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An event-based account of conformity: evidence from attention manipulations targeting event-file encoding and retrieval

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ABSTRACT

Previous findings have raised doubt in whether comparable conformity effects can be obtained for information from humans and computers or other systems of little or no social importance. In the present study, we compared the impact of “other choices” (i.e. choices of another agent that did or did not match the participant’s initial choices) of humans and computers on preferences of participants for one of two pictures. In Experiment 1, we found conformity effects only when the other choices came from humans. In Experiment 2, we manipulated the attention allocated to encoding picture-choice combinations by means of a secondary go/nogo task. Conformity effects were found for humans and computers if the secondary task did not require a response. In Experiment 3, we manipulated the attention allocated to retrieving picture-choice combinations, which resulted in conformity effects for all conditions. Taken altogether, our findings suggest that conformity effects can be obtained for “computerized” informational sources under attentional conditions that reduce the specificity of encoding or the selectivity of retrieving event files.

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Conformity; divided attention; encoding; theory of event coding (TEC)

Introduction

Conformity

Conformity refers to a social phenomenon in which individuals change their personal behavior and opinion to match others showing a conflicting behavior or opinion (Cialdini & Goldstein, 2004; Whiten, 2019; Wijenayake et al., 2020). One of the famous and foundational studies assessing conformity was performed by Asch (Asch, 1951). In his experiments, participants were asked to judge the length of a line in a very simple perceptual task. Interestingly, and in contrast to conditions in which participants worked alone, when participants were to judge after confederates had made other, obviously incorrect judgments, they changed their own judgment in the direction of the wrong judgments in approximately one third of the trials.

The Asch experiment stimulated many more investigations (Cialdini & Goldstein, 2004; Claidière & Whiten, 2012), showing the impact of various factors on conformity, including contextual and personal conditions, and task/stimuli characteristics determinants (Wijenayake et al., 2020). For example, contextual factors include the group size (Asch, 1956; Bond, 2005; Gerard et al., 1968; Latané & Wolf, 1981; Tanford & Penrod, 1984); group identity or its importance to participants (Abrams et al., 1990; Qin et al., 2022; Salomons et al., 2018; Vollmer et al., 2018); the belonging culture (Bond & Smith, 1996; Chu, 1979; Haas et al., 2022); the presence of dissenters (Asch, 1955); the anonymity of responses (Abrams et al., 1990; Asch, 1956; Huang & Li, 2016); and decade of testing, as

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a continuous decay of conformity effect was observed, especially in Western individualistic societies (Bond & Smith, 1996).

Personal determinants, in turn, include self-confidence and personality (Crutchfield, 1955; DeYoung et al., 2002; Haas et al., 2022; Mausner & Bloch, 1957; Simonson & Nowlis, 2000); age (Allen & Newton, 1972; Pasupathi, 1999; Walker & Andrade, 1996); gender (Bond & Smith, 1996; Eagly, 1983; Eagly et al., 1981; Matthew et al., 2019; Wijenayake et al., 2019); the personal susceptibility to influence (McGuire, 1968); and also personal psychological reactance degree (Goldsmith et al., 2005). Especially in consumer behavior studies (Lascu & Zinkhan, 1999), related factors include: the social/professional role, such as market mavens or other consumers (Clark & Goldsmith, 2005); consumer styles, such as status-seeking or role-relaxed consumers (Clark et al., 2007; Kahle, 1995a, 1995b); and people's susceptibility (Bearden et al., 1989; Bearden and Rose (1990).

Finally, task/stimuli characteristics include: the objective/subjective nature and difficulty of the task (Asch, 1956; Wijenayake et al., 2020); task importance (Baron et al., 1996); and stimulus features (Grosbras et al., 2007). All in all, researchers proposed that conformity is impacted by characteristics of situation, task, brand information, group size, personal characteristics, and also social hierarchy (Clark et al., 2007).

Traditional models of conformity

Researchers have proposed several models to explain or account for conformity. Most accounts are interested in behavior as observed in Asch's experiments, where participants are exposed to other informational sources, like peers, experts, or strangers, and the behavioral response agreement between this source and participants is assessed. Full conformity is assumed to occur with complete agreement between them, and nonconformity in the case of no agreement (Nail & Van Leeuwen, 1993). Conformity includes two kinds of manifestations: one is normative conformity, in which people conform to the instructions or expectations from others. If people accept influence from others to obtain a favorable reaction, this is called *compliance*, but if one performs a specific behavior to satisfy a group, this is called *identification*. The other manifestation is informational conformity, in which people conform to information from others, such as an expert or peer. This is called internalization (Lascu & Zinkhan, 1999) and is the specific form of conformity that our current study was interested in.

Nail and Ruch (1986, 1992, 1993) have created a particularly comprehensive theoretical framework for studying conformity based on social response theory (MacDonald et al., 2004). The model identifies different kinds of conformity, including conformity, independence, congruence, and anti-conformity. In this model, important factors are the participant's initial or pre-exposure response, the response of the influence source, and the participant's response to this influence—the post-exposure response. If the responses from participant and influence source are the same both before and after exposure, this is called congruence or uniformity. Conformity, on the other hand, represents a condition in which people changed their post-exposure response from initial disagreement to agreeing with the influencing source. According to this approach, independence or self-conformity represents a condition in which people insist on their pre-exposure initial response independently of influence source; and anti-conformity is a condition in which people change their response from the pre-exposure initial response independently of the influence source (Nail et al., 2000; Nail & Sznajd-Weron, 2016; Willis, 1963).

Explanation from theory of event coding

The available evidence indicates that conformity is a product of individual, task, and context characteristics (Clark et al., 2007; Laursen & Faur, 2022). Irrespective of whether the context is informational or normative (Wijenayake et al., 2020), or whether participants privately accept or publicly comply to other people's opinion or behavior (Brauer & Chaurand, 2010; Huang et al., 2014),

the varieties of information or norms usually relate to social or human sources and issues, as conformity to social/human pressure or influence is assumed to depend on perceiving the reference information source as related to one's own social identity, group, or category (Abrams et al., 1990).

