

Running head: MISLEADING HEADLINES

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The Effects of Subtle Misinformation in News Headlines

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Abstract

Information presented in news articles can be misleading without being blatantly false. Experiment 1 examined the effects of misleading headlines that emphasize secondary content rather than the article's primary gist. We investigated how headlines affect readers' processing of factual news articles and opinion pieces, using both direct memory measures and more indirect reasoning measures. Experiment 2 examined an even more subtle type of misdirection. We presented articles featuring a facial image of one of the protagonists, and examined whether the headline and opening paragraph of an article affected the impressions formed of that face even when the person referred to in the headline was not the person portrayed. We demonstrate that misleading headlines affect readers' memory, their inferential reasoning and behavioral intentions, as well as the impressions people form of faces. On a theoretical level, we argue that these effects arise not only because headlines constrain further information processing, biasing readers towards a specific interpretation, but also because readers struggle to update their memory in order to correct initial misconceptions. Practical implications for news consumers and media literacy are discussed.

Keywords: News communication; Reading comprehension; Misinformation; Memory updating; Inferential reasoning; Facial impressions; Media literacy

The Effects of Subtle Misinformation in News Headlines

Information that is initially accepted as valid but is later found to be incorrect can have a persistent influence on people's memory and reasoning. As recently reviewed by Lewandowsky, Ecker, Seifert, Schwarz, and Cook (2012), corrections of invalid information are often relatively ineffective even when people demonstrably remember the correction. As a result, people continue to rely on retracted misinformation in their inferential reasoning. For example, when the cause of a (fictional) fire is first presented as negligence but this information is then retracted, people continue to make inferences in line with the retracted cause (e.g., that an insurance claim might be rejected because of negligence). This continued reliance on misinformation occurs despite unimpaired recall of event details and of the retraction itself (Ecker, Lewandowsky, Swire, & D. Chang, 2011a; Johnson & Seifert, 1994). These effects have also been reported in real-world contexts, when misconceptions regarding news events are corrected (Lewandowsky, Stritzke, Oberauer, & Morales, 2005; Nyhan & Reifler, 2010; also see Nyhan, Reifler, Richey, & Freed, 2014).

The dual-process theory of misinformation effects (Ecker, Lewandowsky, & Tang, 2010a; Wilson & Brekke, 1994) assumes that if misinformation represented in memory is automatically activated in response to cues, it requires strategic processing—such as the explicit recollection of the retraction—to avoid reliance on misinformation. Misinformation effects therefore arise when misinformation is automatically retrieved and strategic monitoring fails (Ecker et al., 2010a; for a review, see Lewandowsky et al., 2012).

One of the few factors known to reduce continued reliance on misinformation is the provision of a plausible alternative account. For example, in the case of the hypothetical fire, if the negligence retraction is accompanied by a statement that arson materials were found, references to retracted misinformation (i.e., to negligence) are typically reduced (cf. Ecker,

Lewandowsky, & Apai, 2011b; Ecker et al., 2010a; Johnson & Seifert, 1994; Seifert, 2002; also see Kendeou, Smith, & O'Brien, 2013). Compared to a simple retraction, the additional provision of an alternative allows the reader to meaningfully revise and correct the invalid account—or in terms of the dual-process account, it permits recruitment of a strategically-driven memory updating process to avoid erroneous reliance on outdated misinformation during later reasoning.

Although providing an alternative account usually reduces misinformation effects, it does not reliably eliminate them (cf. Ecker et al., 2011b, 2010a; Johnson & Seifert, 1994; Seifert, 2002). Updating of information in memory is error-prone and often results in incomplete updates, meaning that corrected information can linger and continue to affect memory and reasoning (Bjork & Bjork, 1996; Ecker, Lewandowsky, Oberauer, & Chee, 2010b; Oberauer & Vockenberg, 2009).

An Overview of the Present Study

To date, laboratory research on misinformation has looked mainly at the effects of misleading information that eventually turns out to be unequivocally false and that is therefore explicitly exposed and corrected (e.g., the correction in the fire example contained an explicit retraction of the initial account, followed by the provision of the alternative). Real-world misinformation can likewise be clearly false, and examples include false criminal accusations (Clow & Leach, in press; also see Ecker, Lewandowsky, Fenton, & Martin, 2014a) and the non-existent link between childhood vaccines and autism (Ratzan, 2010).

However, misinformation in the real world is often more subtly misleading, with misdirection resulting from information that is technically true but misleading in substance. To illustrate: Accurate numbers or trends can be communicated in a way that makes them appear to have more (or less) practical significance than they actually do; for example, a small or

practically insignificant aspect of data can be used to argue for the existence (or non-existence) of a larger, significant issue or trend, such as claims of global cooling by climate-change contrarians that use only a few recent cherry-picked data points (cf. Lewandowsky, 2011). People can be misled even when nothing inaccurate is said at all, with misdirection resulting solely from hints, innuendo, framing, word choices, or the relative placement and ordering of various pieces of information (for a recent news-related example, see Otieno, Spada, & Renkl, 2013). For example, a person might be associated with a certain deed or role by mere contiguity—the image of a witness might be presented in the media in a fashion that leads readers to believe the person is a suspect (Wemple, 2013), or a statistical graph might be coupled with an unrelated argument in a way that fools readers into assuming that the graph supports the argument (e.g., a statistic relating to general kidney disease in a publication on GM food safety; Arizona Center for Advanced Medicine, 2012). In these more subtle cases of misdirection, corrections are often incidental or implicit rather than explicit (e.g., the image or statistics graph might have an accurate caption, but the incongruence with the accompanying information is not explicitly addressed).

The present paper deals with these more subtle types of misinformation in two structurally-similar experiments (see Figure 1). A first experiment examined the effects of misleading headlines on readers' processing of news articles under realistic conditions. We did not use blatantly and unequivocally false headlines that misrepresent the article in all its aspects, as such headlines should be quite uncommon and are more akin to the types of misinformation investigated in previous research. Instead, we used headlines that were more subtly misleading by placing emphasis on a minor aspect rather than the dominant point of the accompanying article. By misrepresenting the gist of the article, the headline may lead to an inaccurate initial understanding of the topic. Reading the remainder of the article can potentially rectify this by

providing a more complete and accurate representation, and the dominant point of the article can thus be regarded as alternative information that should offset the effects of the initial misdirection. In other words, the article can serve as a correction of the misinformation contained in a headline to the extent that people update their initial, inaccurate understanding. A second experiment looked at the subtle misconception that can result from an incongruent pairing of a headline with a person's image in an article. We used article headlines that did or did not refer to the person in the photo, assuming that people would spontaneously associate the two. The initial impression of the person in the photo should thus be biased by the headline (e.g., whether the headline refers to a crime victim or perpetrator), which would be inaccurate in case of a mismatch. Again, reading the article (e.g., comparing the names and roles of persons in the article to the photo caption) could potentially rectify this by providing a more complete and accurate representation.

Thus, the rationale behind both experiments was that, in principle, reading an entire article provides sufficient corrective information to amend the misinformation conveyed by a headline that is incongruent with either the article itself or an image presented in the article. However, given the pervasive persistence of misinformation found in previous research, our general hypothesis was that this corrective updating should be incomplete. In other words, we expected a measurable impact of misleading headlines. In the following section, which leads up to Experiment 1, we specifically focus on the role of headlines and their congruence with the accompanying article. We return to the congruence of headlines and photos in the transition to Experiment 2.

