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The Emotion-Induced Belief Amplification Effect

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Abstract

Exposure to images constitutes a ubiquitous day-to-day experience for most individuals. From mass-media exposure, to engagement with social-networking sites, to educational contexts, we are bombarded with images. Here, we explore the effect that emotional images have on belief endorsement. To investigate this effect, we test whether statements accompanied by emotionally arousing images become more or less believable than the same statements when they are accompanied by neutral images or by no images. We find that emotional images increase statement believability (Experiment 1, replicated in preregistered Experiment 2). We discuss the implications of this finding in the context of interventions aimed at reducing misinformation.

Keywords: belief update; misinformation; emotional arousal

Introduction

Humans are a highly visual species. They can process an image in only 13 milliseconds (Potter et al, 2014), they can remember for days 2000 images they've been minimally exposed to (Grady et al, 1998), they are more persuaded if an argument contains visual aids (Vogel, Dickson, & Lehman, 1986), and they judge statements as true more often when these statements are accompanied by an image (Newman et al, 2012). Thus, images can have a powerful influence on people, especially if they elicit emotions. A classic example of an emotional image having a powerful impact on human society is Sam Shere's 1937 photograph of the Hindenburg airship traveling from Frankfurt and arriving in New Jersey in flames. This image captured the areal tragedy and thereby instilled the belief that Hydrogen fueled passenger air travel is highly dangerous. It put an end to this means of travel, even though this hadn't been the first, nor the deadliest such incident (Lowndes, 2019).

The power of impactful, emotional images hasn't been lost in journalistic reporting. Thus, being a consumer of news media guarantees your exposure to emotionally arousing imagery, from natural disasters and wars, to tragic accidents, and grieving victims (Newhagen, 1998; Allan & Zelizer, 2004; Miller, 2006; Shoshani & Slone, 2008; Höijer, 2010). And reporters' use of emotional visual content to capture the attention of their audiences is not just based on lay intuitions on how to win the competition for sensationalism. Empirical research provides strong evidence for the hypothesis that viewers are more engaged with information presented by news reports that feature emotionally arousing content. For example, viewers are more likely to attend to news articles if these are accompanied by visual depictions of victimization, (Zillmann, Knobloch, & Yu, 2001), threatening images (Knobloch et al, 2003), or alarming images (Gibson & Zillmann, 2000).

Furthermore, images presented alongside information as supporting material have also been found to influence the believability of the information conveyed. For example, including brain images in neuroscience articles increases the believability of the articles' conclusions (McCabe & Castel, 2008; but see Schweitzer, Baker, & Risko, 2013). In another study, smoking warnings accompanied by images illustrating smoking hazards have been found to be more believable than written warnings alone (Shi et al, 2016). Despite this burgeoning literature, the impact of emotional images on message believability remains unexplored. Here, we are investigating whether statements accompanied by emotionally arousing visual stimuli become more or less believable than when accompanied by either neutral or no visual stimuli.

The belief formation literature provides compelling indications that emotional arousal could influence the believability of information. On one hand, emotional images may enhance believability of associated statements by making these statements more memorable. Extensive research shows that emotionally charged events experience enhanced encoding and subsequent recall (Cahill et al, 1994). For example, in a naturalistic experiment, Miller (2006) found that television news viewers were more likely to recall information when the news report was more emotional in nature, especially when it elicited feelings of disgust (Miller, 2006). And better memory for an experienced event has been shown, in a different context, to increase believability.

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Repeated presentation of trivia facts leads to increased believability of the facts, a phenomenon known as the illusory truth effect (Begg, Anas, & Farinacci, 1992; Ozubko & Fugelsang, 2011; Vlasceanu & Coman, 2018). This effect is so robust it has been shown to hold even in the presence of countervailing knowledge (Fazio, Brashier, Payne, & Marsh, 2015). Based on these findings, one would expect that emotionally arousing images would increase believability, an effect potentially mediated by memory accessibility.