While there are a few studies that explored the conformity effect when the reference information was not (overly) social or at least not human in nature (Kim & Hommel, 2015; Qin et al., 2022; Salomons et al., 2018; Vollmer et al., 2018), whether and to what degree such non-human information can induce conformity remains an open issue. For example, a researcher compared “robot peer” and “human peer” conditions using Asch's conformity paradigm. Participants were asked to indicate which of three comparison lines on the right matches a target line on the left. Children (Vollmer et al., 2018) and adults (Qin et al., 2022; Salomons et al., 2018) were found to conform to robot peers, no matter whether they were or were not the majority in this group. The authors proposed that people may treat robots just like people, and their interactions with robots like real-life interactions with humans, so that participant-robot interactions would also be social in nature. Kim and Hommel (2015) suggested that people may also show conformity phenomena to computer-generated information without obvious social meaning. Their study employed a two-phase conformity paradigm (Shestakova et al., 2012). In the first phase, participants were to rate the perceived beauty of unfamiliar faces, presented one by one, by pressing a number key. After each judgment, they were presented with another number, and participants were told that they only need to watch this number but do nothing. After a break, the second phase followed, in which participants were again to rate the same face stimuli in terms of beauty. Even though the number presented after the initial judgment carried no explicit social meaning, the authors observed a conformity effect (internalization according to Lascu & Zinkhan, 1999): participants in the second stage changed their previous rating in the direction of the shown number, that is, the beauty of the face stimuli was rated lower than before if the random number happened to be lower; and rated higher than before if it happened to be higher than the initial rating.

Kim and Hommel (2015) proposed a parsimonious account for the underlying mechanism of conformity behavior using the Theory of Event Coding (TEC; Hommel, 2015, 2019; Hommel et al., 2001). The account deemphasized the importance of social/human nature in conformity, and instead focused on the importance of cognitive representations (event files) in generating the post-exposure response based on a mixture of the initial (self-produced) response and the other-produced response. Specifically, according to TEC, event files are cognitively coded in terms of their perceivable (stimulus and response) features, irrespective of whether these are self- or other-produced and whether they relate to “self” or “others” (Hommel, 2004, 2009; Hommel et al., 2009; Prinz, 1990). If so, rating a face in the first phase would create an integrated event representation (event file; Hommel, 2004) comprising feature codes related to the stimulus and the corresponding rating score. Perceiving the random number would create another event file containing the feature codes related to the face stimulus and the number, irrespective of the number's social meaning. Encountering the same face again in the second phase would then retrieve both event files, including the coded scores, so that participants may report the (perhaps weighted) average of both retrieved ratings, which would look like a conformity effect.

Rationale and study hypothesis

From the literature on conformity, we drew two conclusions that will be particularly relevant for the present study. First, when participants are exposed to social/human source information, task/stimuli characteristics modulate the extent of conformity, suggesting that attention plays a role. For example, adding incentives for response accuracy in Asch's paradigm increased conformity to social pressure (Baron et al., 1996). Likewise, inducing an abstract mindset increased, but inducing a concrete mindset eliminated participants' susceptibility and conformity to social influence (Ledgerwood & Callahan, 2012). When people pay less attention to sound discrimination, higher social pressure caused more conformity; but when they pay more attention to stimuli, both high and low social pressures caused

very little conformity (Tesser et al., 1983). People's resistance to peer pressure also depends on their attentional resources, which can be varied by means of dual-tasks (Grosbras et al., 2007). Second, if the information source is not social/human, or at least lacks social/human meaning, people may sometimes also show conformity. For example, children are sensitive to information from robots without obvious social/human meaning (Kim & Hommel, 2015; Vollmer et al., 2018). In the present study, we were interested in seeing how these two factors interact: Could it be that the degree to which people conform differently to agents with or without a social meaning depend on the availability of attention resources?

Study aims

We note that the experimental paradigm used by Kim and Hommel (2015) and others (Huang et al., 2014; Klucharev et al., 2009; Shestakova et al., 2012; Zaki et al., 2011) raised concerns, as their results may be affected or even caused by regression to the mean. Ihmels and Ache (2018) re-analyzed Kim and Hommel's data, after excluding conditions with extreme high and low initial ratings. Their reanalysis showed conformity effect in conditions that should not have evoked them, suggesting that the conformity effect in Kim and Hommel (2015) might have been overestimated. Hence, it was necessary to modify this paradigm to avoid the possible effect from regression to the mean.

The first aim of the present study was thus to see whether less-social/human conformity effects (i.e., adjustments of judgments caused by response from a computer which contains no explicit social/human connotation) can be demonstrated in a modified experimental paradigm that excludes any impact of regression to the mean. The paradigm was inspired by previous studies (Huh et al., 2014; Wright & Schwartz, 2010), developed and successfully tested by Kim and Hommel (2018). It also includes two experimental phases. However, in order to prevent regression to the mean, they replaced the free rating procedure by a forced choice task: in each trial of the first phase, the participant was presented with two pictures shown simultaneously on the screen and was asked to choose which one he/she favors. After this choice response, the participant was exposed to another "choice," indicated by highlighting one of the two pictures. In one group, this other choice was explicitly instructed to represent the choice of a human peer (social meaning) but, in another group, as reflecting a choice of the computer (lesser social meaning). These other choices could either be the same as or different from the participant's own initial choice. After a break, in the second phase participants were presented with the same stimuli, trial by trial, and the participants were again to select their favorite picture. In analyzing the results, we considered the choice changes in the "same" condition as baseline (reflecting random or arbitrary change tendencies, independent from the impact the other choice); and increases of choice changes in the "different" condition as compared to changes in the "same" condition as evidence for the conformity effect. According to TEC, conformity effects can be expected in both human peer and computer conditions (Kim and Hommel, 2015).

