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ARTICLE

The power of pupils in predicting conforming behavior

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ABSTRACT

During social interactions, people look into each other's eyes to grasp emotional signals. Accordingly, prior research has shown that the eyes reveal social messages that influence interpersonal communication. Here, we tested whether variations in a subtle eye signal – pupil size – influence people's conforming behavior. Participants performed an estimation task in light of the estimation provided by another individual whose pupil size had been manipulated. The distance between the two estimations was taken as an index of spontaneous conformity. Results revealed that participants conformed more strongly toward individuals with large pupils than toward individuals with small or medium pupils. These findings suggest that pupil size is a source of social influence that impacts upon spontaneous interpersonal conducts.

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Affect; conformism; face perception; pupil size; social cognition

Extensive research on social influence has shown that people tend to be influenced by others' opinions and attitudes (For reviews, Cialdini & Goldstein, 2004; Cialdini & Trost, 1998). Accordingly, research on conformity has documented that individuals have the tendency to structure an ambiguous situation in accordance with what other people suggest (Cialdini & Trost, 1998). The classic works by Asch (1956) and by Deutsch and Gerard (1955) have set the stage for more than half a century of research on when conformity occurs (For a review, Mackie & Skelly, 1994). This research has revealed that individuals are motivated to conform to either form an accurate interpretation of reality (i.e., informational conformity) or to obtain social approval from others (i.e., normative conformity). Moreover, it has been shown that liking and similarity increase conformity (Lott & Lott, 1961; Mackie & Skelly, 1994; Paladino, Mazzurega, Pavani, & Schubert, 2010; Vaes, Paladino, Castelli, Leyens, & Giovanazzi, 2003). For instance, Paladino and colleagues (Paladino et al., 2010) showed that a manipulation aimed at increasing the similarity with a target (i.e., through synchronous multisensory stimulation) significantly promoted spontaneous conformity toward such a target. In their study, participants observed the face of a stranger being stimulated in synchrony (vs. asynchrony) with one's own face. Results showed that participants felt a stranger to be closer and more similar to themselves after being exposed to synchronous stimulation. In turn, participants displayed conformity and anchored one's behavior to that of the stranger.

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In a similar vein, conformity is sensitive to subtle manipulations in intergroup contexts. That is, conformity is more likely toward ingroup than outgroup members as people like ingroup members and feel more similar to them rather than to outgroup members (Vaes et al., 2003). Research has also shown that conformity occurs when the source of influence is perceived as valuable. As a case in point, research on political psychology has shown that people tend to spontaneously follow competent and agentic politicians (Carraro & Castelli, 2010). Taken together, these findings suggest that conformity is a subtle form of favoritism that tends to occur with someone we like (see, Mackie & Skelly, 1994).

The present research sought to extend prior work by testing whether conforming behavior is influenced by the facial appearance of the potential source of influence. Extensive research has shown that facial appearance provides a rich source of social information. Indeed, our impressions of others are often based on limited information that is rapidly extracted from their faces (Zebrowitz & Montepare, 2008). In less than a second we are able to perceive trustworthiness, likeability, competence, and dominance from faces (Brambilla, Biella, & Freeman, 2018; Willis & Todorov, 2006). Importantly, these evaluations predict important social outcomes (for a review, Todorov, Olivola, Dotsch, & Mende-Siedlecki, 2015). For instance, perceived facial untrustworthiness predicts death sentences for convicted murderers (Wilson & Rule, 2015) while perceived competence from faces predict the results of political elections (Ballew & Todorov, 2007). A critical question in this context is whether conformity can be trigged by facial appearance. As such, even if people extract considerable information about others from their facial appearance, no prior research has shown whether conformity is sensitive to subtle manipulations of facial cues. Thus, here we tested whether variations in a subtle but visible facial cue of a social target – pupil size – influence people's spontaneous conformity toward such a target.

