorov, 2006). Happiness and anger expressions are thus associated with two very distinct emotional states and underlying neural bases and therefore are expected to trigger categorical processing of social stimuli and serve as contexts for the allocation of attentional control. Importantly, we expected the difference in the congruency index between the high vs. low proportion congruent trials to be significant in the same direction for both consistent and inconsistent members, providing further evidence for the use of emotional stimuli as spontaneous social categories.

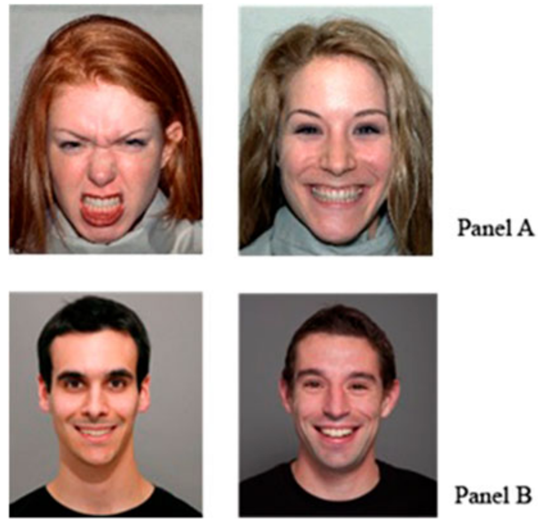


**Figure 1.** *Panel A are examples of angry (left) and happy (right) facial stimuli used in Experiment 1. Panel B are examples of false smile (left) and true smile (right) stimuli used in Experiment 2. Reproduced with permission.*

## Method

### *Participants*

Thirty-six undergraduate students (six males) at a Canadian university ($M$ = 22.9 years) participated in the experiment for course credit. All participants were naïve to the purpose of the study.

### *Procedure*

Stimulus presentation, timing and data collection were controlled using the E-prime 2.0 software package, run on a standard Pentium 4 PC. Stimuli were presented on a 17″ computer screen and consisted of 16 different photographs of women from the NimStim Set of Facial Expressions (http://www.macbrain.org/resources.htm). The faces of eight different models each portrayed a happy and angry expression (see Figure 1, Panel A).

Each participant was randomly assigned to one of four counterbalanced conditions and was presented with eight of the 16 photographs. Four photographs depicted happy expressions and four photographs (from different models) depicted angry expressions. In an initial pilot study, a separate group of participants ($N$ = 20) was instructed to label the emotion of each target person. Over 80% of participants identified each emotion correctly.

In accordance with previous research on social categories (Canadas et al., 2013), the experiment included a modification of the Eriksen flanker task (Eriksen & Eriksen, 1974) in which each trial consisted of an initial 200 ms fixation cross followed by the central presentation of an emotional face representing the context (see Figure 2). After a 400 ms interval, five arrows appeared above or below the face for 2000 ms or until the participant responded. In the congruent condition, all five arrows pointed in the same direction. In the incongruent condition, the central arrow and the four flanking distractors pointed in opposite directions. Participants were instructed to respond as quickly and accurately as possible to the direction of the central arrow by pressing either the 'Z' (left) or 'M' (right) key. Participants were further instructed to carefully attend to all faces because at the end of the experiment they would be asked questions pertaining to these faces. The inter-stimulus interval was 1000 ms and participants were given breaks between each of five blocks.

As previously noted, three of the four face identities in each category were consistent with the