The Role of Headlines

Headlines play a substantial role in news communication. A headline serves to summarize the main idea of an article, it permits consumers to scan a large number of news items

to get an abbreviated news update or to choose which articles to read, and it serves to grab attention and maximize interest (Dor, 2003; Geer & Kahn, 1993; Ifantidou, 2009; van Dijk, 1988). It has been argued that many readers spend more time scanning headlines than reading articles, as this strategy will maximize their informational gain relative to invested cognitive effort (Dor, 2003). Headlines also permit a quick assessment of whether to expect a factual news article or an opinion piece (Graney, 1990). They provide context, facilitating comprehension and constraining interpretation of content based on activation of relevant background knowledge (Bransford & Johnson, 1972; Dor, 2003; Geer & Kahn, 1993; Ifantidou, 2009; Krug, George, Hannon, & Glover, 1989; Miller, Cohen, & Wingfield, 2006; Otero & Kintsch, 1992; Wiley & Rayner, 2000).

A headline will therefore not only be the first (and sometimes only) element of an article that is encoded, but it will also have an effect on what information a reader focuses on—or ignores—when reading an article (McCrudden & Schraw, 2007; Otero & Kintsch, 1992). To the extent that a headline activates background knowledge, it will determine how information contained in an article is integrated with pre-existing knowledge, thereby affecting what information a reader retains (cf. Krug et al., 1989; Rawson & Kintsch, 2002; Surber & Schroeder, 2007; but see León, 1997). More specifically, encoding information in a particular mindset, or with a particular schema in mind, will facilitate later retrieval of information that is congruent with that mindset (Bransford & Johnson, 1972; Dooling & Lachman, 1971). To achieve maximum effect, headlines are often more negative in tone than the article (ACIJ, 2011), exaggerate article gist (Andrew, 2007), or over-emphasize conflict (Althaus, Edy, Entman, & Phalen, 1996). For example, a study on headlines during the 2004 Canadian elections found that across various outlets, headlines of both news and opinion pieces were less neutral (i.e., more positive or negative, and thus less objective) than the accompanying articles (Andrew, 2007).

Gricean maxims of communication imply that readers expect a headline to be relevant and accurate in relation to the article. In most cases, this is the case; however, headlines can also misrepresent the gist of an article and can therefore be misleading (Australian Centre for Independent Journalism [ACIJ], 2011; Althaus, Edy, & Phalen, 2001). For example, the online version of the UK's *Express* recently featured the headline "Air pollution now leading cause of lung cancer" (Rawle, 2013) above an article that, while stating that air pollution was "a leading *environmental* cause of cancer deaths" [emphasis added], also cited a cancer researcher that "...although air pollution increases the risk of developing lung cancer by a small amount, other things have a much bigger effect on our risk, particularly smoking." If a headline mismatches the article's content, it may affect readers' comprehension of and memory for the article, both because reading the headline will constrain subsequent processing of the article, and because the headline itself provides an inaccurate summary of the article, which may be difficult to correct.

A handful of studies have investigated the role of the congruence between a news headline and the associated article, but the results have been inconclusive. It is therefore still unclear what the cognitive consequences of misleading headlines are. Tannenbaum (1953) paired news articles with various headlines, each emphasizing a different aspect of the articles. He found that headlines can influence interpretation of the articles, for example by shifting participants' responses regarding the guilt of a defendant in a murder trial. He also found, however, that this effect did not occur consistently across scenarios, and that it was present mainly after superficial reading of an article. Geer and Kahn (1993) paired an article on a political candidate's education policy with either a neutral, a positively slanted or negatively slanted headline. The authors used open-ended questions to assess people's support for the policy, and an analog scale to measure support for the politician. They found that a negative headline led to more negative assessment of the policy but not the political candidate, relative to

a neutral or positive headline (which did not differ). Pfau (1995) presented participants with a New York Times article concerning a riot that led to a number of police officers being injured. The riot was described in the headline as either a “black riot” (as in the original article), or a “union riot.” Participants rated the violence of the incident and the behavior of the involved parties on five-point scales, and were also asked to write a pretend “letter to the editor” concerning the article. Pfau reported that the riot was perceived as more violent when the headline referred to a “black riot” rather than a “union riot.” Likewise, with the “black” label participants’ letters expressed more fear-related thoughts, referred more often to the alleged brutality of the incident, and perceived the article as more strongly biased (against the protesters).

Other research, however, failed to find misleading-headline effects. Leventhal and Gray (1991) presented crime articles together with headlines that were either neutral or biased in favor of the accused or the victim. Participants were asked to recall various details regarding the protagonists, and were also asked to assess who was responsible for the crime and how severely they should be punished. Leventhal and Gray reported that insinuating headlines affected neither memory for article content nor assessment of the crimes, arguing that whatever effect headlines might have on the reader’s initial understanding will be offset and corrected by further reading. Condit et al. (2001) used an article describing research into diabetes, emphasizing the multi-causality of the disease and hence making a case against genetic determinism. The headline was either congruent or incongruent (i.e., it conveyed a sense of low or high genetic determinism). The authors reported that reading the article shifted participants’ beliefs in the direction suggested by the article, but that this effect was independent of the congruence of the headline. Follow-up interviews suggested that many participants were aware of and dissatisfied with the misleading headline in the incongruent condition, but that they were able to discount it.

The Obviousness of Misdirection

Condit et al.'s (2001) study provides a possible clue to why misleading-headline effects are not found consistently, and will provide a starting point to derive predictions for Experiment 1. News articles with misleading headlines typically involve only incidental or implicit corrections, leaving it up to the reader to notice the conflict between the headline and the article. To the extent that such a conflict is not detected, there will be little incentive to engage in strategic updating processes. In other words, one could assume that strategically applied corrective processing during either the reading of an article or its retrieval would require that a person notices the *need* for updating (cf. Figure 1; also Ecker et al., 2010a; Guzzetti, Snyder, Glass, & Gamas, 1993; Hinze, Slaten, Horton, Jenkins, & Rapp, in press; Marsh & Fazio, 2006; Rapp, Hinze, Kohlhepp, & Ryskin, 2014; Rapp & Kendeou, 2007, 2009; van den Broek & Kendeou, 2008; Wilson & Brekke, 1994). In terms of the dual-process model, it follows that if no conflict between headline and content is perceived, processing of the article will be largely automatic and the misleading headline can 'freely' unfold its effect during both comprehension and retrieval; in this case, the impact of a misleading headline should be measurable. Conversely, if a conflict is perceived, there is at least an opportunity for the impact of the misleading headline to be attenuated, although it remains to be seen how well people can update their memories.

We expected more obviously misleading headlines to lead to a higher rate of conflict detection, which in turn may trigger the deployment of more strategic processing resources towards corrective gist-memory updating—while potentially drawing resources away from the encoding of other details (cf. Magliano, Trabasso, & Graesser, 1999; Marsh & Fazio, 2006). This implies that a more obviously misleading headline may not affect inferential reasoning but may affect memory for the article. By contrast, we expected less obviously misleading headlines to have greater impact on reader's comprehension and reasoning because they are less likely to

trigger strategic corrective updating; we did not, however, expect an effect on memory for the article because the headline should be less likely to lead to the perception of conflict and the associated diversion of processing resources.

To manipulate the obviousness of the misdirection, we used two different types of article: factual articles and opinion pieces. Factual articles discussed a quantitative variable (e.g., crime rate) that exhibited an insignificant short-term trend (e.g., an increase from the previous year of 0.2%) embedded in a significant and opposing long-term trend (e.g., a continuous decline of 10% during the last decade), and the headline focused either on the insignificant or significant trend; thus, in the former case, the headline quite clearly contradicted the main fact discussed in the article. Opinion pieces contrasted a layperson's opinion with the opinion of an expert and the headline highlighted either the layperson's opinion or the arguably more trustworthy expert opinion. The misdirection by the headline was less obvious than in the factual condition because it required an assessment and weighing up of perceived expertise. We therefore assumed that the headline-article conflict would be more obvious in a factual piece than in an opinion piece.

We employed both fact recall measures and inferential reasoning measures, and made two predictions: Misinformation effects on inferential reasoning should be larger for opinion pieces than factual pieces, or should only be present for opinion pieces. By contrast, recall should be impaired more by a misleading headline in case of factual article compared to opinion pieces.