On the other hand, emotional arousal could negatively affect belief endorsement. This prediction is supported by at least two potential mechanisms: a heuristic judgement mechanism (Murphy & Zajonc, 1993; Tversky & Kahneman, 1973; Petty & Briñol, 2015), and an attention mechanism (Loftus, Loftus, & Messo; 1987; Loftus, 1979; Hope & Wright, 2007). The former mechanism would posit that since emotions can be used as heuristics for judgements, negative feelings during statement evaluations could be misinterpreted as disagreement with the statement (Petty & Briñol, 2015). The latter mechanism would predict that negative emotional images may capture attention in a weapon focus effect manner (Loftus, Loftus, & Messo; 1987; Loftus, 1979; Hope & Wright, 2007), leading to increased memory for the image but suppressed memory for the statement, which can then lead to a decrease in the statement's believability (Vlasceanu & Coman, 2018). Thus, both mechanisms would predict negative emotional arousal to decrease statement believability.

Here, we investigate the impact of emotional images on believability in a main study and a preregistered direct replication study. Participants first rated the believability of a set of statements. They were then exposed to the statements again – this time alongside images that were conceptually relevant and negatively-valenced. The images were either highly arousing, neutrally arousing, or blank screens. We were interested to assess the degree to which the believability of the statement is affected by the arousing image that accompanied it, as measured in a subsequent believability task.

Experiment 1: Main study

Method

Participants. To detect a moderate effect size of 0.30 for within-subject comparisons with 0.80 statistical power we estimated a sample of 90 participants. Based on previous studies conducted in the lab which result in approximately 10% of the sample discarded due to pre-established criteria, we collected data from a total of 107 participants. Participants were recruited on Cloud Research (Litman, Robinson, & Abberbock, 2016), an Internet-based research platform similar to Amazon Mechanical Turk (MTurk) and were compensated at the platform's standard rate. The study protocol was approved by the Princeton University Institutional Review Board. Of the 107, 5 participants failed our attention checks and were therefore discarded from further analyses, following our pre-established discarding criteria. The attention checks were: two open-ended questions asking participants what their favorite food is (1) and how their day is going (2). An additional exclusion criterion was embedded in the task and involved indoor/outdoor and animate/inanimate judgements for each image (3). Participants who provided no answers to (1) and (2) or incorrectly answered more than 30% of the image judgments were discarded from analyses. After the exclusions, we performed statistical analyses on the final set of 102 participants (M_{age}=49.21, SD_{age}=17.26; 61% women).

Stimulus materials. We undertook preliminary studies to develop a set of 42 statements and their associated images. These statements were equally split into: 21 correct pieces of information (e.g., "*There are more jails than colleges in the U.S.*"), and 21 incorrect pieces of information. (e.g., "*Using a phone while pumping gas can ignite a fire.*"). The 42-statement set was selected from a larger initial set of 70 statements that we pretested using the Qualtrics platform on Cloud Research (N=153; M_{age}=35.06, SD_{age}=10.55; 39% women). We matched the correct and incorrect statements on three dimensions: perceived believability (i.e., as measured by the composite value of the questions "*How accurate do you think this statement is?*" and "*Do you think there is evidence that supports this statement?*"), perceived relevance (i.e., "*How relevant is this statement to you?*"), and perceived emotionality (i.e., "*How emotionally charged do you think this statement is?*"). All questions involved 0-100-point scales. The final set of chosen statements was selected such that the 21 true statements (Facts) did not differ significantly from the 21 false statements (Myths) on these dimensions.

We also developed a set of 42 pairs of images, each pair being representative of a statement. Of the two images in a pair, one was intended to be more emotionally arousing than the other. Otherwise, the two images were intended to be equivalent on several dimensions. To construct the intended stimuli set, we pretested a total of 288 images using the Qualtrics platform on Cloud Research (N=203; M_{age}=36.70, SD_{age}=28.99; 40% women) on four dimensions: emotional arousal (i.e., as measured by the question "*How emotionally arousing do you find this image?*"), emotional valence (i.e., "*How positive or negative do you find this image?*"), relevance for the statement (i.e., "*How closely do you think this image represents the statement?*"), and visual complexity (i.e., "*How visually complex do you find this image?*"). All questions involved 1-7 Likert scales, except where indicated otherwise. The final set of images contained 42 emotional images rated significantly more emotionally arousing than the 42 neutral images (Mean-Emotional images rating=4.94, SD=0.60; Mean-Neutral images rating=3.59, SD=0.53, $p<0.001$). To ensure both image types were categorized as having negative emotional valence, participants rated the question "*How emotionally positive or negative do you find this image?*" on a 9-point scale from 1="*Extremely positive*", to 9="*Extremely negative*", with the midpoint being marked