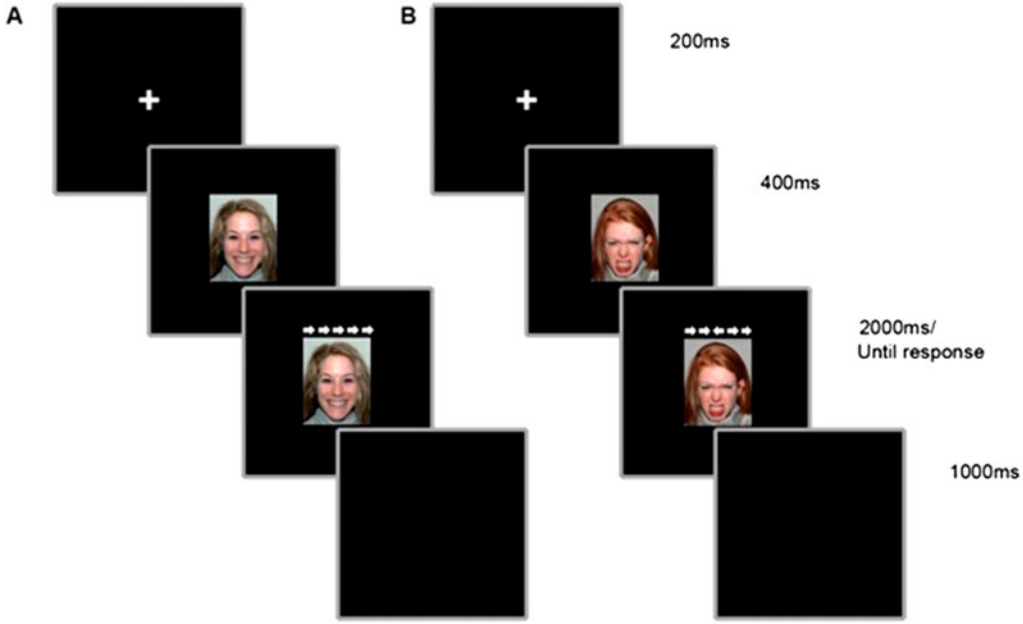


**Figure 2.** *Presentation latencies in Experiment 1. Panel A is an example of a congruent flanker trial with a happy context face. Panel B is an example of an incongruent trial with an angry context face. Reproduced with permission.*

proportion of congruency associated with the category, while the fourth face identity was inconsistent (see Figure 3). The group and the specific face identity associated with either a high or low proportion of congruency was randomly selected and counterbalanced across participants. Specifically, we created four different counterbalanced orders so that each group of faces was associated equally often with a high or low proportion of congruency. Furthermore, each specific face identity was associated equally often with the consistent and inconsistent condition. All participants performed one initial practice block consisting of 16 trials followed by five experimental blocks consisting of 128 trials each.

## Results

The practice and the first block were considered learning trials and this data was not included in the analysis. Errors (3.1%) and outliers (i.e., latencies 2.5 SD above or below the mean, 1.8%) were excluded from the analyses. Data from one participant with an excessive proportion of errors (i.e., more than 20%) and four participants who experienced technical problems with the computer programme were also excluded from the analysis.

Analysis of the mean response latencies revealed a congruency effect, $F(1, 30) = 106.07, p < .001; \eta^2 = .78$. As expected, participants took longer to respond on incongruent ($M$ = 651.03 ms; SD = 90.53; 95% CI [72.53, 121.01]) than on congruent ($M$ = 567.15 ms; SD = 64.89; 95% CI [51.86, 86.74]) trials. To test our specific hypotheses related to the impact of target consistency on this congruency effect we computed an index of congruency (i.e., incongruent minus congruent trials; Funes, Lupianez, & Humphreys, 2010). The index was then submitted to a repeated measure ANOVA that included group congruency (high vs. low) and individual face consistency (category consistent vs. inconsistent) (see Table 1a).

A main effect of group congruency was observed, $F(1, 30) = 6.10, p = .019; \eta^2 = .17$, which was not qualified by individual face consistency, $F(1, 30) = 1.12, p = .30; \eta^2 = .04$. As expected, larger

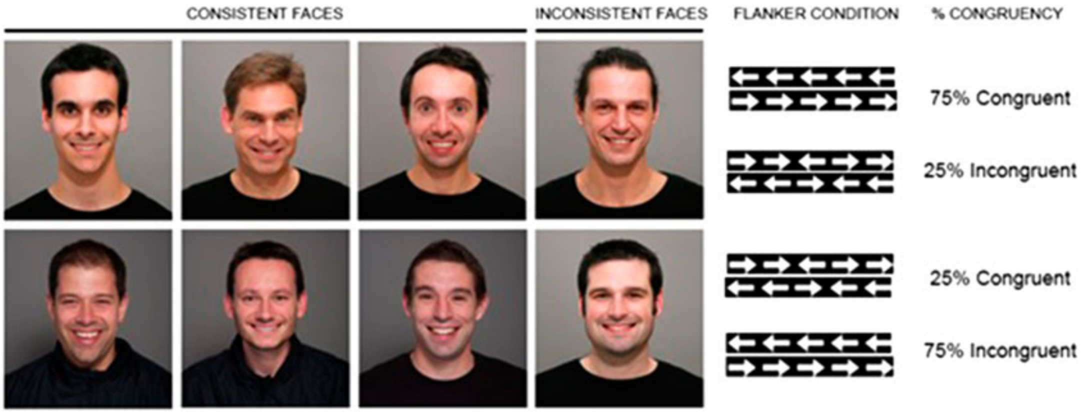


**Figure 3.** *Example of a trail when false smile faces were paired with high proportion congruent trials and true smiles faces were paired with low proportion congruent trials. Reproduced with permission.*

congruency effects were found for the high ($M$ = 88.23 ms; SD = 49.94; 95% CI [39.91, 66.65]) compared to low ($M$ = 79.83 ms; SD = 48.67; 95% CI [38.89, 65.06]) group congruency conditions and this pattern did not differ for consistent and inconsistent faces.