Experiment 1

Experiment 1 examined whether a misleading headline would affect readers' memory for the article or their inferential reasoning, using factual articles and opinion pieces. Experiment 1 thus employed a 2 (article type: factual/opinion) \times 2 (headline congruence: congruent/incongruent) within-subjects design.

Method

Participants. A-priori power analyses (G*Power 3; Faul, Erdfelder, Lang, & Buchner, 2007) suggested a minimum sample size of 43 participants to detect an effect of small-to-medium size $f = 0.2$, at $\alpha = 0.05$, $1 - \beta = 0.8$, and a moderate correlation between repeated measures of $r = 0.4$. We tested 51 undergraduate students from the University of Western Australia (44 females, 7 males; mean age was $M = 20.0$ [$SD = 7.63$] years).

Stimuli. We devised two factual articles and two opinion pieces, each with less than 400 words, and accompanying congruent and incongruent headlines (see Appendix A for all materials). The factual-article topics were concerned with natural disaster fatality rates and burglary rates; both articles explained that there was a slight short-term increase but a substantial long-term decrease in rates overall; a headline emphasizing the short-term increase was considered incongruent (e.g., ‘Number of Burglaries going up’, as opposed to the congruent headline ‘Downward Trend in Burglary Rate’). The opinion articles were about the safety of genetically modified (GM) foods and fluoride in drinking water; both articles contrasted a citizen’s safety concerns with statements made by scientific bodies allaying such concerns; a headline that emphasized the layperson’s opinion was considered incongruent (e.g., ‘Fears of Fluoride in Drinking Water’ as opposed to the congruent headline ‘Fluoride Beneficial in Drinking Water’). Each participant read all four articles (one per condition). The order of conditions and the assignment of articles to congruent/incongruent headline conditions were counterbalanced across participants.

Our headlines thus used relatively common “cherry-picking,” which can be essentially misleading without being subject to the criticism of being manifestly false. To confirm those aspects of our manipulation, we conducted a manipulation-check study (a) to test whether people noticed the contradiction conveyed by the misleading headlines, and (b) to ascertain that people

indeed found the incongruent headlines less appropriate than the congruent ones; that is, whether participants could identify all misleading headlines—including those that went unnoticed on their own—when provided with both congruent and incongruent alternatives.

We presented the materials to $N = 15$ students from the University of Western Australia (11 females, 4 males; mean age $M = 26.6$ [$SD = 6.52$] years; none of them participated in the main study). As in the main study, each participant read all four articles (one per condition, with article-headline assignment counterbalanced). After reading each article, participants rated the appropriateness of the headline on a 5-point scale¹. The results concerning the headline-appropriateness rating are presented in Figure 2. A 2×2 repeated-measures ANOVA yielded the predicted interaction, $F(1,14) = 5.76$; $MSE = 1.53$; $p = .03$; $\eta_p^2 = 0.29$. Participants found all headlines appropriate (scores > 3) except the incongruent headlines of the factual pieces. There was no difference between the congruent and incongruent versions of the opinion pieces, $F(1,14) = 1.22$; $MSE = 0.99$; $p = .29$. After participants had read and rated all articles, we re-presented the articles together with both congruent and incongruent headlines and asked participants to choose the more appropriate headline. Again, the results confirmed our expectations: Participants selected the congruent headline 80 % of the time for the opinion pieces and 90 % of the time for the factual pieces (the probability of choosing the congruent headline 80 % of the time or more by chance was $p < .001$). Having established that people found our incongruent headlines misleading (i.e., less appropriate than the congruent headlines), but only noticed the incongruence in case of the factual articles, we continue our description of the main experiment.

Procedure. Participants were instructed to carefully read each article as they would be asked to answer rating questions regarding the articles. They were presented with the articles one at a time, and rated each article on 5 scales (e.g., asking how interesting, easy to read, and

informative it was; see Appendix A for details) immediately after reading it. Participants were told that they had two minutes to read each article and respond to the ratings (informal pilot testing had shown this was sufficient time), but this time limit was not rigorously enforced.

Specifically, participants were presented with a booklet containing all articles (article order was counterbalanced) and rating scales. For each article, the booklet contained three pages: (1) a cover page, featuring only a number (1-4) and the respective article headline (in 26 pt Times New Roman font), (2) the page featuring the article together with its headline (the article was printed in two columns, in 13 pt Times New Roman font, and the headline appeared above the article and spanned the entire width of the page; it was printed in 38-51 pt Times New Roman font), and (3) a page with the five rating scales (i.e., the article was out of view when participants responded to the scales). After each article, participants worked on an unrelated task for about five minutes.

After reading all articles, a surprise test followed, targeting all articles in the same order they were encoded. This involved two recall questions (one asking for a summary of each article, one asking to state the main point of the article), a multiple-choice recognition question targeting a factual detail unrelated to the main topic of the article and its headline, and three inference questions. The inference questions asked participants to make a judgment regarding a trend extrapolation (e.g., how much disaster-related fatality rates would change over the next three years), future government spending (e.g., adjustment of funds for research into the health risks of fluoridation), and a self-related behavioral intention assessment (e.g., willingness to pay extra for non-GM food) on various fixed visual analog scales (e.g., -25% to +25%, 0 to 30%; see Appendix A for details).

Results

Memory scores. The ‘main point’ recall question was used to check adequate encoding. Only four participants answered one of these ‘main point’ questions incorrectly, but all four demonstrated some retention of content in response to other questions, so all were retained for analysis.² A memory measure was derived from the recall summary and the recognition item: For each article, we selected the four main ideas contained in the article, and scored each as recalled (1) or not recalled (0). Following precedent (e.g., Ecker et al., 2011a, 2011b, 2014a), scoring was done by a trained scorer unfamiliar with the hypotheses; a random subset of 20 scoring sheets was additionally scored by a second scorer; inter-rater reliability was $r = .91$. We then added the score on the recognition question (0/1) and divided the result by 5, yielding a global memory score varying from 0 to 1.³

Mean memory scores across conditions are shown in Figure 3. We conducted a 2 (article type: factual/opinion) \times 2 (headline congruence: congruent/incongruent) repeated measures ANOVA, which yielded a main effect of headline congruence, $F(1,50) = 6.96$; $MSE = 0.021$; $p = .01$; $\mu_p^2 = 0.12$, qualified by a significant interaction, $F(1,50) = 9.22$; $MSE = 0.020$; $p < .01$; $\mu_p^2 = 0.16$. The pattern was clear-cut: A misleading headline impaired memory for the article, but only in case of a factual article ($M = .46$ [95 % $CI = .41 - .52$] in the incongruent and $M = .58$ [$CI = .52 - .64$] in the congruent condition; opinion article: $M = .56$ [$CI = .51 - .61$] and $M = .55$ [$CI = .50 - .60$], respectively).

Inference scores. Responses to the inference questions were standardized and averaged to yield an inference score ranging from 0 to 1, where higher values indicate more reliance on the article’s gist (i.e., the expert opinion). The reason for combining the heterogeneous item scores into a global inference score was to reduce the impact of item-specific variance. This decision was supported by the fact that for each article, the three inference questions were all positively

but moderately correlated (with $.04 < r < .49$, and a mean correlation across articles of $r = .26$ for the fact articles and $r = .30$ for the opinion articles; see Table 1 for details; we note that the heterogeneity does not allow strong specific conclusions regarding, for example, behavioral intentions; rather, the inference questions served to provide a more general and robust assessment of topic-related inferential reasoning).