The second aim of the present study was to get a better understanding of the mechanism underlying the conformity effect. This idea was inspired by above-discussed previous studies (Grosbras et al., 2007; Tesser et al., 1983), suggesting that manipulating the attentional resources participants' allocate to stimuli may affect the conformity to a less-social/human informational source—as expected from the TEC account. TEC assumes that effects that rely on interactions between previously created event files and the present can only be demonstrated if two conditions are met (Hommel, 2022): The original event file has been created, for instance binding to-be-judged stimuli to the corresponding judgment in the first phase, and this original event file is retrieved when being confronted with the same stimuli again, something we assume happen in the second phase. Possible contextual dependencies of conformity effects may thus depend on an impact on feature binding, on event-file retrieval, or both.

To identify the possible contributions from these processes, we first ran the basic conformity paradigm without manipulating the attentional allocation in Experiment 1, hypothesizing stronger conformity effect in social/human than computer conditions. Then we attempted to target each of them separately by means of a secondary task (which was shown to impact attention allocation in

previous findings) in Experiment 2 and 3, so to see whether this would interact with the respective contextual dependency or impact of the nature of the information source. We hypothesized that in both social/human and computer (lesser social/human meaning) conditions, manipulating participants' attention allocated to the available source information (responses from the social/human or computer source) should affect the degree of participants' conformity (Bearden & Rose, 1990; Grosbras et al., 2007).

In our experiments, we report all measures, manipulations, and exclusions, as well as our methods to determine sample sizes. Full data for all experiments are available on OSF.

Experiment 1

Design and participants

Experiment 1 had a mixed factor design, with *nature* of “other choice” (human vs. computer peer information) as a between-participant factor, and response *similarity* (the other choice was the same as vs. different from participant's own initial choice) as a within-participant factor. We tested 111 students from one University in China in total. They were split into two groups, a “human peer” group with 56 participants, age 19–23, mean age 21.04, SD = 0.972, 11 males; and a “computer peer” group with 55 participants, age 19–24, mean age 20.38, SD = 1.009, 13 males. This sample size provided 80% power to detect an effect size of $f = .212$ or greater in a between-samples F test with a 5% false-positive rate, number of groups was set to 2, and measurements was 4, correlation among repeated measure was 0.5, using an sensitivity power analysis (G*Power; Faul, Erdfelder, Lang, & Buchner, 2007). The experimental protocol was approved by the local ethics committee. All participants had normal or corrected-to-normal vision. They were naïve with regards to the purpose of the study, gave their informed consent, and were paid for their participation. At the end of the experiment, all participants were debriefed about the study.

Procedure

The program was written with E-Prime. We created 110 set pairs in total from 220 pictures of flowers. As shown in Figure 1, in session 1, participants were presented with pairs of two pictures on a computer screen in each trial. They were initially to decide which of the two they favor (like better)

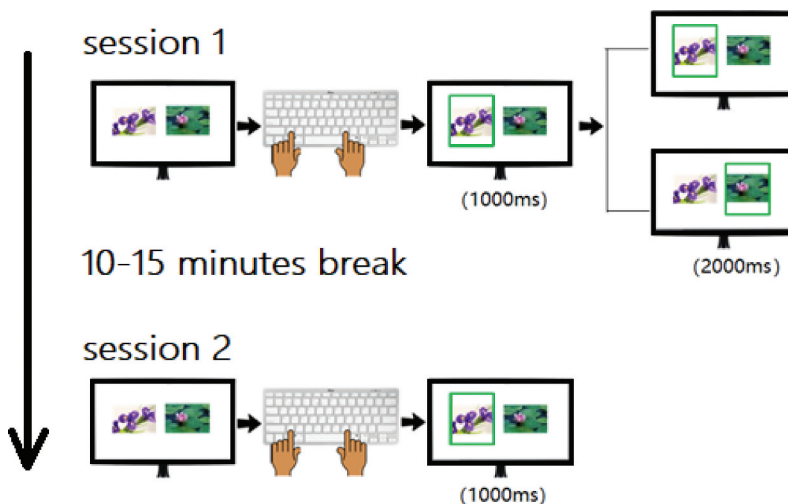


Figure 1. Schematic representation of experiment 1.

and indicate their choice of the left or right picture by accordingly pressing the Z or the M key of the computer keyboard. Their choice was indicated by a green frame surrounding the chosen picture that appeared for 1000 ms. Then the reference event, i.e. the other choice, occurred: the same pair of pictures was presented again, also with a green frame surrounding one of the pictures. Importantly, this time the frame could surround either the same picture that was chosen by the participant or the other one, with a probability of this choice being the “same” as or “different” from the participant’s own initial choice of 50%. In the “human peer” condition, participants were told that this “other choice” would represent the average choice of other students; while in the “computer peer” condition, participants were told that this “other choice” was generated by the computer. Participants were told that they would need to watch the reference event without making any action, but to orally report the two choices within 2000 ms. This was to make sure that the reference event was attended but that participants did not engage in another judgment. After a 10- to 15-minute break, in the second session, the same 110 pairs were presented again, in random sequence, and participants needed to press the Z or M key to indicate their post-exposure choice. No reference event was presented in this session.

Results

For each participant, and separately for the two nature conditions (human peer vs. computer peer), we calculated the percentage of stimulus pairs for which participants’ choice changed from the first to the second session, for both when the “other choice” was the same as or different from the participant’s choice. That is, we calculated changed items/total items ratios for same and different “other choices” separately. We took the choice-change percentage when the “other choice” was the same as the participant’s initial choice as baseline, which may represent the extent that one participant changed his/her choices without the impact from social influence (anti-conformity), in both “same” and “different” conditions. Percentage of choice-changes were submitted to a 2×2 analysis of variance (ANOVA) with nature (human vs. computer) varying as between-participant factor, and choice similarity (same vs. different) as within-participant factor.

The ANOVA revealed significant main effects of similarity, $F(1, 109) = 7.551, p = .007, \eta_p^2 = 0.065$, the percentage of choice-changes was higher for different (Mean = 0.237, SE = 0.008) than for same “other choices” (Mean = 0.216, SE = 0.009). The main effect of group was not significant, $F(1, 109) = 1.321, p = .253, \eta_p^2 = 0.012$. Importantly, a significant two-way interaction involving the two factors was obtained, $F(1, 109) = 4.812, p = .030, \eta_p^2 = 0.042$.