Furthermore, a corresponding analysis of error rates revealed only a significant main effect of congruency, $F(1, 30) = 33.50$, $p < .001$; $\eta^2 = .53$, such that participants made more mistakes on incongruent trials ($M$ = 3.76%; SD = 3.93; 95% CI [3.14, 5.26]) than on congruent trials ($M$ = 0.94%; SD = 1.86; 95% CI [1.48, 2.48]). No other main effects or interactions were significant, all $F$s < 1 (see Table 1b).

Recent evidence suggests that different emotional expressions drive and capture attention differently (Fox et al., 2000; Ohman, Flykt, & Esteves, 2001; Vuilleumier & Schwartz, 2001). To examine this possibility, we explored whether the pattern of results described above was moderated by target emotion. Specifically, we conducted a type of emotion (happy vs. angry for the high proportion of congruency) by individual face consistency (category consistent vs. inconsistent) by group congruency (high vs. low proportion congruent) ANOVA on the index of congruency with the first factor between subjects and the last two factors within subject. As expected, while the main effect of group congruency was significant, $F(1, 29) = 6.01$, $p = .02$; $\eta^2 = .17$, this effect was not qualified by either the consistency of the individual faces, $F(1, 29) = 1.13$, $p = .30$; $\eta^2 = .04$, or the type of emotion in the high and low congruency trials, $F(1, 29) < 1$; $\eta^2 = .009$.

**Table 1a.** *Congruency effect in ms for Experiments 1 and 2 (standard error in brackets)*

| | *Consistent faces (CF)* | | *Inconsistent faces (IF)* | | *Social-context-specific PCE (HPC–LPC)* | |
|---|---|---|---|---|---|---|
| *Experiment* | *HPC* | *LPC* | *HPC* | *LPC* | *CF* | *IF* |
| Experiment 1 | | | | | | |
| Congruency effect (I–C) | 85 (9.0) | 79 (8.5) | 92 (8.9) | 80 (9.0) | 5 (4.6) | 12 (5.0) |
| Experiment 2 | | | | | | |
| Congruency effect (I–C) | 102 (7.6) | 91 (7.7) | 107 (10.7) | 93 (7.8) | 11 (5.8) | 14 (10.3) |

HPC, high proportion of congruent trials; LPC, low proportion of congruent trials; I, incongruent; C, congruent.

**Table 1b.** *Congruency effect in error rates for Experiments 1 and 2 (standard error in brackets)*

| | *Consistent faces (CF)* | | *Inconsistent faces (IF)* | | *Social-context-specific PCE (HPC–LPC)* | |
|---|---|---|---|---|---|---|
| *Experiment* | *HPC* | *LPC* | *HPC* | *LPC* | *CF* | *IF* |
| Experiment 1 | | | | | | |
| Congruency effect (I–C) | 2.6 (.7) | 2.4 (.5) | 3.1 (.7) | 3.2 (.8) | 0.2 (.6) | −0.1 (1.1) |
| Experiment 2 | | | | | | |
| Congruency effect (I–C) | 4.0 (.9) | 5 (1.0) | 3.6 (.9) | 4.2 (1.0) | −1 (0.6) | −0.5 (.8) |

HPC, high proportion of congruent trials; LPC, low proportion of congruent trials; I, incongruent; C, congruent.

## Discussion

The primary aim of Experiment 1 was to explore whether distinct emotional expressions (i.e., happiness vs. anger) function as contextual cues to allocate attentional control. Our findings provide initial support for the extension of the social-context-specific proportion congruency effect to the domain of emotional expressions. In particular, emotional expressions associated with a high proportion of congruent trials showed a larger congruency effect than those associated with a low proportion of congruent trials. Moreover, in accordance with previous findings (Canadas et al., 2013), we also found that the social-context-specific proportion congruency effect observed in the consistent instances of each emotion group (e.g., three happy faces paired with congruent flanker trials) generalised to inconsistent members (i.e., one happy face paired with incongruent flanker trials); in fact the effect was even larger for inconsistent faces (see Table 1). These results suggest the existence of a fast categorization process related to emotions in which mere exposure to eight unfamiliar faces with divergent emotional expressions is sufficient to use these emotions as a basis for categorization and influence the subsequent allocation of attentional control.