The eyes are an important source of social information (Farroni, Csibra, Simion, & Johnson, 2002) and pupil size in an uncontrollable but visible social signal (Kret, 2015; Kret & de Dreu, in press). The pupil dilates in response to changes in ambient light, but also reflects cognitive and affective states (Laeng, Sirois, & Gredebäck, 2012). For instance, pupil size positively correlates with memory load (Beatty & Kahneman, 1966) and with the difficulty of mental calculations (Hess & Polt, 1964). Pupil dilation also reflects social interest. Indeed, heterosexual women's pupils tend to dilate when exposed to photographs of nude men whereas heterosexual men's pupils tend to dilate when exposed to photographs of nude women (Hess & Polt, 1960; Lick, Cortland, & Johnson, 2016).

Moreover, a number of studies have examined how pupil size is interpreted, revealing that those with large pupils are generally perceived positively by their interaction partners (Brambilla, Biella, & Kret, 2019; Hess, 1965; Kret & De Dreu, 2017). In a seminal paper, Hess (1965) revealed that male individuals liked women with large pupils better than women with small pupils. In a similar vein, it has been shown that people are more willing to interact when partners have large rather than small pupils (Brambilla et al., 2019). Moreover, individuals with large pupils are judged to be sociable, and trustworthy, and those with small or constricting pupils cold, and untrustworthy (Kret & De Dreu, 2017; Kret, Fischer, & De Dreu, 2015). In a line of studies using the Trust Game, Kret and colleagues showed that people are more trusting of partners with dilating pupils rather than those with constricting pupils and also reciprocate more to the former (Kret & de Dreu, in press). When making eye-contact with a partner who's pupils dilate, observers' pupils tend to dilate in response, fostering a trust response. The pupil mimicry–trust linkage recruits activity in theory of mind areas, suggesting that this might be a basic bonding mechanism that is initially triggered by the perception of social interest (signaled by the dilated pupils; Prochazkova et al., 2018). Taken together, these studies show that people use pupil size as a source of social information to inform their global evaluations of other individuals.

Accordingly, there is good reason to expect that subtle variations in pupil size could alter conforming behavior. Combining research showing that conformity increases when the source of influence is liked (Carraro & Castelli, 2010; Paladino et al., 2010; Vaes et al., 2003) with findings showing that individuals with large pupil sizes are trusted and perceived positively (Brambilla et al., 2019; Hess, 1965; Kret & De Dreu, 2017; Kret et al., 2015), we expect that people would conform more strongly toward individuals with large pupils. We tested this prediction in two studies where we measured conformity toward a social target with different pupil size. These studies helped us to extend prior research evidence on the factors promoting and disrupting conforming behavior, as well as prior research on the behavioral consequences of observed pupil dilation, an area that has received scarce attention.

Experiment 1

Experiment 1 was designed as a first test of our hypothesis that pupil size of a social target influences conforming behavior toward such an individual. To do so, an estimation task served as a subtle measure of conformity (Castelli, Vanzetto, Sherman, & Arcuri, 2001). Specifically, participants were asked to perform the estimation task and provide an answer in light of the estimation provided by another individual whose pupil size had been manipulated in order to create two experimental conditions: large and small pupil sizes. We expected that participants would differentially use the target's estimates as an anchor for their own judgment.

Method

Participants

An a priori power analysis was conducted for sample size estimation (using GPOWER 3.1; Faul, Erdfelder, Lang, & Buchner, 2007). With an $\alpha = .05$ and power = .80, the projected sample size needed to detect a medium effect size ($d = .50$) is N = 128 (t-test, difference between two independent means). One hundred, eighty-three adults were recruited online to participate in the study. Participants were instructed that the study would involve the inspection of images. Therefore, they were asked to perform the task by using a desktop computer in order to see them clearly. Unfortunately, 65 participants failed to follow the instructions and performed the task using the screen of their smartphones. Those participants were not included in the analyses, leaving a total of one hundred and eighteen participants.[1]