Two tailed paired t-tests showed that changing percentage was significantly higher for different than same “other choices” (the conformity effect) if the “other choice” was from “human peer” and had a social connotation, $t(55) = 3.349, p = .001, d = 0.417$; but not in the “computer peer” condition which contained less-social/human meaning, $t(54) = 0.412, p = .682, d = 0.049$. Independent-samples t-tests showed that changing percentage when “other choices was different from mine,” social/human group changed more than computer peer group, $t(109) = 2.094, p = .039, d = 0.398$; but no social group effect for changing percentage when “other choices was the same as mine,” $t(109) = 0.025, p = .980, d = 0.005$. Please see [Figure 2](#).

Discussion

In accordance with our hypothesis, participants changed their choice toward the “other choice” more if this other choice was different from their own previous choice. That is, we were able to replicate the basic conformity effect with our paradigm. As the structure and logic of this paradigm excludes regression-to-the-mean effects, we can be certain that our similarity effect is a pure and valid reflection of conformity. Interestingly, this conformity effect was only found for the human peer condition, but not the computer peer condition. That is, participants changed their previous choice only if they were exposed to other people’s choices that they thought to represent the opinions of a relevant reference group, but not if they thought that these choices represent computer outcomes.

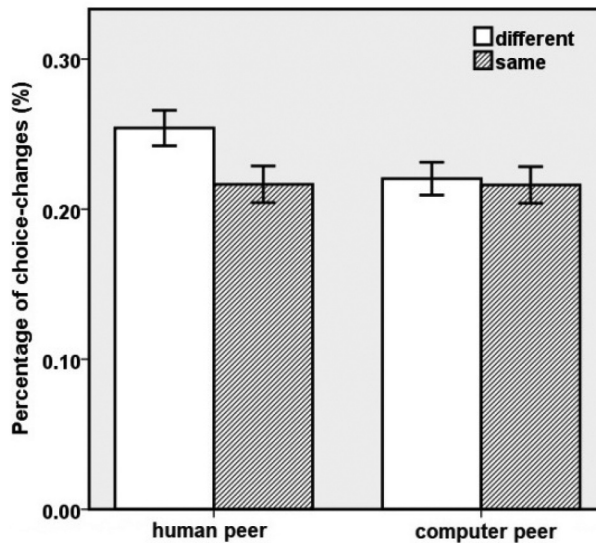


Figure 2. Percentage of choice-changes as a function of nature of “other choice” (human peer vs. computer peer information), and choice similarity (the other choice was the same as vs. different from participant’s own initial choice) for experiment 1. Conformity effect were represented by subtraction of the choice-changes percentage obtained for same “other choices” from that obtained for different “other choices.” Error bars represents ± 1 standard error.

On the one hand, our findings are consistent with previous observation that conformity effects are more pronounced in social contexts (Abrams et al., 1990), but less likely when the social connotation is low or absent, such as when participants respond anonymously (Asch, 1956) or when the other opinions stem from robots rather than from human peers (Vollmer et al., 2018, results from adult participants). On the other hand, however, our findings are different from results from robot studies (Vollmer et al., 2018, results from children participants; Qin et al., 2022; Salomons et al., 2018) in which the “other choices” were explicitly described as stemming from artificial agent or computer (Kim & Hommel, 2015).

More generally speaking, it makes sense to assume that computer information as used in Experiment 1 has less social meaning than information coming from a robot (with more agency features). A robot may be perceived as a more representative artificial intelligence expert, and the humanlike appearance of the robot may potentially play an important role as well (Qin et al., 2022). Hence, the inconsistencies in previous studies do not necessarily suggest that conformity effects with computer-generated intervening events are impossible to obtain (Kim & Hommel, 2015), but rather may imply the existence of not yet fully understood contextual and/or task factors, such as the attention allocation between stimuli and choice responses information, that determine whether such effects do or do not occur. This motivated us to further investigate the processes underlying the conformity phenomenon in computer conditions in two additional experiments, in which we sought to determine whether the different impact of human and computer conditions on conformity is related to encoding and/or retrieval processes.

Experiment 2

According to TEC, the occurrence of conformity effects relies on at least two processes: the binding of the to-be-responded-to stimulus, like the pictures in our Experiment 1, to the response, such as pressing a key or otherwise indicating a preference, irrespective of the author of this response, and the later retrieval of the corresponding bindings when encountering the same stimulus in the second session (Hommel, 2022). Hence, conformity relies on both *encoding* of

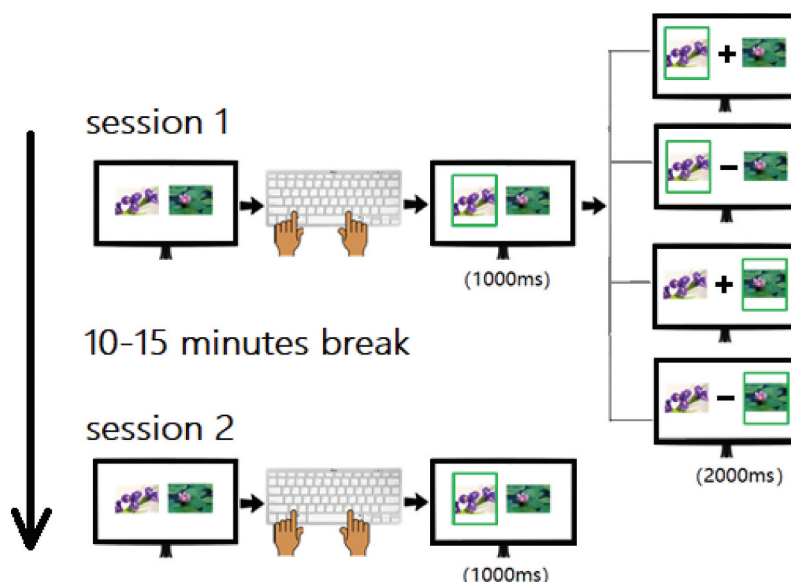


Figure 3. Schematic representation of experiment 2.

the initial response and *retrieval* when performing the post-exposure response. Accordingly, the impact of contextual variability on conformity effects, such as in comparisons of human and computer conditions, might be also related to encoding, retrieval, or both. In Experiment 2, we focused on encoding.