## EXPERIMENT 2

In Experiment 2 our goal was to explore whether subtypes of the same facial expression are sufficient to replicate the pattern of findings related to the distinct emotions in Experiment 1. We used facial expressions that are assumed to belong to the same general type of emotional expression, but which seem to communicate different meanings (Niedenthal et al., 2010) from happiness or joy (Frank et al., 1993; Frank & Stennett, 2001) to affiliation or dominance (Abel, 2002; Fogel, Nelson-Goens, Hsu, & Shapiro, 2000; Keltner, Moffitt, & Stouthamer-Loeber, 1995; LaBarre, 1947; Tipples, Atkinson, & Young, 2002). Specifically, in this study we included Duchenne (true smiles) and non-Duchanne (false or "social" smiles) as our social context. Our aim was to investigate whether the social-context-specific proportion congruency effect observed in Experiment 1with distinct emotions and in our previous research on gender (Canadas et al., 2013; in preparation) would replicate when more subtly different expressions were used as social contexts. We predicted that because people place importance on learning to detect false or deceitful actions in others, they would spontaneously use true and false smiles to categorise people and process social contexts (Buck, 1988).

Previous work has identified the structural and dynamic features of true vs. false smiles (Bernstein, Sacco, Brown, Young, & Claypool, 2010; Cacioppo, Petty, Losch, & Kim, 1986; Ekman, et al., 1980; Frank, 2002; Hess & Kleck, 1994; Maringer et al., 2011). In particular, in still photographs the 'Duchenne marker' distinguishes these expressions. In 'true' smiles, there is a pronounced contraction of the orbicularis oculi, the muscle around the eyes, which causes a lift of the cheeks, a narrowing of the eye opening, and consequently the appearance of wrinkles around the eyes. In sum, given the social meaning of true vs. false smiles, the personality traits associated with them, and individuals' ability to correctly identify and differentiate between these expressions (Ambadar et al., 2009; Hess & Kleck, 1994; Krumhuber et al., 2007; Maringer et al., 2011; Miles & Johnston, 2007), we expected participants to automatically categorise facial stimuli on the basis of these two types of smiles and consequently to differentially allocate attentional control.

To examine this hypothesis, participants were presented with true or false smiles. While one type of smile (e.g., true smiles) was associated with a high proportion of congruency, the other type (e.g., false smiles) was presented with a low proportion of congruency. If individuals spontaneously use these subtle cues to categorise people according to emotion, they should show a larger congruency effect for the type of smile associated with a high (vs. low) proportion of congruent trials. Furthermore, based on previous findings, we expected this pattern even for inconsistent faces, which are associated with the opposite proportion of congruency as the rest of the category exemplars.

## Method

### *Participants*

Thirty-four students (one male) at a French university ($M$ = 20.0 years; SD = 2.06) participated in the experiment for course credit. All participants were naïve to the purpose of the study.

### *Procedure*

The procedure was similar to Experiment 1, except that the emotional stimuli in Experiment 2 were composed of 16 photographs of eight men portraying true and false smiles. These expressions were created using standard instructions (Ekman & Davidson, 1993) to elicit different smiles (see Figure 1, Panel B). Three consistent category members and one inconsistent category member within each of the two groups of true and false smiling facial expressions were created in accordance with the procedures described in Experiment 1. The emotional expression and the specific stimuli associated with high or low proportion of congruency were randomly selected and counterbalanced across participants.

Participants were presented with eight of the 16 photographs – four depicting true smiles and four (from different models) depicting false smiles. They performed one practice block consisting of 16 trials, followed by five experimental blocks of 128 trials each.

In a pilot study, a separate group of participants ($N$ = 30) was asked to rate each face according to its trustworthiness using a 1 (not at all trustworthy) to 7 (very trustworthy) Likert scale. Participants rated faces with true smiles ($M$ = 4.93, SD = .73) as being significantly more trustworthy and therefore true than faces with false smiles ($M$ = 3.39, SD = .89), $t(29) = 7.21$, $p < .001$. The faces were however equally matched in attractiveness, $F(1, 29) = 1.04$, $p = .42$.