Mean inference scores across conditions are presented in Figure 4. A 2 (article type: factual/opinion) \times 2 (headline congruence: congruent/incongruent) repeated measures ANOVA yielded a main effect of article type, $F(1,50) = 31.23$; $MSE = 0.031$; $p < .001$; $\mu_p^2 = 0.38$, qualified by a significant interaction, $F(1,50) = 4.25$; $MSE = 0.020$; $p = .04$; $\mu_p^2 = 0.08$. A contrast analysis confirmed that headline congruence had an effect for opinion articles ($M = .54$ [$CI = .48 - .59$] in the incongruent and $M = .60$ [$CI = .55 - .64$] in the congruent condition, respectively), $F(1,50) = 5.87$; $MSE = 0.016$; $p = .02$; $\mu_p^2 = 0.11$, but not for factual articles, $F < 1$ ($M = .44$ [$CI = .40 - .48$] and $M = .42$ [$CI = .38 - .46$] in incongruent and congruent conditions, respectively). Again, this is a clear-cut result: A misleading headline affected inferential reasoning (e.g., behavioral intentions consistent with the gist of the article), but only in case of an opinion article. We caution against the over-interpretation of the article type main effect. It is known from previous research that the overall level of inferences depends strongly on the specific questions that are asked and differs across scenarios (cf. in particular Ecker et al., 2014a).

Discussion

Experiment 1 was designed to test how misleading headlines (a) impact on inferential reasoning, and (b) how they affect memory for news articles. We take up both issues in turn.

Concerning (a), misleading headlines affected people's inferential reasoning in case of opinion but not factual articles. Factual articles were designed such that the incongruent headline

would convey a relatively obvious mismatch with the gist of the article. By contrast, opinion articles more explicitly presented two ‘sides of a story’—including the one featured in the headline—and were thus assumed to produce less perceived inconsistency. A manipulation-check confirmed that only the incongruent headlines of the factual articles were spontaneously perceived as inappropriate, whereas for the opinion articles the misleading nature of a headline became apparent only in comparison to an alternative.

The fact that misleading headlines for the opinion articles only affected inference scores, but not memory, is thus consistent with a prediction derived from the dual-process model of the continued influence of misinformation. The model argues that it requires strategic control processes to avoid an impact of automatically activated misinformation: To the extent that people become aware of an inconsistency—in this case, between the headline and the gist of the article—the more they will strategically devote cognitive resources to the resolution of the resulting conflict via corrective updating processes (cf. Ecker et al., 2010a; Marsh & Fazio, 2006; Rapp & Kendeou, 2007; van den Broek & Kendeou, 2008; Wilson & Brekke, 1994). This explains why a misleading headline affected inference scores with opinion pieces but not factual articles—only in the latter case was there a perceived inconsistency that triggered corrective updating, which in turn reduced any potential impact of the misleading headline on subsequent reasoning. In other words, the misleading opinion-article headlines probably unfolded their effects without readers noticing their slant.

Our opinion pieces dealt with technologies that were described as safe by authoritative bodies but evoked safety concerns from non-expert citizens. The impact of our manipulation was reflected in the fact that people were more concerned with potential health risks of the technologies if the headline expressed concern. The presentation of two contradictory views on a topic is common media practice and reflects an emphasis on ‘balanced’ coverage of topics even

when there is no underlying balance in empirical evidence (Boykoff & Boykoff, 2004; Clarke, 2008). It is left to the reader to gauge whether one of the views expressed should carry more weight than the other, for example based on an appraisal of argument strength and perceived source credibility (Chaiken & Maheswaran, 1994; Guillory & Geraci, 2013; Petty & Cacioppo, 1986). However, readers are likely to treat the newspaper itself as a credible source and put trust in an editor's decision to emphasize a particular viewpoint in a headline. Thus, readers might use the headline's slant as a heuristic for their own weighting of arguments, which in turn will affect their interpretation of the article and their subsequent risk assessment. Our data showed this to be the case.

Concerning (b)—the effect of a misleading headline on *memory* for the article—we found an effect only for factual articles. This pattern is consistent with the idea outlined in the introduction that a headline serves to guide the reader towards encoding of headline-congruent information at the expense of headline-incongruent material (cf. Otero & Kintsch, 1992; Surber & Schroeder, 2007). We additionally hypothesized that memorial effects would only be observed when a detected inconsistency focuses cognitive resources on corrective updating thereby drawing cognitive resources *away* from the encoding of an article (cf. Magliano et al., 1999; Marsh & Fazio, 2006). A misleading headline thus had a direct impact on people's memory only when it was perceived as inappropriate, whereas no effects on memory were observed when the headline was merely slanting interpretation of an article without being detectably at odds with its content.⁴

Experiment 2

Experiment 1 investigated the effects of headlines that were incongruent with the content of the accompanying article. Experiment 2 investigated a different, more subtle way in which a headline can be misleading, namely when it is incongruent with an image featured in the article.

Images depicting a protagonist are frequently included in news articles. Images can have a strong and immediate influence on readers' spontaneous inferences (Garry, Strange, Bernstein, & Kinzett, 2007; Henkel, 2012; Strange, Garry, Bernstein, & Lindsay, 2011). Like headlines, images can serve to attract attention and are usually processed before the full article is read, likely in close temporal proximity with reading of the headline. We therefore assumed that people would spontaneously infer that a photo of a person would be that of a person referred to in the headline and the initial section of the article. Experiment 2 was designed to test people's updating of such spontaneous person-to-role associations in the case of incongruence; that is, when the person in the picture later turns out *not* to be the person in the headline.

The conceptual and methodological structure of Experiment 2 was thus identical to that of the first study, as shown in Figure 1, although this experiment used a very different set of indirect measures. Participants read fictional newspaper articles about a criminal incident, which described both a 'good' person (typically the victim) and a 'bad' person (the culprit). Each article featured a person's photograph; that person either corresponded to the person described in the headline and the initial paragraph (headline congruent with the person in the photo), or it corresponded to a person described in the latter part of the article (headline incongruent with the person in the photo). The experiment thus used a 2 (person-in-photo: bad/good) \times 2 (headline congruence: congruent/incongruent) within-subjects design. As illustrated in Figure 1, the pairing of headline and photo either led to a valid or biased initial representation of the person-to-role association and an accurate or inaccurate initial impression of the person in the photo. In case of a congruent headline there was no need for a corrective memory update, whereas the incongruent headline condition required a corrective update. We note that in contrast to Experiment 1, articles differed not only regarding the headline but also the opening paragraph;

this was done to create a more natural, realistic reading experience, and to increase the probability that the face would in fact be initially associated with the first described protagonist.

To assess whether or not people updated their memories, we used an indirect measure involving face ratings. Previous research has established that face ratings are sensitive to prior information about personality such as kindness and honesty (Gross & Crofton, 1977; Hassin & Trope, 2000; Paunonen, 2006). For example, Paunonen (2006) reported that the face of a person described as honest was subsequently judged as more kind and attractive. It follows that the same face may be rated differently in response to our experimental manipulation. For example, if a face is presented as belonging to a “bad” person (e.g., the headline implies that the face is of a perpetrator), then it should be rated lower on positive attributes. Conversely, a face of a presumed victim should be given more positive ratings.

To the extent that memory updating is imperfect, a face initially thought to belong to a bad person should receive a relatively negative rating even when the face turns out to belong to a good person and vice versa. Based on the previous relevant literature, we selected four traits that have been described as central to the process of impression-formation: attractiveness, trustworthiness, dominance, and aggressiveness. Attractiveness and trustworthiness typically load high on a “valence” factor, while dominance and aggressiveness load highly on a “dominance” factor (cf. Oosterhof & Todorov, 2008; Todorov, Said, & Verosky, 2011). We expected an effect to most likely emerge on the valence dimension, both because the trustworthiness trait seems most central in the present distinction between criminals and non-criminals, and because previous research reported effects on valence ratings (Gross & Crofton, 1977; Paunonen, 2006).

Method

Participants. Following a-priori power analysis (see Experiment 1), we tested 47 undergraduates from the University of Western Australia (39 females, 8 males, mean age $M = 18.6$ [$SD = 2.9$] years) via an online survey.