Experiment 2 was designed exactly as Experiment 1, except that we adopted a dual-task design by adding a secondary task to the first session in Figure 3 of the experiment, in which encoding should take place. This secondary task was adopted from a previous study (Swallow & Jiang, 2010). It was supposed to draw attentional resources away from the encoding process and toward the concurrently processed information, which in turn should hamper the storage of the relevant initial response and its binding to the corresponding picture. Without storing this respective event file, conformity could not take place according to TEC, which predicts that the more difficult dual-task conditions should reduce the conformity effect – if encoding would be the critical process.

Like Swallow and Jiang, we used a go/nogo task, in which participants were presented with one of two additional signs other than the pictures. In our case, for the secondary task, we presented “plus” or “minus” signs in between the two pictures that served to indicate the “other choice”, and participants were to press the space key to the plus sign but to refrain from responding to the minus sign. According to previous studies using this task, we expected that the go-trials of this kind of secondary task facilitate encoding the stimuli and both choices into event files memory more than nogo-trial do (the so-called *Attentional Boost Effect*; Mulligan & Spataro, 2015; Spataro et al., 2013; Swallow & Jiang, 2013). If so, event files should be more detailed and specific after go trials than after nogo-trials, which might prevent or reduce the confusion between “own” and “other” event files, so that the conformity effect should be smaller after go than after nogo trials – if encoding plays a role. Accordingly, a possible interaction between the nature of “other choice” factor and the secondary task manipulation (go vs. nogo) would point to a role of encoding, with respect to the question at which condition conformity effects to “other choices” do or do not occur. Note that our hypothesis was made according to a highly-related study (Bearden & Rose, 1990), in which the authors proposed that (with informational, but not normative information) manipulating attention may be an effective method of impacting conformity: more attention on the stimuli and information reflects that participant were reluctant to accept the other’s judgment, i.e., they showed less conformity.

Design and participants

Experiment 2 had a mixed-factor design, with *nature* of “other choice” (human and computer information) as a between-participant factor, choice *similarity* (the other choice was the same as vs. different from participant’s own initial choice) and *encoding* (strong vs. weak) as within-participant factors. We tested more participants to detect the sought-for effects and confirm our results. One-hundred and twenty-eight participants were tested, and they were randomly assigned to one of the two experimental nature conditions: A “social” group with 64 participants, age 18–25, mean age 20.20, $SD = 1.644$, 11 males; or a “computer” group with 64 participants, age 17–22, mean age 19.41, $SD = 1.411$, 7 males. This sample size provided 80% power to detect an effect size of $f = .187$ or greater in a between-samples F test with a 5% false-positive rate, number of groups was set to 2, and measurements was 8, correlation among repeated measure was 0.5, using an sensitivity power analysis (G*Power; Faul et al., 2007).

Procedure

The method was the same as in Experiment 1, except that we added a secondary task to manipulate encoding. As shown in Figure 3, the two pictures were shown again to present the “other choice”, which was indicated by a green frame surrounding one of the pictures. This time, however, a “+” or “-” sign appeared in the middle of the two pictures (Meng et al., 2019) and participants were to press the space key for the “+” (a go response) but to refrain from responding for the “-” sign (a nogo response). Participants again were to verbally report the two choices within 2000 ms. The combinations of go/nogo conditions and same/different “other choices” were all equally probable. The second session was as in Experiment 1.

Results

Choice-change percentages were computed as in Experiment 1 and submitted to a repeated measures $2 \times 2 \times 2$ ANOVA with nature of “other choices” (human vs. computer) varying as between-participant factor, and choice similarity of “other choice” (same vs. different) and secondary task action (go vs. nogo) as within-participant factors.

The ANOVA revealed a significant main effect of similarity, $F(1, 126) = 16.392$, $p < .001$, $\eta_p^2 = 0.115$: the choice-change percentage was higher for different (Mean = 0.261, $SE = 0.007$) than same “other choices” (Mean = 0.230, $SE = 0.007$). Importantly, a significant two-way interaction between similarity and secondary task action was observed, $F(1, 126) = 8.803$, $p = .004$, $\eta_p^2 = 0.065$; also for the three way interaction, $F(1, 126) = 4.753$, $p = .031$, $\eta_p^2 = 0.036$. No other significant effects were found, $ps > 0.160$ (see Figure 4).

Because the two-way interaction between similarity and secondary task action was significant, we further ran two-tailed paired t-tests, showing that the similarity effect (the conformity effect) was significant in nogo trials, $t(127) = 5.085$, $p < .001$, $d = 0.429$; but not in go trials, $p = .404$. To disentangle the three-way interaction, we analyzed the results by means of repeated measures 2×2 ANOVAs with choice similarity of “other choice” (same vs. different) and secondary task action (go vs. nogo) as within-participant factors, separately for human and computer group.

For the human group, we found a significant main effect of similarity, $F(1, 63) = 15.215$, $p < .001$, $\eta_p^2 = 0.195$: the choice-change percentage was higher for different than same “other choices”. No significant effects involving secondary task were found, $ps > 0.55$. Two-tailed paired t-tests showed that the similarity effect (the conformity effect) was significant (after Bonferroni correction) in nogo trials, $t(63) = 3.020$, $p = .004$, $d = 0.378$, and in go trials, $t(63) = 2.778$, $p = .007$, $d = 0.327$.