Experimental stimuli

One image of a western European male with a neutral expression served as our experimental stimulus. The picture was standardized in Adobe Photoshop, converted to gray scale, and cropped to reveal only the eye region. Next, we erased everything between the eyelashes (eye white, iris, and pupil). The eyes were then filled with new eye whites and irises, and an artificial pupil was added. To emphasize the convex shape of the eye and increase naturalness, we made the eye white around the iris brighter than the eye white in the outer edges of the eye. To manipulate pupil size, we created two stimuli (see Figure 1): in one the image had pupils 40% larger than the standard pupil. In the second, the image had pupils 40% smaller than the standard pupil (see Brambilla et al., 2019; Kret et al., 2015).

Procedure

Participants were asked to participate in a study aimed at testing their cognitive abilities. Thus, participants were presented with a sequence of eight images each containing several '*s*' letters. For each image, participants were asked to inspect the screen for only five seconds and estimate the number of letters displayed on the screen. Importantly, at the top of each image, participants could see the estimation provided by a stranger accompanied with an image of that person. In one condition, participants saw eight times the face of an individual with large pupils. In the other condition, participants saw eight times the face of an individual with small pupils. Participants were randomly exposed to one of the two experimental conditions. The estimation of the stranger could thus be used as anchors while reporting personal judgments. The absolute distance between the provided anchors and personal appraisals can be taken as an index of spontaneous conformity toward the stranger (for a similar procedure, Castelli et al., 2001; Paladino et al., 2010; Vaes et al., 2003).

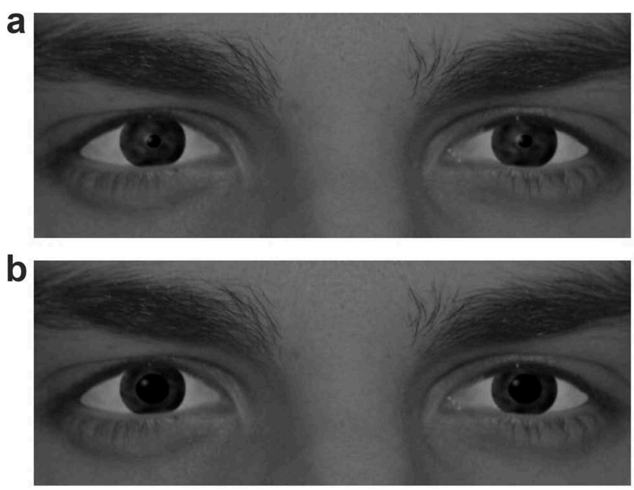

Figure 1. Face stimuli: a) Small pupils, b) Large pupils.

Results

The absolute differences between the participant's and stranger's estimates were averaged to provide a measure of conformity. Higher scores indicated a greater distance between the estimations provided by the stranger and those provided by the participants. Thus, higher scores indicated low conformity. To test our hypothesis we computed a *t*-test.[2] In line with our hypothesis, results showed that conformity was higher toward a target person with large pupils (M = 30.52, SD = 17.66) than toward a target person with small pupils (M = 39.46, SD = 22.75), $t(116) = 2.36$, $p = .02$, $d = .43$, 95% CI [.69, .80].[3]

Experiment 2

Experiment 2 was designed to test whether the effect we found in Experiment 1 was driven by the depiction of the social target as having large pupil size, small pupil size, or both. To do so, in Experiment 2, we added a control condition in which the target of influence had a medium pupil size. Moreover, in Experiment 2 all participants were sampled in the lab and seated in a chair that was positioned approximately 60 cm away from a 22-in LCD computer monitor (Asus® VW226; Resolution: 1680 pixels × 1050 pixels; Refresh rate: 59 Hz).