Stimuli. We used naturalistic face images typical of those found in newspaper articles. Face stimuli were taken from the freely available database “Labeled Faces in the Wild” (Huang, Ramesh, Berg, & Learned-Miller, 2007). This database features naturalistic face images collected from the internet. A pool of 45 face images of not immediately recognizable persons were pre-selected; selected faces had a neutral or moderately happy expression as typically seen in newspaper-article photos, and images contained minimal background information. Each face image was converted to a monochrome version, and cropped and re-sized (205×210 pixels; size on screen approx. 6×6 cm) to achieve consistency across images.

The initial pool of 45 face stimuli was used in a pilot study to select the stimulus set for the main study—16 pairs of similar, age- and gender-matched faces.. Twelve students from the University of Western Australia, none of whom participated in the main experiment (3 males and 9 females; mean age 24.7 years), rated all faces via an online survey. Each face was rated individually on the four traits attractiveness, dominance, aggressiveness, and trustworthiness, as well as masculinity/femininity⁵ and presumed socio-economic status on a scale from 0 (low) to 10 (high). Participants also rated the expressed emotion on a scale from 0 (negative—sad, angry, or upset) to 10 (positive—happy, loving, or joyful). Finally, they were asked to estimate the person’s age, and whether they recognised the person (if they thought they recognized the person, they were asked to provide a name or any person-related information that came to mind). No participant recognized any of the depicted persons.

Using the pool of 45 faces, we created 30 candidate pairs of similar faces, based on gender, apparent age, and matching features (some faces were part of multiple pairs). We then selected the 16 pairs with the highest similarity as determined by the pilot-study ratings (with the constraint that each face was used in only one pair). A total of 30×8 *t*-tests on the face ratings were carried out, with an alpha level set at $\alpha = 0.001$. There were no significant differences between the two faces of each selected pair except five pairs that differed in estimated age (by an average margin of 14.8 years), one pair that differed in estimated socio-economic status (difference of 1.42 on ten-point scale), and one pair that differed in rated emotionality (difference 2.33 on ten-point scale).

We then devised 16 scenarios, each involving a crime or accident. Each scenario was associated with a specific pair of faces. For each scenario, we generated 2 news articles that were substantially identical but manipulated the congruence of the picture. In both articles, there was a ‘good’ person (a victim or police officer or prosecutor) and a ‘bad’ person (the culprit). The two persons were always described as people of the same gender and similar age. To manipulate the congruence variable, the two articles (1) altered the order in which they focused on the good and the bad person, and (2) they had different headlines such that the headline always matched the initial paragraph.⁵ For example, the headline of one article was “Man charged over Thornlie murder”⁶; this article began with a description of a pensioner being arrested for murdering his neighbor. The corresponding second article had the headline “Grandfather killed in Thornlie”, and accordingly first described the discovery of the victim’s body before reporting the arrest of the pensioner. Each article was presented with the image of a face (i.e., one of the two faces associated with the particular scenario), much like a real-world newspaper article would incorporate an image. The fictitious name of one of the two protagonists (i.e., the name of the good or bad person) was printed beneath the face image. This resulted in 8 different versions of

each of the 16 scenarios (2 headlines/articles \times 2 faces \times 2 names/roles; see Appendix B for examples). The articles, the assignment of scenarios to conditions, as well as the assignment of specific faces to good/bad roles was counterbalanced across participants.

Procedure. Participants were presented with 16 news articles (4 per condition), one at a time, each paired with one face. Participants were instructed to read the articles carefully as they would be asked questions about the events described and the people involved; there were no time limits. After reading each article, participants answered two 4-alternative multiple choice questions, which only served to check adequate encoding (e.g., “Where was the murderer arrested?”—at the park/workplace/police station/his property). After completing all 16 news articles, all presented faces were presented again, one-by-one and in random order, and participants rated each face on the two valence and two dominance traits (on 0-10 scales). Lastly, all faces were presented a third time in random order, and participants were asked to classify each face as belonging to a ‘good’ (innocent victim, police officer, prosecutor) or ‘bad’ (culprit, criminal) person, to test participants’ memory for the face-role associations.

Results

Comprehension scores. All participants demonstrated above-chance comprehension on the 32 multiple-choice comprehension questions ($M = 27.13$; $SD = 3.47$; range = 18-32; the probability of correctly guessing ≥ 18 responses is $p < .0002$).

Face ratings. For each participant and condition, we averaged the two valence and the two dominance trait ratings separately and mapped them onto a 0-1 scale. Two 2 (person-in-photo: bad/good) \times 2 (headline congruence: congruent/incongruent) repeated measures ANOVAs were conducted, with significance level set at $\alpha = 0.025$ to correct for multiple tests. In these analyses, perfect memory updating during encoding would imply a main effect of person-in-photo but no main effect of headline congruence and no interaction—face ratings should be

based purely on whether the face depicts a good or bad person, irrespective of who people initially thought the person in the picture might be. In contrast, the failure of updating would imply an interaction but no main effects—face ratings should be determined entirely by the headline’s *valence* (e.g., positive face ratings in case the headline focus was on the ‘good’ person, and negative ratings when the headline focused on the ‘bad’ person). Because both headlines could be either congruently paired with a good (bad) person’s photo, or incongruently paired with a culprit’s (good person’s) photo, reliance on the headline alone would result in an interaction.

The analysis on dominance ratings yielded no significant effects, all $F(1,46) < 3.43$, all $p > .07$. The analysis on valence ratings yielded a main effect of person-in-photo, $F(1,46) = 11.31$; $MSE = 0.006$; $p = .002$; $\eta^2_p = .20$, which was qualified by an interaction, $F(1,46) = 12.25$; $MSE = 0.017$; $p = .001$; $\eta^2_p = .21$ (see Figure 5). When the headline was congruent with the image (i.e., no corrective updating required), a bad person’s image was rated more negatively than a good person’s image ($M = .32$ [$CI = .27 - .36$] for the bad person and $M = .42$ [$CI = .39 - .46$] for the good person; compare the two dark bars in Figure 5), $F(1,46) = 25.83$; $MSE = 0.010$; $p < .001$; $\eta^2_p = .36$. This effect was eliminated (and even reversed numerically) if headline and photo mismatched, and the face ratings shifted in the direction suggested by the headline: the good person’s image was rated more negatively with an incongruent headline that focused on the culprit ($M = .35$ [$CI = .30 - .40$]), compared to the congruent case (compare the two rightmost bars in Figure 5), $F(1,46) = 10.03$; $MSE = 0.012$; $p = .003$; $\eta^2_p = .18$, and the bad person’s image was rated more positively with an incongruent headline that focused on the good person ($M = .38$ [$CI = .34 - .43$]), compared to the congruent case (compare the two leftmost bars), $F(1,46) = 6.92$; $MSE = 0.014$; $p = .01$; $\eta^2_p = .13$. In other words, the misleading headline pulled people’s face perceptions away from the true role of the

person pictured; when headline and identity matched (dark bars), ratings were extreme, when there was incongruence (light bars), ratings were intermediate, thus reflecting partial updating.⁷

Memory for face-role associations. Memory for face-role associations was relatively poor overall ($M = .60$; $CI = .56 - .65$). Only a subset of 17 participants demonstrated above-chance memory for the correct (updated) face-role associations, using a lenient criterion (i.e., role-memory $> .69$; which maps into a probability of guessing ≥ 11 out of 16 correctly of $p = .11$). It might be expected that the face-rating interaction of person-in-photo and headline congruence might become less prominent, and the main effect of person-in-photo more prominent, in this subgroup of participants because if memory updating was successful the interaction with a main effect of person-in-photo should disappear. However, the interaction was still significant in this subgroup, $F(1,16) = 20.83$, $MSE = 0.021$; $p < .001$; $\eta^2_p = .57$, but not the main effects ($F_s < 1$).