For the computer group, we found a not-quite-significant main effect of similarity, $F(1, 63) = 3.436$, $p = .068$, $\eta_p^2 = 0.052$: the choice-change percentage tended to be higher for different than same “other choices”. No significant main effect of secondary task was found, $p = .744$,

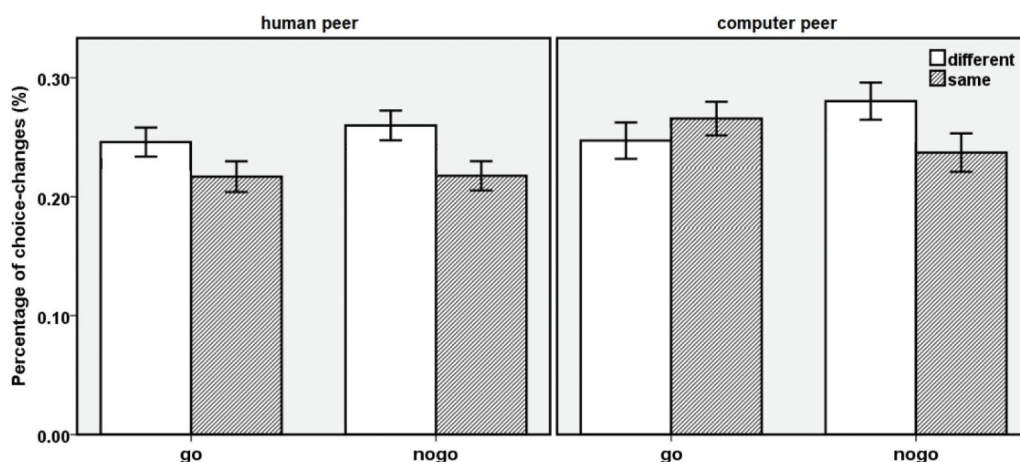


Figure 4. Percentage of choice-changes as a function of the nature of the “other choice” (human vs. computer information), encoding (go vs. nogo), and the choice similarity (the other choice was the same as vs. different from participant’s own initial choice) for experiment 2. Conformity effect was represented by subtraction of the choice-changes percentage obtained for same “other choices” from that obtained for different choices. Error bars represent ± 1 standard error.

the interaction between similarity and secondary task was significant, $F(1, 63) = 11.622$, $p = .001$, $\eta_p^2 = 0.156$. Two-tailed paired t -tests showed that the similarity effect (the conformity effect) was significant in nogo trials, $t(63) = 4.253$, $p < .001$, $d = 0.490$; but not in go trials, $p = .318$.

Discussion

In Experiment 2, the conformity effect was modulated by similarity and encoding, while the nature of the “other choice” no longer had a main effect, which has a number of implications. First, we again obtained a significant effect of similarity (the conformity effect), which replicates our finding from Experiment 1 and demonstrates the robustness of our paradigm with respect to conformity effects. Second, the absence of a significant main difference between the human and computer condition shows once again that human and computer intervening events can act alike under some conditions (Kim & Hommel, 2015; Vollmer et al., 2018), even though our findings from Experiment 1 indicate that this may not generally be the case. Third, while the main effect of peer type in Experiment 1 suggested that the nature of the informational source might be key, the interaction obtained in Experiment 2 rather points to factors related to encoding and the specificity of the event files that are encoded.

From a TEC perspective, this outcome might imply two not mutually exclusive accounts. For one, go-trials may indeed have mobilized more attentional resources, and this might indeed have facilitated the integration of pictures and opinions, very much along the lines of Swallow and Jiang (2010, 2013). However, this may not only have created more robust bindings but may also have boosted the attention to authorship, that is, the discrimination between the participant’s own initial choice and the choice of the “other.” Hence, event-file discriminability might have been improved through go-trials, perhaps by a stronger emphasis on agency. This in turn might have worked against the retrieval of the “other choice” when encountering the pictures again in the second session, which would prevent the conformity effects from occurring. For another, go-trials cannot only be assumed to mobilize more attention, they also bring in an additional response. If the code of this response would tend to be integrated into the event file representing the “other choice”, this event file would become more different from the event file representing the participant’s own initial choice, which in turn would increase event-file discriminability. In any case, it makes sense to assume that go-trials rendered the

event files representing the participant's own initial choice and the "other choice" more discriminable, which is likely to reduce the retrieval of the latter in the second session.

Experiment 3

Experiment 3 followed a similar logic as Experiment 2 but focused on retrieval rather than encoding. Accordingly, we moved the secondary task to the second session, in which the retrieval of memory traces created in the first session were likely to be involved in creating the conformity effect. That is, in the post-exposure choice response session, we added the secondary go/nogo task signaled by plus and minus signs to the primary task, which still required a post-exposure choice response to the two pictures.

Ample evidence regarding the impact of divided-attention manipulations on memory retrieval suggests that no attentional boost effect is to be expected (e.g., Craik et al., 1996; Graf & Schacter, 1987; Lin et al., 2021; Lozito & Mulligan, 2010). This suggests that, in the retrieval session, the secondary task can be assumed to divide attention and impair memory retrieval of previously encoded information. If so, we would assume that in the retrieval session in Experiment 3, fewer attentional resources are available for the retrieval of event files, which should render retrieval less selective. To the degree that conformity reflects the confusion of even files, as TEC suggests, this should increase the probability of obtaining conformity effects. Indeed, a previous study found that the conformity effect is stronger the less attention people spend on the task (Bearden & Rose, 1990). Given that both go and nogo trials divert attention from the main task, we expected substantial conformity effects in both go- and nogo-trials.

Design and participants

Experiment 3 had a mixed-factor design, with *nature* of "other choice" (human vs. computer information) as a between-participant factor, and choice *similarity* (the other choice was the same as vs. different from participant's own initial choice) and secondary task action (go vs. nogo) as within-participant factors. One hundred and one participants were tested, and they were randomly assigned to the "social" group with 51 participants, age 18–23, mean age 19.96, SD = 1.52, 4 males; or the "computer" group with 50 participants, age 18–24, mean age 20.30, SD = 1.50, 5 males. This sample size provided 80% power to detect an effect size of $f = .211$ or greater in a between-samples F test with a 5% false-positive rate, number of groups was set to 2, and measurements was 8, correlation among repeated measure was 0.5, using an sensitivity power analysis (G*Power; Faul et al., 2007).

Procedure

The first session was as in Experiment 1. However, in the second session, the presentation of the stimulus pairs that participants were to judge was combined with the presentation of either a "+" or a "-" sign. Participants were to press the space key when being presented with a "+" sign (go response) and refrain from responding when being presented with a "-" sign (nogo response). The remaining parts of the second session were as in Experiment 1 and 2, see Figure 5.