at 5="*Neutral*"). Both the Emotional images (M=7.76, SD=0.41, p<0.001) and the Neutral images (M=6.59, SD=0.67, p<0.001) were rated significantly more negative than the Neutral midpoint of 5. Crucially, the emotional images did not significantly differ from the neutral images on how representative of the statement they were (Mean-Emotional images rating=5.25, SD=0.58, Mean-Neutral images rating=5.18, SD=0.48, p=0.57) and they also did not differ on how visually complex they were (Mean-Emotional images rating=4.24, SD=0.79, Mean-Neutral images rating=4.28, SD=0.74, p=0.82). These controls within the stimulus set serve to disambiguate a potential effect of emotional arousal on believability from confounding explanations. For instance, they ensure the emotional images do not add additional evidence in support of their corresponding statements compared to the neutral images.

Design and procedure. Participants were told they would participate in an experiment about people's opinions concerning information frequently encountered on the Internet and were directed to the survey on the Qualtrics platform. After completing the informed consent form, participants were warned about the graphic content of the experiment, and told they can end their participation at any point should they experience any discomfort. After the warning, participants were asked to complete a series of demographic measures. Then, they were instructed to rate a set of 42 statements (one on each page) by indicating the degree to which they believed each statement (i.e., "*How accurate do you think this statement is?*" from 1-*Extremely inaccurate* to 100-*Extremely accurate*). This phase acted as both the believability pre-test and the encoding phase. Next, participants were asked to answer a distracter question (e.g., "*Please describe your favorite food*"), that also served as an attention check. During the statement-image association phase of the experiment, participants were shown the initial 42 statements again (also one on each page), this time alongside an image, and were asked two irrelevant questions that also served as attention checks (e.g., "*Does this image capture an indoor or an outdoor scene?*" and "*Does this image capture any people?*"). The pseudo-random pairing of images to statements was assigned such that of the 42 total statements, 6 of them were randomly assigned to the emotional image association condition, 18 statements were assigned to the neutral image association condition, and 18 statements were assigned to the blank image association condition. The decision to present fewer highly emotional images was made in order to minimize the psychological discomfort of the participants and to more closely match real-world conditions, where typically highly emotional events happen with reduced frequency, relative to neutral events (Walker, Skowronski, & Thompson, 2003). Moreover, varying the proportion of critical items has been found in a meta-analysis to have no impact on a similar effect, the illusory truth effect (Dechêne, Stahl, Hansen, & Wänke, 2010). These assignments were counterbalanced such that across the entire sample each statement was equally likely to be displayed with either an emotional, a neutral, or a blank image. After another distracter task (i.e., "*Please provide a brief description of how your day is going so far*"), participants were instructed to rate the believability of the initial 42 statements again (believability post-test phase). No images were presented in this phase. Finally, participants were debriefed and asked to review the false statements they were exposed to during this experiment to acknowledge their inaccuracy.