## Results

Consistent with the analytic strategy used in Experiment 1, the practice block and the first block were considered learning trials and therefore, data from these blocks were not included in the analyses. Trials with errors (2.7%) and outliers (i.e., response latencies 2.5 SD above or below the mean, 1.8%) as well as data from one participant with excessive error rates (i.e., more than 20%) were also excluded from the analyses.

A preliminary analysis of mean response latencies revealed a significant congruency effect, $F(1, 32) = 200.75$, $p < .001$; $\eta^2 = .86$. In accordance with previous findings, participants took longer to respond on incongruent ($M$ = 677.75 ms; SD = 82.18; 95% CI [66.09, 108.69]) than congruent ($M$ = 578.75 ms; SD = 71.90; 95% CI [57.82, 95.10]) trials. As in Experiment 1, we computed an index of congruency (incongruent minus congruent trials) and included it to a repeated measures ANOVA with group congruency (high vs. low) and Individual Face Consistency (consistent vs. inconsistent with the category) as within subject factors.

As expected, the main effect of group congruency was significant, $F(1, 32) = 5.76$, $p = .022$; $\eta^2 = .15$, and the interaction between group congruency and individual face consistency was not significant, $F(1, 32) < 1$; $\eta^2 = .01$. In accordance with our predictions, the congruency effect was larger in the high proportion congruent condition ($M$ = 104.71 ms; SD = 52.67; 95% CI [42.36, 69.67]) than the low proportion congruent condition ($M$ = 92.13 ms; SD = 44.50; 95% CI [35.78, 58.85]) and this pattern did not differ for consistent and inconsistent faces, $F(1, 32) < 1$; $\eta^2 = .01$.

Furthermore, a corresponding analysis of error rates showed only a significant main effect of Congruency, $F(1, 32) = 26.69$, $p < .001$; $\eta^2 = .45$. Specifically, participants made more mistakes on incongruent ($M$ = 4.85%; SD = 5.20; 95% CI [4.18, 6.88]) than congruent ($M$ = 0.66%; SD = 1.44; 95% CI [1.16, 1.91]) trials. Furthermore, the interaction between Group Congruency and Individual Face Consistency was not significant, $F(1, 32) < 1$; $\eta^2 = .00$.

To further explore whether true and false smiles drive the capture of attention differently (Fox, 2002; Ohman, et al., 2001; Vuilleumier & Schwartz, 2001), we conducted a Type of Smile (true vs. false for the high proportion of congruency) by Individual Face Consistency (category consistent vs. category inconsistent) by Group Congruency (high vs. low proportion congruent) ANOVA on the index of congruency with the first factor as a between subjects variable and the last two factors as within subject variables. We found a main effect of group congruency, $F(1, 31) = 5.65$, $p = .024$; $\eta^2 =.15$, that was not qualified by either face consistency, $F(1, 31) < 1$; $\eta^2 = .002$, or type of smile, $F(1, 31) = 1.31$, $p = .26$; $\eta^2 = .04$.

## Discussion

The results of Experiment 2 demonstrated that the categorization processes and the associated pattern of allocation of attentional control found in Experiment 1 replicated with more subtle emotional expressions. The observed pattern of results replicated the findings of Experiment 1. Specifically, we showed that categorization effects related to emotional expressions as indexed by social-context-specific proportion congruency effects occur independent of the consistency of the faces. That is, participants applied the same cognitive control to consistent true smiles associated with a high proportion of congruent trials also to inconsistent true smiles associated with a low proportion congruent trial. The fact that we used the same category of expression (i.e., smiles) with subtle markers that differentiated true from false smiles suggests that individuals attend closely to the emotional expressions of others. Because people are experts at identifying other's expressions, even when emotions are not directly relevant to the task at hand or even when they are associated with very subtle cues, they are used to define the social contexts.

Together the results in both Experiments 1 and 2 lead us to conclude that emotional expressions (i.e., angry vs. happy and true vs. false smiles) function as do other important social categories such as sex, that is, they serve as cues for the categorization of faces and the subsequent contextual allocation of attentional control. Given that the methods of the two experiments were nearly identical (with only the type of emotion and related stimuli differing), we performed an overall analysis to increase statistical power. The results of the jointed analysis (group congruency × face consistency × experiment) demonstrated a strong main effect of group congruency [$F(1, 62) = 11.07$, $p = .001$; $\eta^2 = .15$; observed power = .91]. Furthermore, once again and as predicted, the group congruency × face consistency interaction was not significant [$F(1, 62) < 1$, $p = .47$, $\eta^2 = .00$; observed power = .01].