Results

Choice-change percentages were computed as in Experiment 1 and submitted to a repeated measures $2 \times 2 \times 2$ ANOVA with nature of "other choices" (human vs. computer) varying as between-participant factor, choice similarity of "other choice" (same vs. different) and secondary task action (go vs. nogo) as within-participant factors.

The data were analyzed as in Experiment 2. The ANOVA revealed a significant main effect of similarity, $F(1, 99) = 14.311$, $p < .001$, $\eta_p^2 = 0.126$, indicating that the choice-change percentage was higher for different (Mean = 0.261, SE = 0.010) than same "other choices" (Mean = 0.229, SE = 0.010). No other effect was significant, $ps > 0.29$. Please see Figure 6.

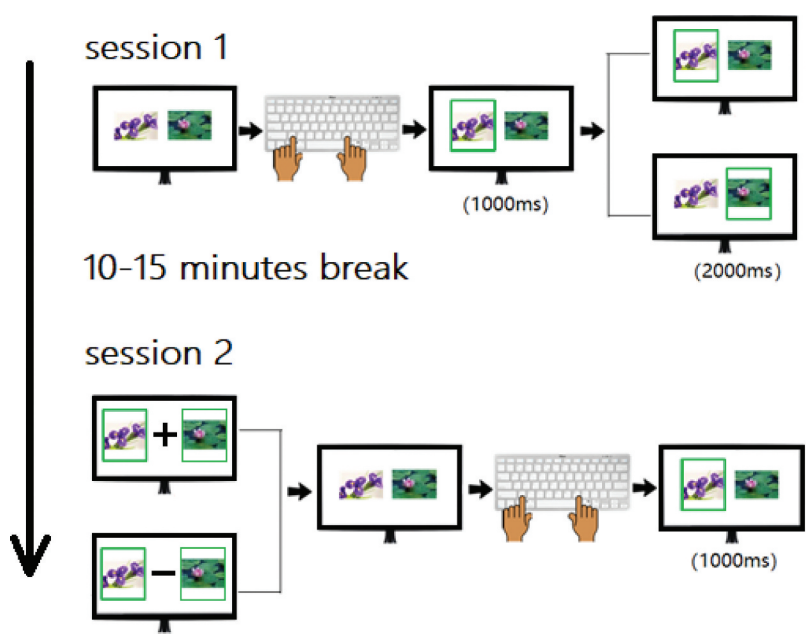


Figure 5. Schematic representation of experiment 3.

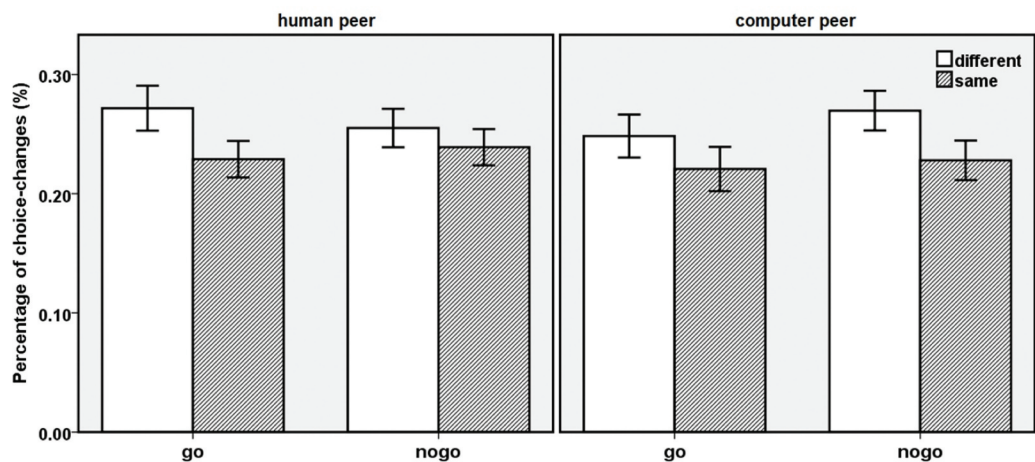


Figure 6. Percentage of choice-changes as a function of nature of “other choices” (human vs. computer), similarity of “other choice” (same vs. different) and secondary task action (go vs. nogo) for experiment 3. Conformity effect was represented by subtraction of the choice-changes percentage obtained for same “other choices” from that obtained for different “other choices”. Error bars represents ± 1 standard error.

Discussion

The fact that we obtained only a significant main effect of similarity has three important implications. First, we again found a conformity effect as in Experiment 1 and 2, thus providing further evidence for the robustness of our paradigm. Second, we again found no main difference between human and computer conditions, suggesting that conformity effects in computer conditions also exist. Third, we found evidence that divided attention in retrieval increased the conformity effect to previously encoded information from both human and computer sources. This finding is also consistent with the observation of conformity effects in the “nogo” condition of Experiment 2.

General discussion

In this study, we ran three experiments using a modified conformity paradigm that precluded artifacts from regression-to-the mean effects (Kim & Hommel, 2018). Participants chose between pairs of pictures, were exposed to “another choice” that was attributed to either a relevant human peer or the computer peer, without a secondary task (Experiment 1 and 3) or with a secondary task that was likely to affect the encoding of picture-choice bindings (Experiment 2), then took a break, and then chose between the same pairs of pictures without a secondary task (Experiment 1 and 2) or with a secondary task that was likely to affect the retrieval of picture-choice bindings (Experiment 3). Participants showed conformity to other social/human, but not computer choices in the absence of a secondary task (Experiment 1), to social/human other choices in all trials during encoding (Experiment 2), and to computer choices in nogo trials during encoding (Experiment 2), and lastly in both go and nogo trials during retrieval (Experiment 3).