Results

The belief change score for every statement for each participant was computed by subtracting the belief score in the pre-test phase from the belief score in the post-test phase, and then averaging these differences across all statements within each condition (Emotional, Neutral, and Blank). We note that in our study some of the statements were accurate, while some of the statements were inaccurate. To test whether the accurate and inaccurate statements elicited different results, we ran a Repeated Measures ANOVA with Accuracy and Image Type as independent variables and found no main effect of accuracy (p=0.462), and no interaction between image type and accuracy (p=0.115). Therefore, we decided to conduct the analyses combining the correct and incorrect statements. A Repeated Measures ANOVA with Item Type as the within-subjects independent variable and belief change as the dependent variable revealed a main effect of Item Type, F (2, 202)=3.491, p<0.032, η_p^2=0.033. Posthoc analyses revealed that statements in the Emotional condition showed a significant increase in believability (M=8.50, SD=15.92) compared to statements in both the Neutral condition (M=6.10, SD=12.50), t(101)=2.11, p<0.038, *Cohen's d*=0.17, *CI*[1.14, 4.66], and Blank condition (M=5.17, SD=14.55), t(101)=2.18, p<0.032, *Cohen's d*=0.22, *CI*[1.52, 6.35] (Fig.1A).

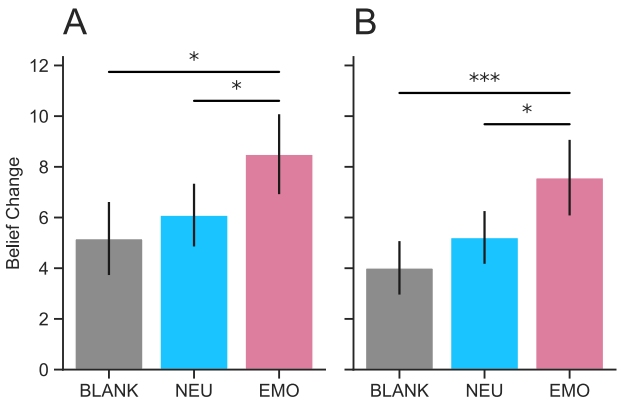


Figure 1. Belief change computed as the difference between Post-belief estimation and Pre-belief estimation in Main Study (Panel A) and Replication Study (Panel B). Blank condition represented in grey, Neutral condition represented in blue, and Emotional condition represented in red. Error bars represent ±1 standard error of the mean.

Discussion

We find that all statements increase in believability upon re-exposure. Furthermore, the results show that statements in the Emotional condition increase in believability even more, compared to those in both the Neutral and Blank conditions. This finding is consistent with the hypothesis that emotional images may enhance believability of associated statements by making these statements more memorable, according to literature on the illusory truth effect (Begg et al, 1992; Ozubko & Fugelsang, 2011). This finding also provides evidence against the competing hypothesis that emotional images may hinder statement believability, as predicted by a heuristic judgement mechanism or an attention mechanism.

To solidify the finding that emotional images increase statement believability compared to neutral or no images, we conducted a preregistered, direct replication of Experiment 1.

Experiment 2: Replication study

Method

Participants. To run a direct replication of Experiment 2, we collected data from a total of 104 participants, also recruited on Cloud Research, and compensated at the platform's standard rate. Of the 104, 4 participants failed the attention checks described in Experiment 1 and were therefore discarded from further analyses as stated in the preregistration. After the exclusions, we performed statistical analyses on the final set of 100 participants (M_{age}=55.8, SD_{age}=14.98; 63% women).

Stimulus materials. We used the same stimuli as in Experiment 1.

Design and Procedure. We used the same design and procedure as in Experiment 1.

Results

The belief change score for every statement for each participant was computed by subtracting the belief score in the pre-test phase from the belief score in the post-test phase, and then averaging these differences across all statements within each condition (Emotional, Neutral, and Blank). To test again whether there is a difference in the effect between the accurate and inaccurate statements, we conducted a Repeated Measures ANOVA with Accuracy and Image Type as independent variables, and found no main effect of accuracy (p=0.751), and no interaction between image type and accuracy (p=0.466). Thus, as before, we conducted the analyses combining the correct and incorrect statements. A Repeated Measures ANOVA with Item type as the within-subjects independent variable and belief change as the dependent variable revealed a statistically significant main effect of Item Type, $F(2,402)=9.937$, $p<0.001$, $\eta_p^2=0.076$. Posthoc analyses revealed that statements in the Emotional condition showed a significant increase in believability (M=7.57, SD=14.91) compared to statements in both the Neutral condition (M=5.21, SD=10.39), $t(99)=2.38$, *Cohen's d*=0.18, $p<0.019$, CI[0.39, 4.32], and Blank condition (M=4.01, SD=10.55), $t(99)=3.55$, *Cohen's d*=0.28, $p<0.001$, CI[1.56, 5.55] (Fig.1B).