Discussion

Experiment 2 showed that valence ratings of faces were affected not only by the actual role of the pictured person, but also by the congruence of the headline plus opening paragraph and the photo (in the remainder of this discussion section, the term ‘headline’ will refer to the larger frame conveyed by the headline and the opening paragraph together). Before discussing this main finding, we acknowledge that the effect was limited to the valence dimension; regarding the dominance dimension, we speculate that some of the ‘good’ people in our stories were police officers and prosecutors, and might have been perceived as rather dominant, compared to a victim or even some of the ‘bad’ people in our scenarios (this notion is corroborated by the fact that the dominance trait was the only trait out of the four we used [i.e., attractiveness, trustworthiness, dominance, aggressiveness] not to exhibit an interaction between

person-in-photo and headline congruence). In the context of crime scenarios, at least, the valence dimension may thus be the primary dimension of classification for news readers.

Results from the valence ratings demonstrated that readers spontaneously integrated information from a headline with a photo in the associated article. The congruence of headline and photo therefore affected subsequent face valence ratings: Headlines that were incongruent with the photo led people to make face judgments that were more in line with the headline, even though the article later on clarified who the person in the picture was. The presence of the significant interaction demonstrated that there was some updating of the initial face-role assumptions, but that it was only *partially* effective. In other words, if a reader initially assumed the face belonged to the culprit (victim), they then continued to rate the face negatively (positively) even when the face actually belonged to an innocent victim (culprit).

This pattern of results is in line with research on the continued influence of misinformation, where more direct and explicit corrections are likewise often found to reduce but not eliminate the influence of misinformation on memory and inferential reasoning (Ecker et al., 2010a, 2011a, 2011b, 2014a; Johnson & Seifert, 1994; Lewandowsky et al., 2012; Seifert, 2002). The results also support the notion that misinformation effects can arise from partial memory updating, where attempted correction of irrelevant information, or its removal from memory, is often incomplete, leading to lingering representations of outdated information (e.g., Oberauer & Vockenberg, 2009).

The notion of partial updating is further supported by our finding that the subgroup of participants who demonstrated superior updating in their explicit memory for face-role associations did not demonstrate superior updating in their face ratings, compared to the overall group. In other words, people with relatively good memory for the actual role of the person pictured failed to demonstrate corrective updating in their face ratings: people rated a face they

initially associated with a negative (positive) role more negatively (positively), even when they subsequently updated the role-association in memory.

In sum, the results of Experiment 2 mesh well with those of Experiment 1 (in particular those of the opinion article conditions): Reading a news article that disconfirms an initial, incorrect conception is not sufficient to remediate the impact of a misleading headline (cf. Figure 1). Both experiments thus provided evidence for a continued influence effect of subtle misinformation conveyed by misleading news headlines.

General Discussion

There can be little doubt that misleading headlines result in misconceptions in readers who do not read beyond the headlines (e.g., Wegner, Wenzlaff, Kerker, & Beattie, 1981). However, it was hitherto unclear what the effects of misleading headlines are if the entire article is read, thus providing an opportunity for any initial misconceptions to be corrected (cf. Condit et al., 2001; Leventhal & Gray, 1991; Tannenbaum, 1953). The present research suggests that misleading headlines affect readers' memory for news articles or their inferential reasoning, and even their impressions of faces featured in the articles.

The effects of misleading headlines are likely to arise concurrently from multiple cognitive mechanisms. First, readers use available information to constrain further information processing. This means that any incoming evidence will always be weighted and interpreted in light of information already received, and a headline can thus serve to bias processing towards or away from a specific interpretation (Dor, 2003; Ifantidou, 2009; Krug et al., 1989; McCrudden & Shaw, 2007; Miller et al., 2006; Otero & Kintsch, 1992; Surber & Schroeder, 2007).

Second, correcting the misinformation conveyed by a misleading headline is a difficult task. Particularly in cases of non-obvious misdirection, readers may not be aware of an inconsistency, and may thus not initiate any corrective updating. By contrast, if a headline is

perceived as inappropriate, people may be able to correct its influence on their understanding of the article, although this correctional effort itself may withdraw resources from mnemonic processing of the article and may thus impair memory. In sum, these effects further corroborate the notion that misinformation tends to influence people's memory and reasoning continuously despite corrections (cf. Lewandowsky et al., 2012). Such effects are likely caused by a failure of strategic monitoring and memory updating processes (Ecker et al., 2010a). A misleading headline can thus do damage despite genuine attempts to accurately comprehend an article. As a certain motivation and effort is required to engage in such strategic processing, headline effects may be also affected by the reader's pre-existing attitudes (cf. Ecker et al., 2014a; Nyhan & Reifler, 2010). Future research should thus aim to investigate the interaction of pre-existing attitudes and headline slant, using a wider variety of articles.

The present paper showed that misleading headlines can lead to misconceptions and misinformed behavioral intentions. The practical implications of this research are clear: News consumers must be (made) aware that editors can strategically use headlines to effectively sway public opinion and influence individuals' behavior (cf. ACIJ, 2011). More specifically, the present research suggests the following: (1) It may be the more indiscernibly misleading headlines in particular, merely highlighting one opinion over another, that have an impact on the reader's reasoning. This will occur even though—or as we have argued: precisely because—readers may not spontaneously perceive the headline as misleading. Such rather indiscernibly misleading headlines can be seen as an extension of the 'balanced evidence' approach so popular in modern-day journalism (Boykoff & Boykoff, 2004; Clarke, 2008): not only do many articles give equal space to the evidence-based opinion of an expert and the unsubstantiated opinion of a non-expert, but the non-expert's opinion can be further validated by also being highlighted in the headline.

(2) Using a headline to emphasize such a non-expert view can be utilized as a tool to influence beliefs and attitudes—in the present study, to fuel safety concerns regarding technologies believed to be safe—and reduce people’s willingness to follow expert advice (also see Otieno et al., 2013). In our specific case, a headline amplifying the opinion of a non-expert citizen made readers more concerned about the safety of GM food and water fluoridation, despite receiving the identical information containing expert advice arguing for the safety of these practices. This is a worrying implication from our research, which is particularly concerning given the generally decreasing trust in scientific experts among segments of the public (Gauchat, 2012). Accordingly, misinformation in the media has, for example, been linked to declining vaccination rates (Smith, Yarwood, & Salisbury, 2007; also see Health Protection Agency, 2011) and rejection of climate-change mitigation policies (Ding, Maibach, Zhao, Roser-Renouf, & Leiserowitz, 2011), and can potentially play a role in determining the support (or non-support) for any matter of public interest, from the invasion of a foreign country (Lewandowsky, Stritzke, Freund, Oberauer, & Krueger, 2013; Lewandowsky, Stritzke, Oberauer, & Morales, 2009) to the rejection of asylum seekers (Macken-Horarik, 2003; Pedersen, Clarke, Dudgeon, & Griffiths, 2005).

(3) Finally, a headline can be used to cast someone in a dubious light even when every word in both the headline and the accompanying article is accurate. The impression of a person can be affected merely by placing someone’s face next to an insinuating headline and structuring the accompanying article in a way that implicates the person in the photo was involved in misdemeanor. To the best of our knowledge, this is the first demonstration of such an effect in the context of news articles. It mimics a similar effect discussed in media psychology, where advertisements placed strategically next to relevant editorial content are assumed to have stronger impact on consumers (cf. Baerns, 2003). In this area, laws regarding the ‘principle of

separation' (i.e., clear separation of advertisements and editorial content) are in place in many countries to protect consumers from being misled. Our research shows that this principle should also be considered and applied to news articles and the images they contain.

As knowledge about misinformation effects can reduce their impact (Ecker et al., 2010a), awareness of the effects of misleading headlines should thus be considered a critical aspect of media literacy and media education. The more people are aware of the issue, the more will they skeptically assess headlines and notice misleading ones, and the more likely will they engage in strategic processing to reduce their impact. Moreover, the modern-day fact-checking movement, which has allowed bloggers with little or no research budget to discuss the veracity of claims made by public figures such as politicians or industry spokespersons (cf. Dobbs, 2012), should not only focus on debunking misrepresentations but should also pay attention to how factually accurate contents are framed by the editors of newspapers and news websites.