One conclusion that can be taken from these findings is that seemingly subtle, task-specific modifications of the design can make a big difference with respect to whether conformity effects from nonsocial, or at least non-human informational sources can be obtained. At the surface, Experiments 1 and 3, and the nogo condition of Experiment 2 look very similar indeed, and yet, rather different outcomes were obtained. This confirms our impression from the available literature, suggesting that effects of conformity are particularly sensitive to manipulations of task and stimuli, which sometimes suggest that more social and less social informational sources have comparable impact on conformity, while other circumstances suggest the opposite. More specifically, our findings suggest that these discrepancies depend on the degree to which task conditions and other circumstances affect the allocation of attentional resources and the direction of the attentional focus during task performance. Conformity effects decreased when participants allocated more attention to their choices in the computer/go condition of Experiment 2; but increased when they allocated less attention to their choices in the nogo conditions of Experiments 2 and 3. While it can be challenging to determine the impact of particular task conditions on the allocation and direction of attentional resources, which may make it hard to predict their impact on conformity effects, our findings strongly suggest that these factors need to be considered in order to better understand the determinants of conforming behavior.

Even though a number of previous studies showed that conformity effect was significantly higher for objective questions with one correct answer (Asch, 1951) than for subjective reports of personal feelings or opinions (Allen, 1965; Klucharev et al., 2009; Wijenayake et al., 2020), our findings suggest that at least under some circumstances, with specific paradigms, and with an appropriate experimental design, conformity behavior to subjective feelings can manifest itself. Moreover, and this was one of the key questions of the present study, conformity effects can be obtained even for choices that participants know were computer-generated. Hence, conformity does not rely only on information that can be traced back to other humans.

Taken altogether, the result pattern obtained in the present study suggests the following admittedly tentative scenario. When people experience responses from either themselves or from others to particular stimuli, they create event files that integrate relevant codes of stimuli features and relevant codes of response features. Findings from Experiment 1 suggest that these event files also contain information about the nature of the agent that generates “other choices”. Hence, people acquire information that allows them to distinguish between human and computer agents, but this information can also be modulated by circumstances. Circumstances that distract from this kind of information seem to be secondary tasks, as used in the present study, which is why the nature of the agent was neglected in the computer source and nogo trials of Experiment 2 and in all trials of Experiment 3. Under more natural conditions that do not require divided attention, as in Experiment 1, the likelihood to consider social/human information more than computer information seems to be considerably higher. In other words, people seem to spontaneously take into account social information more than computer

information – which fits with many demonstrations of a higher impact of social cues (e.g., Deaner & Platt, 2003; Langton & Bruce, 1999).

However, more complex task conditions or circumstances might render computer information equivalent to social information. Our findings suggest that distraction during encoding or retrieval might be one of these conditions. Experiment 3 did not yield any difference between go and nogo trials, suggesting that the additional need to respond in go trials did not have any specific effect. However, the presence of the secondary task as such is likely to have required divided attention to a degree that rendered retrieval of before responses more superficial, so that information about the social/human or computer nature of the agent was considered less. The same seems to have happened in Experiment 2, in which the nature of the agent was also neglected when in nogo trials. Interestingly, the conformity effect was eliminated in the computer and go-trial condition in this experiment. As we have argued, this might be due to the additional mobilization of potential resources, which might have rendered agency information more relevant. However, had that been the case, one would have expected that the nature of the other agent would also have been coded more strongly, which in turn should have yielded a corresponding effect. Alternatively, the presence of the go response might have been crucial, by making the other choice less similar to the own choice. The two accounts would both fit our outcome pattern. In any case, we suggest that conditions that, for one reason or another, make the event files representing people's own choices and those of others, be they of social/human or computer nature, less similar (i.e., more discriminable) can be expected to work against conformity effects. To conclude, our findings show that conformity effects do not necessarily require a social/human nature of other choices, even though social/human sources may be more likely to be considered than computer sources under particular circumstances—especially in simple tasks and in the absence of other distractors or challenges.

The results of our three experiments have both practical and theoretical implications. From a practical perspective, our results suggest that computer information can also influence conformity, similar to a human source, especially if combined with an appropriate manipulation of attentional resource allocation. From a theoretical perspective, our results can be explained by the TEC, which assumes that people encode their own initial response and the exposed other response into different, but confusable event files. When they are facing the same stimuli again, as in our post-exposure session, they tend to confuse the event files more the less specific the event files are and the less attentional resources are available for selective retrieval. The more the event files are confused, the larger will be the conformity effect.

Limitations and future directions

The current work has several limitations that need to be considered in future research. First, our sample was from China, so that the cultural background of our participants can be characterized as collectivistic, as compared to individualistic (Qin et al., 2022); and as vertical, as compared to horizontal (Chen et al., 1997). Even though our results are consistent with Kim and Hommel (2015) whose sample was from Europe, we also note differences from other previous studies. For example, Vollmer et al. (2018) found that adults resisted in a Western sample, whereas Qin et al. (2022) found younger adults accepted conformity and showed conformity effects in a Chinese sample—even with robot peers. It is thus possible that participants from Eastern and Western cultures show systematic differences and, perhaps, different sensitivity to the social/human meaning of conformity-related information. In any case, it seems important to try replicating the impact of attentional manipulations on conformity in Western or otherwise individualistic samples.

Second, it remains important but difficult to tackle the conceptual issue of whether computers and robots can be considered nonsocial sources at all. The degree to which they are perceived as nonsocial might depend on and change with generations, personal experience, and general attitudes toward technology, in the sense that some people may treat computers/robots as social actors (Vollmer et al., 2018). This raises the question of whether other factors

and manipulations can be found, in order to see whether social meaning is relevant for conformity effects at all.

Third, in our study we only investigated informational conformity, which raises the question of whether similar findings can be observed for normative conformity. It is possible that normative information automatically attracts more attention, which may render attentional manipulations less effective. Moreover, the fact that normative information is commonly coming from human agents, it is possible that technological peers have less of an impact.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Ethical approval

All procedures performed in this study were in accordance with the ethical standards of the local ethics committee and with the 1964 helsinki declaration and its later amendments.

Informed consent

Informed consents were obtained from all participants included in this study.

Open scholarship



This article has earned the Center for Open Science badges for Open Data and Open Materials through Open Practices Disclosure. The data and materials are openly accessible at <https://osf.io/m85qh>

Open practices statement

Raw data of the study are available on the Open Science Framework (<https://osf.io/m85qh>). The corresponding author can be contacted to ask for other materials. And the experiments were not preregistered.

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