Method

Participants

An a priori power analysis was conducted for sample size estimation (using GPOWER 3.1; Faul et al., 2007). With an α = .05 and power = .80, the projected sample size needed to detect a medium effect size (f = .30) is N = 111 (ANOVA, fixed effects, omnibus, one-way). In total we recruited one hundred and forty-seven students from a large university in Italy.

Procedure

Participants were presented with a sequence of eight images each containing several '*s*' letters. For each image, participants were asked to inspect the screen for only five seconds and estimate the number of letters displayed on the screen. At the top of each image, participants could see the estimation provided by a stranger accompanied with an image of that person. In the first condition, participants saw eight times the face of an individual with large pupils. In the second condition, participants saw eight times the face of an individual with small pupils. In the third condition, participants saw eight times the face of an individual with medium pupils. Participants were randomly exposed to one of the three experimental conditions.

Results

The absolute differences between the participant's and stranger's estimates were averaged to provide a measure of conformity. Higher scores indicated a greater distance between the estimations provided by the stranger and those provided by the participants. Thus, higher scores indicated low conformity. To test our hypothesis we computed a one-way ANOVA. The analysis revealed that the experimental condition influenced conformity, $F(2, 144) = 3.67$, $p = .028$, $\eta_p^2 = 0.05$. Specifically, conformity was higher toward a target person with large pupils ($M = 29.79$, $SD = 14.36$) than toward a target person with small pupils ($M = 37.41$, $SD = 18.15$), $t(96) = 2.30$, $p = .02$, $d = .46$, 95% CI [.06, .86] or with medium pupils ($M = 38.78$, $SD = 19.71$), $t(95) = 2.56$, $p = .01$, $d = .52$, 95% CI [.11, .92]. Scores did not differ between medium and small pupils, $t < 1$, $p = .72$.

General discussion

Two studies showed that observed pupil size influences spontaneous conforming behavior. Experiment 1 revealed that conformity was more likely when the source of influence displayed large pupils rather than small pupils. Experiment 2 corroborated these findings by showing that conformity was more likely when the source of influence displayed large pupils rather than small or medium pupils. Collectively, these findings demonstrate that people trusted others' estimations better when their pupils were large and conformed to them. This work extends prior research evidence on the factors promoting conforming behavior. Extensive research has investigated when conformity occurs (for a review, Cialdini & Goldstein, 2004). However, this large body of research has overlooked whether facial signals might trigger conforming behaviors. By showing that observed pupil size influences conforming behavior, we extended prior research evidence on the conditions promoting and disrupting interpersonal influence. In a similar vein, we complemented and extended prior findings showing the key role of facial signals in predicting interpersonal interactions (Todorov et al., 2015).

Our findings also extend prior research on the social implications of pupil dilation. Indeed, while a good deal of work has revealed that pupils dilate in response to seeing emotional others (Kret, Stekelenburg, Roelofs, & de Gelder, 2013) or specific others that interest observers (e.g. attractive potential partners; Lick et al., 2016), few studies have investigated how people react to their partners' pupil size. For instance, people evaluate others with dilating compared to constricting pupils as more friendly, attractive and trustworthy, and also invest more in them during trust games. Moreover, after earning a bonus, participants shared more of their financial gain with partners with dilating compared to constricting pupils (Kret & de Dreu, in press). In addition, people are less likely to deceive an interaction partner with dilating pupils while they could have earned extra money when doing so (Van Breen, de Dreu, & Kret, 2018). This positive relation between dilated pupils and person perception also works the other way around. A study showed that when participants were asked to draw pupils in the empty irises of a happy and an angry face, they drew larger pupils in the first than in the latter (Hess, 1965; Kret, 2018). Finally, we recently showed that people with large pupils were more readily approached than those with small pupils (Brambilla et al., 2019). All in all, the current findings are in line with this literature, showing that estimations made by others with large pupils are taken into greater consideration and influence own estimations. Thus, extending prior research, we found that the pupil size of a partner predicts spontaneous behaviors in observers.