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Footnotes

¹ Participants also provided ratings on five other scales, which only served as distractors and are thus not relevant here—see Procedure of main experiment and Appendix A for details.

² Their exclusion did not affect the outcome.

³ Recall and recognition scores were combined to obtain a general memory index. However, because recall targeted the entire article while the recognition question targeted an arbitrary detail, we also analyzed only the recall summary score separately; both analyses yielded comparable results so we report the combined analysis in the following (the recognition score by itself showed a similar effect pattern also).

⁴ Inspection of responses suggests that lower memory scores were mostly due to omission errors, although there were also commission errors (i.e., misrepresentations). Alas, the available data do not permit a more fine-grained analysis.

⁵ Male faces were rated on masculinity, female faces on femininity. This scale was also included in the main study, but it was dropped from analyses because it was unclear how to combine ratings for male and female faces onto the same scale; that is, it was impossible to ascertain whether or not a specific masculinity rating of a male face (e.g., $x = 3$) was equivalent to the analogous femininity rating of a female face (i.e., $10 - x = 7$). Moreover, although Todorov, Said, and Verosky (2011) mentioned masculinity as related to the ‘dominance’ factor, masculinity was not included in the original factor analyses of Oosterhof and Todorov (2008).

⁶ Thornlie is a Perth suburb.

⁷ We note that there are alternative ways to present the data in Figure 5. Specifically, the analysis could have included a factor of “headline focus”, that is, whether the headline focused on a good or bad person. Such an analysis would return a main effect of headline focus such that a person ostensibly referred to as a good person in the headline is rated more positively than a

person referred to as a bad person (compare the two outer bars in Figure 5 with the two middle bars). This alternative way to look at the data does not change the general interpretation of results but does make clear that readers initially associated the person in the photo with the role mentioned in the headline (an association we did not measure directly).

Appendix A—Materials used in Experiment 1 *(to be placed in Online Supplement)*

News Articles (with Incongruent / Congruent Headline)

Factual articles.

Number of Burglaries Going Up (incongruent) / Downward Trend in Burglary Rate (congruent)

The Australian Office of Crime Statistics (AOCS) released their annual crime figures yesterday. The report shows that residential burglary rates in Australia have gone up 0.2% since last year.

According to Ted Forest from WA's Neighbourhood Watch, "most burglaries are committed by teenagers who see an opportunity. We strongly urge homeowners to lock their doors and windows, install an alarm, and make arrangements with their neighbours when they go away to watch over their property. People should also avoid leaving expensive items in view of others, especially during school holidays, which is a popular time with burglars."

Frank Whitacker from the AOCS pointed out that the "numerical increase in burglaries is not a significant increase by any means. If you look at the bigger picture, the overall

trend in burglary rates has actually been downward for over 10 years, and burglaries have declined by 15% since 2000. So inducing panic in communities is unnecessary."

Across the states in Australia, households in the Northern Territory and Western Australia were most likely to be the victims of a break-in (7.7% and 5.1% of households respectively), whilst households in Tasmania and Victoria were the least likely to be targeted (2.6% and 2.8% of households, respectively).

Household victimization surveys, conducted across OECD countries in 2005, found that Australia had the 9th highest victimization rate for burglaries (3.4%), which was higher than Japan, Italy, and Canada, but lower than the United Kingdom, New Zealand, and the United States.

More Natural Disasters, More Deaths (incongruent) / More Natural Disasters, Fewer Deaths (congruent)

Natural disasters are on the rise. About two-thirds of the increase in the number of natural disasters is the result of rises in hydro-meteorological disasters. These disasters include droughts, hurricanes, typhoons and floods and have been increasing over the past 25 years. In 1980, there were only about 100 such disasters reported per year but that number has risen to over 300 a year since 2000. Experts say that increase is caused by climate change. In contrast, natural geological disasters, such as volcanic eruptions, earthquakes, and landslides, have remained steady in recent decades.

Earth might seem like a more dangerous place than ever, given the constant media reports of natural disasters. At a press conference yesterday, the director of the Center for Research on the Epidemiology of Disasters (CRED) stated "it is logical to think that the rapid global increase in human population should place more people in the path of natural events, raising both the number of events that are classified as natural disasters and their accompanying death tolls. In some areas, this is exactly what we are seeing." So it's not only the climate that is changing, but also us humans.

Drawn by cost pressure, undeveloped land and fertile soil, people are flocking to disaster-prone regions. People are tempting nature with rapid urbanization in disaster-prone regions, increasing the likelihood that flash floods, storms, or earthquakes will affect their towns and villages. This creates a situation in which ordinary events like earthquakes and hurricanes become increasingly elevated to the level of natural disasters that reap heavy losses in human life and property.

In any given year, the death toll at the hands of Mother Nature varies greatly, and last year witnessed more fatalities than the

year before. However, over a longer time span, the global number of deaths from natural disasters has in fact decreased by 5% in recent decades, thanks to better disaster preparedness and prevention programs.

Hurricane Katrina in 2005 became the costliest and one of the deadliest natural disasters of all time, causing over \$200 billion dollars in damage. In 2010, the earthquake in Haiti, the heat wave in Russia, and the floods in Pakistan were the biggest killers, and deadly earthquakes also struck Chile, Turkey, and China in one of the most active seismic years in decades.

Opinion articles.

GM Foods may Pose Long-term Health Risks (incongruent) / GM foods are Safe (congruent)

In 2050, the world population will have risen to about 9.2 billion compared to the 6.9 billion in 2010. Therefore, global farm output must increase substantially in order to feed the world in 2050. A crucial tool for agriculture to address the food security issue is GM (Genetically Modified) crops. To meet that food demand we need to increase our agricultural yields and increase the efficiency of how plants take up nutrients. It means growing plants that use less water to produce the same output and improving resistance to disease and pests.

Irene Michaels from Organic Food Science Australia says the GM argument cannot be justified, as all of the claims about higher yield and longer shelf life have not been proven. "GM crops may have slightly increased levels of nutrients and vitamins but in order to do that, scientists have to interfere with the plants' complex metabolic pathway. This technology can't deliver on its promises as it is still unknown whether the genetically mutated food is safe to eat, as long-term health impacts remain undetermined."

Others argue that GM technology is needed because it allows foods to grow and survive in different climates. Due to the stronger breeds of crops being grown, the food quality of GM foods is improved, and GM foods require less use of harmful pesticides because they are more resistant against pests. In a recent statement issued by a consortium of over a dozen international science academies, including the Australian Academy of Science, it was explained, "GM products have been used for many years and have been consumed without any substantiated evidence of ill effects on health. There is no logical reason they should be of any health concern, and their safety has been confirmed by many peer-reviewed studies world-wide."

Crops with the highest percentage of genetic modifications worldwide are soybeans, canola, corn, rice, sugar beet, potatoes and cotton. In Australia, the only GM crops produced are cotton and canola with GM cotton making up 90% of the Cotton crop.

Fears of Fluoride in Drinking Water (incongruent) / Fluoride Beneficial in Drinking Water (congruent)

Fluoride is a mineral, which occurs naturally in minute quantities in most water supplies, though at varying concentrations throughout the world. Fluoride is also added to drinking water supplies to promote dental health by preventing tooth damage and decay. It has been used for more than sixty years around the world, including over forty in Western Australia. While some European countries have discontinued its use in drinking water, the Perth Water Corporation and WA health authorities are currently reviewing plans to extend the fluoridation scheme to Perth's semi-rural outer suburbs.

Many groups have objected to fluoridation over the years, with Robert Paul from the Wanneroo Citizens' Association claiming that it may be harmful and increase the risk of bone cancer, osteoporosis, as well as a host of other serious medical complications. "It is hard to know whether concentration levels of fluoride in the water have exceeded the supposedly safe levels, as it is tasteless and odourless in water. Fluoride has been used as an insecticide and rat poison. Putting it in drinking water poses a health risk, and is an unethical type of mass medication that disregards a person's freedom of choice."