# GENERAL DISCUSSION

The present experiments investigated the possibility that facial expressions of emotion function as contextual cues to allocate attentional control. In Experiment 1, we focused on angry and happy expressions. These expressions are considered to be opposite in conveyed valence, to involve different facial muscles and to produce different emotional responses (Ekman et al 2002; Russell & Carroll, 1999; Winkielman, Berridge, & Wilbarger, 2005). In Experiment 2, we focused on true and false smiles, which are associated with the same expression but have subtly different facial features that convey distinct social meaning about the trustworthiness of the target person.

Together, the results of Experiments 1 and 2 suggest that participants are sensitive to emotional expression in face perception and categorise faces accordingly; these categories and the proportion of congruency associated with them determine the allocation of attentional resources. Specifically, the findings indicate that participants used facial expressions rather than individual identities when performing the attentional task. A clear pattern emerged across the two experiments: happy vs. angry faces and true vs. false smiles served as cues to categorise faces. Together these findings indicate that participants were able to identify both explicit and more subtle affective expressions and use these emotions as contexts to cue the allocation of attentional control. These results support the classic models of social perception. According to such models, we process others initially according to social category membership (Brewer, 1988; Fiske & Neuberg, 1990; Hugenberg et al., 2010) and only subsequently according to idiosyncratic characteristics. Furthermore, only when perceivers are motivated to look at perceived individuals in greater detail will this latter stage occur.

An alternative account of the categorization effect demonstrated here is that participants learned the emotional contexts (i.e., 2 emotional expressions) more easily than the individual contexts (i.e., 8 identities). However in a recent study conducted in our laboratory we presented again 8 stimuli; this time 4 animals and 4 tools, instead of two groups of faces, and in this case participants showed attentional control based on the specific proportion of congruency associated to the stimulus and not to that proportion of congruency associated to the group.[1] Although previous studies have also demonstrated that participants can individuate rather than categorise others when they are given explicit instructions to attend to others (Canadas et al., 2013), we recommend that future research further explores the mechanisms that underlie individuation-categorization processes to better understand when people will and will not apply attentional control.

Even though the present experiments provide convincing evidence that distinct and subtle emotional expressions support the categorization of faces, it is unclear whether the way perceivers react to specific expressions and their ability to fully discriminate between these emotions plays an important role in these processes (Fiske et al., 1987). In particular, it is not clear the impact that embodiment of these emotions and empathising with the target have on the extent to which these facial features are used in categorization processes. Because emotions and social contexts can facilitate and promote future interactions between people and signal approach or avoidance orientations (Marsh, Ambady, & Kleck, 2005; Harmon-Jones & Sigelman, 2001), it is imperative to better understand these mechanisms.

One strategy to achieve this goal is to manipulate or control the emotional state of participants. Because the feelings of participants can interact with the perception of faces presented, they can play an important role in evaluating the genuineness of smiles (Forgas & East, 2008). While positive mood can increase the perceived trustworthiness of happy faces, negative mood can decrease such judgements. Accordingly, it would be interesting in future research to examine whether inducing context-congruent emotions in comparison to a neutral state would increase categorization and congruency effects. Alternatively, blocking facial expressions and inhibiting mimicry of perceived emotions (Niedenthal, et al., 2010) may work to reduce categorization and congruency effects.

[1] Categorisation is not always the outcome when using this paradigm. As part of a doctoral dissertation (accessible at: http://digibug.ugr.es/bitstream/10481/25133/1/21595574.pdf) we conducted a study using the same basic procedure as the two experiments presented here but that included as stimuli four animals and four tools (instead of two groups of faces). The results of this study showed a significant group × stimuli consistency interaction, $F(1, 28) = 7.17$, $p = .012$; $\eta^2 = .20$, in which the effect of the inconsistent pictures was opposite to that of the consistent pictures. Therefore in this study we found individuation rather than categorisation. We assume that in this latter case participants learned about eight individual contexts rather than about two categories.

In conclusion, emotional expressions are important in social interaction: they facilitate and promote communication between peers, and signal whether to approach or avoid a person or environment (Harmon-Jones & Sigelman, 2001). From a cognitive approach, emotional expressions have been shown to selectively guide attention. In the present research, we utilised a multi-disciplinary approach by bringing together the literature on social categorization processes, emotion and attentional control. In particular, we replicated the context-specific proportion congruency effect with emotional faces as context cues. These findings provide new evidence that emotional expressions can spontaneously lead to categorization processes underlying the contextual allocation of attentional control and other related attentional processes.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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