Discussion

In a preregistered, direct replication of the main study we found again that all statements increase in believability upon re-exposure, and that statements in the Emotional condition increase in believability even more, compared to those in both the Neutral and Blank conditions, solidifying our trust in the observed effect.

General Discussion

In two studies we found that emotional arousal increases statement believability. This finding is consistent with previous research showing that increasing mnemonic accessibility increases believability (Vlasceanu & Coman, 2018; Vlasceanu, Morais, Duker & Coman, 2020). We speculate that the emotion-induced belief amplification effect could therefore be driven by memory, although this mechanism remains to be empirically tested.

Moreover, there might be other factors that could also impact the manifestation of this effect. For instance, in the current studies, we purposefully employed a highly controlled paradigm in which participants received no details about the source of the information. In real-world contexts, the source of information was found to reliably impact believability (Pornpitakpan, 2004; Jennings, 2018). In mass-mediated communication, for example, news stations are more or less aligned with the ideology of their viewers, as viewers spend more time-consuming attitude-consistent media (Knobloch-Westerwick & Meng, 2009). MSNBC viewers might be more convinced of the accuracy of a statement if associated with an emotional image, as would Fox viewers be upon exposure to emotionally charged images. Such ideological commitments could constitute factors that would amplify the effect observed in the current investigation. This might be due to the normative component implied by the ideological nature of the information source (Brady et al, 2017). Future research could programmatically investigate variables such as ideological commitment, attitudinal extremity, or perhaps vary the alignment between a participant's ideology and that of the source of information.

At the same time, when it comes to beliefs, individuals oftentimes communicate with one another, shaping each other's beliefs in the process. Future research building on the effect investigated herein could explore how communicative contexts impact its manifestation (Vlasceanu, Enz, & Coman, 2018; Vlasceanu, Morais, Duker & Coman, 2020). How does the effect propagate in a social network after a central speaker broadcasts messages to individuals? It is often the case that factual statements are broadcasted by newscasters while images or videos supporting the conveyed information are concurrently displayed. Does the belief amplification effect

propagate from the original source? If so, how deep in the network does it propagate? Fowler and Christakis (2010) show that even though there are 6 degrees of separation in real-world networks, influence only spreads three degrees away from the originating source. Empirical findings from the literature on the propagation of memory effects in social networks also support this conclusion (Coman et al, 2016). We do not know whether other cognitive effects, such as the one investigated here, have similar characteristics in communicative settings.

Finally, the current research has broad, direct implications for understanding how images could affect both accurate and inaccurate beliefs, which, in our study were equally subject to the belief amplification effect. This is important as this effect could be instrumental to the investigation of strategies aimed at decreasing the believability of inaccurate information in the population. The urgency of research uncovering misinformation reduction tactics has been acknowledged by many (Pennycook et al, 2018; Vosoughi, Roy, & Aral, 2018; Vlasceanu & Coman, 2018), and is of immediate importance given the potential for fake news to spread at increasingly fast speeds on social media platforms. For example, a recent Twitter study reported that false news diffuse "farther, faster, deeper, and more broadly than the truth" (Vosoughi, Roy, & Aral, 2018). Understanding which cognitive processes are successful in amplifying trust in accurate information is a crucial first step that can inform future investigations into techniques aimed at reducing misinformation spread in vulnerable communities. For instance, future such work could consider pairing classical strategies of debunking of inaccurate beliefs (Lewandowsky et al, 2012) with associating negatively arousing images with accurate information. This pairing of tactics could prove more effective than a simple debunking intervention. If proven effective, such interventions will add to the tools that policy makers employ in the battle against one of the top threats faced by the world today, the misinformation epidemic (Farkas & Schou, 2019; Lewandowsky et al, 2012).

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