These findings open interesting directions for future research. Indeed, given that we used few target faces as stimuli, more research is needed to confirm the robustness of our findings across a wider range of facial stimuli and individuals. In a similar vein, in light of the distinction between informational and normative conformity (Deutsch & Gerard, 1955) further studies should test whether our findings generalize across different conformity motivations. Considering that in our experiments participants did not interact with a real person and that they were asked to perform a difficult task, it would be reasonable to expect that in our experiments participants were pushed by a goal of accuracy. Therefore, it would be important to test whether conformity toward individuals with large pupils could also emerge in conditions where people are seeking social approval.

A further interesting avenue for future research would be to test the social implications of our findings. Indeed, our findings may reflect an adaptive strategy wherein it is advantageous to trust and follow liked individuals (i.e. large pupils; Kret et al., 2015) in order to foster cooperation and social connection. In contrast, people should be cautious in following disliked individuals (i.e. small pupils; Kret et al., 2015) that may pose a threat to social relations. Collectively, it would be worth testing whether pupil size during a social interaction is related to actual character and therefore the behavioral consequences elicited by partners' pupil size are adaptive.

Finally, an important area of investigation would be to test the underlying mechanism(s) driving the effect we found. Based on research showing that pupil dilation is positively associated with increased cognitive load (Hess & Polt, 1964; see also Just & Carpenter, 1993) a possibility would be that participants conformed on the estimation of the target with large pupils because this estimation was perceived as reliable and as the outcome of a cognitive effort.

However, an alternative interpretation based on prior research showing that conformity increases when the source of influence is liked (Carraro & Castelli, 2010; Paladino et al., 2010; Vaes et al., 2003) and that individuals with large pupils are perceived positively (Brambilla et al., 2019; Hess, 1965), could be that liking would drive our effects. In the context of a neutral or positive interaction, this positive impression could be established through pupil dilation mimicry (Kret, 2017; Kret & De Dreu, 2017; Kret et al., 2015). When people unconsciously mimic the dilating pupils of their interaction partner, their pupils through biofeedback inform social decisions. A recent fMRI study showed that pupil dilation mimicry is associated with activity in a neural network that is involved in theory of mind processes (Prochazkova et al., 2018). The main effect of pupil mimicry on theory of mind network activation was driven by pupil dilation mimicry and less by pupil constriction mimicry. Thus, when making an estimation as in the current research, participants might have tried to judge how capable the other is in making such judgments. While looking into his dilating pupils, a positive impression was formed, making participants more susceptible to his judgment. Future studies should test this intriguing possibility shading more light on the processes influencing the perception of others' eyes.

Notes

1. Due to a technical error the gender of participants was not recorded in both experiments.

2. Preliminary analyses revealed that the measure of conformity was normally distributed (Skewness<1) in both studies. Moreover, we did not identify statistical outliers (i.e., scores either below or above 3SD the grand mean).
3. To test our hypothesis in a more conservative way, we analyzed our data using mixed linear models with one random intercept for each conformity trial and one random intercept per participant. The non-aggregated absolute distance between the participant's and stranger's estimates was the dependent variable. Our independent variable (i.e., pupil size) was added as a fixed effect. This analysis confirmed our results. The difference between the two conditions was significant, t = 2.36, p = .02. We run the same analysis in Experiment 2. Given that Experiment 2 involved more than two conditions we contrasted each condition to a reference group (i.e., large pupils). The analysis showed a significant effect of small pupil size condition compared to the reference level, t = 2.16, p = .03, and a significant effect of medium pupil size condition compared to the reference level, t = 2.52, p = .01.

Author contributions

M. Brambilla, M. Biella, and M. Kret conceived the studies. M. Brambilla and M Biella ran the studies. M. Biella conducted the data analysis. M. Brambilla drafted the first version of the manuscript, while M. Biella and M. Kret read and commented on it

Disclosure statement

No potential conflict of interest was reported by the authors.

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