Others argue that adding fluoride to drinking water is an important element in promotion of dental health, especially in children. Two thirds of the Australian population's drinking water has been fluoridated, which has led to a substantial decrease in tooth decay over time in comparison to non-fluoridated drinking areas. Many major health organizations including the Australian Dental Association state that "The evidence supporting the safety, efficacy, and cost-effectiveness of fluoridation of community water supplies comes from multiple sources, covering 50 years of legitimate peer-reviewed research including long term studies on large populations. Ongoing assessments are stringently carried out, ensuring that the concentration of fluoride does not exceed 1.5 ppm in drinking water systems. At this level, fluoride is absolutely safe."

The population in Perth's outer suburbs, in particular in the cities of Wanneroo and Swan, and the Shire of Serpentine-Jarrahdale is rapidly growing. Many of these semi-rural areas are not connected to the major metropolitan water supply, but rely on smaller, independent water supply networks.

Rating Scales (all Articles)

1. How interesting did you find the preceding news article? (1: 'very uninteresting' to 5: 'very interesting')
2. How easy to read was the preceding news article? (1: 'very difficult' to 5: 'very easy')
3. How informative was the preceding news article? (1: 'very uninformative' to 5: 'very informative')
4. Have you heard about the topic in the preceding news article before? (Yes/No)
5. How familiar are you with the topic discussed in the preceding news article? (1: 'not familiar at all' to 5: 'very familiar')
6. [in manipulation-check study only] How accurately did the headline summarize the preceding article? (1: 'very misleading' to 5: 'entirely accurate')

Recall Questions (all Articles)

1. Briefly summarize the article in a few sentences.
2. Summarize the main point of the article in no more than 10 words.

Recognition Questions

Burglary rate. Which of the following countries was NOT mentioned in the article as having a lower burglary rate than Australia? (Japan / Italy / Canada / The Netherlands)

Natural disasters. Which natural disaster was mentioned specifically at the end of the article? [Hurricane Katrina (2005) / Indian Ocean Tsunami (2004) / Black Saturday Bushfire (2009)]

GM food. What are the only two GM crops produced in Australia? (Rice & Sugar beet / Canola & Cotton / Corn & Soybeans / Wheat & Potato)

Fluoridation. Which of the following areas was NOT mentioned in the article as rapidly growing in Perth's outer suburbs? (The City of Wanneroo / The City of Rockingham / The Shire of Serpentine-Jarrahdale / The City of Swan)

Inference Questions

Burglary rate.

1. After reading the burglary article, indicate in the percentage scale below how much you think the level of burglaries will change over the next 3 years. (-25% to +25%)
2. What should happen to government funding for burglary prevention programs over the next 3 years? (-25% to 25%)
3. If you owned an average home in an average suburb in Australia, what do you think would be your lifetime risk of being burgled at least once? (0% to 30%)

Natural Disasters.

1. After reading the Natural Disaster article, indicate in the percentage scale below by how much you think the death toll from Natural Disasters will change over the next 10 years. (-25% to 25%)
2. What should happen to government funding for disaster preparedness programs in affected areas? (-25 to +25%)
3. Some budget life insurances exclude natural disasters as a cause of death. How much more would you be willing to pay extra for the inclusion of natural disasters? (0% to 30%)

GM food.

1. After reading the GM foods article, indicate how much you think the consumption of GM foods will add to Australia's public health expenditure over the next 10 years. (0 to 30%)
2. What should happen to government funding for research into the health risks associated with GM foods? (-25% to +25%)
3. How much would you pay extra at the grocery store to ensure you are buying non-GM foods? (0 to 30%)

Fluoridation.

1. After reading the Fluoride water article, indicate how much you think drinking fluoridated water will add to the public health expenditure in Perth's outer suburbs over the next 10 years. (0 to 30%)
2. What should happen to government funding for research into the health risks associated with water fluoridation? (-25% to +25%)
3. If you had the choice, how much extra would you be willing to pay for water that is untreated and thus free of fluoride? (0 to 30%)

Appendix B—Example Stimuli used in Experiment 2 (to be placed in Online Supplement)

Condition: Person-in-photo: Bad / Headline: Congruent

Perth woman defrauds investors of \$3 million

A Perth finance broker has been charged with defrauding investors of more than \$3 million using a scheme that claimed to sell shares in a phoney land development called 'Glendaleville'. Mrs Denise Carmel, 62, started the scheme in 2008, selling investments in the alleged village-type development for pensioners. While she paid "small" monthly dividends to investors, she is thought to have gained \$3.26 million from the offences with which she has been charged, with individual amounts ranging from \$40,000 to \$400,000.

Several of the woman's victims, who ranged between 53 and 73 years old, had as their only source of income the age pension. Martha Clarke, a Hillarys grandmother, was among the hardest hit, losing over \$300,000. Police have confirmed that the scheme was organised "professionally and meticulously," fooling even experienced investors.



Mrs Carmel

Condition: Person-in-photo: Bad / Headline: Incongruent

Pensioners fleeced in \$3 million fraud

A Hillarys grandmother was among the hardest hit in a recent investment fraud, losing over \$300,000. Mrs Martha Clarke had invested in a phoney land development called 'Glendaleville'. Victims of the scheme were mainly pensioners, between 53 and 73 years old, with investment amounts ranging from \$40,000 to \$400,000. Police have confirmed that the scheme was organised "professionally and meticulously," fooling even experienced investors.

A Perth finance broker has been charged with defrauding investors. Mrs Denise Carmel, 62, started the scheme in 2008, selling investments in the alleged village-type development for pensioners. While she paid "small" monthly dividends to investors, she is thought to have gained \$3.26 million from the offences with which she has been charged.



Mrs Carmel

Condition: Person-in-photo: Good / Headline: Incongruent**Perth woman defrauds investors of \$3 million**

A Perth finance broker has been charged with defrauding investors of more than \$3 million using a scheme that claimed to sell shares in a phoney land development called 'Glendaleville'. Mrs Denise Carmel, 62, started the scheme in 2008, selling investments in the alleged village-type development for pensioners. While she paid "small" monthly dividends to investors, she is thought to have gained \$3.26 million from the offences with which she has been charged, with individual amounts ranging from \$40,000 to \$400,000.

Several of the woman's victims, who ranged between 53 and 73 years old, had as their only source of income the age pension. Martha Clarke, a Hillarys grandmother, was among the hardest hit, losing over \$300,000. Police have confirmed that the scheme was organised "professionally and meticulously," fooling even experienced investors.



Mrs Clarke

Condition: Person-in-photo: Good / Headline: Congruent**Pensioners fleeced in \$3 million fraud**

A Hillarys grandmother was among the hardest hit in a recent investment fraud, losing over \$300,000. Mrs Martha Clarke had invested in a phoney land development called 'Glendaleville'. Victims of the scheme were mainly pensioners, between 53 and 73 years old, with investment amounts ranging from \$40,000 to \$400,000. Police have confirmed that the scheme was organised "professionally and meticulously," fooling even experienced investors.

A Perth finance broker has been charged with defrauding investors. Mrs Denise Carmel, 62, started the scheme in 2008, selling investments in the alleged village-type development for pensioners. While she paid "small" monthly dividends to investors, she is thought to have gained \$3.26 million from the offences with which she has been charged.



Mrs Clarke

Tables

Table 1

Inference Score Intercorrelations in Experiment 1

Intercorrelation	Article			
	Fact 1	Fact 2	Opinion 1	Opinion 2
Items 1 and 2	.43*	.49*	.33*	.25^
Items 1 and 3	.24^	.25^	.45*	.32*
Items 2 and 3	.11	.04	.35*	.14

Note. * $p < .05$; ^ $p < .10$

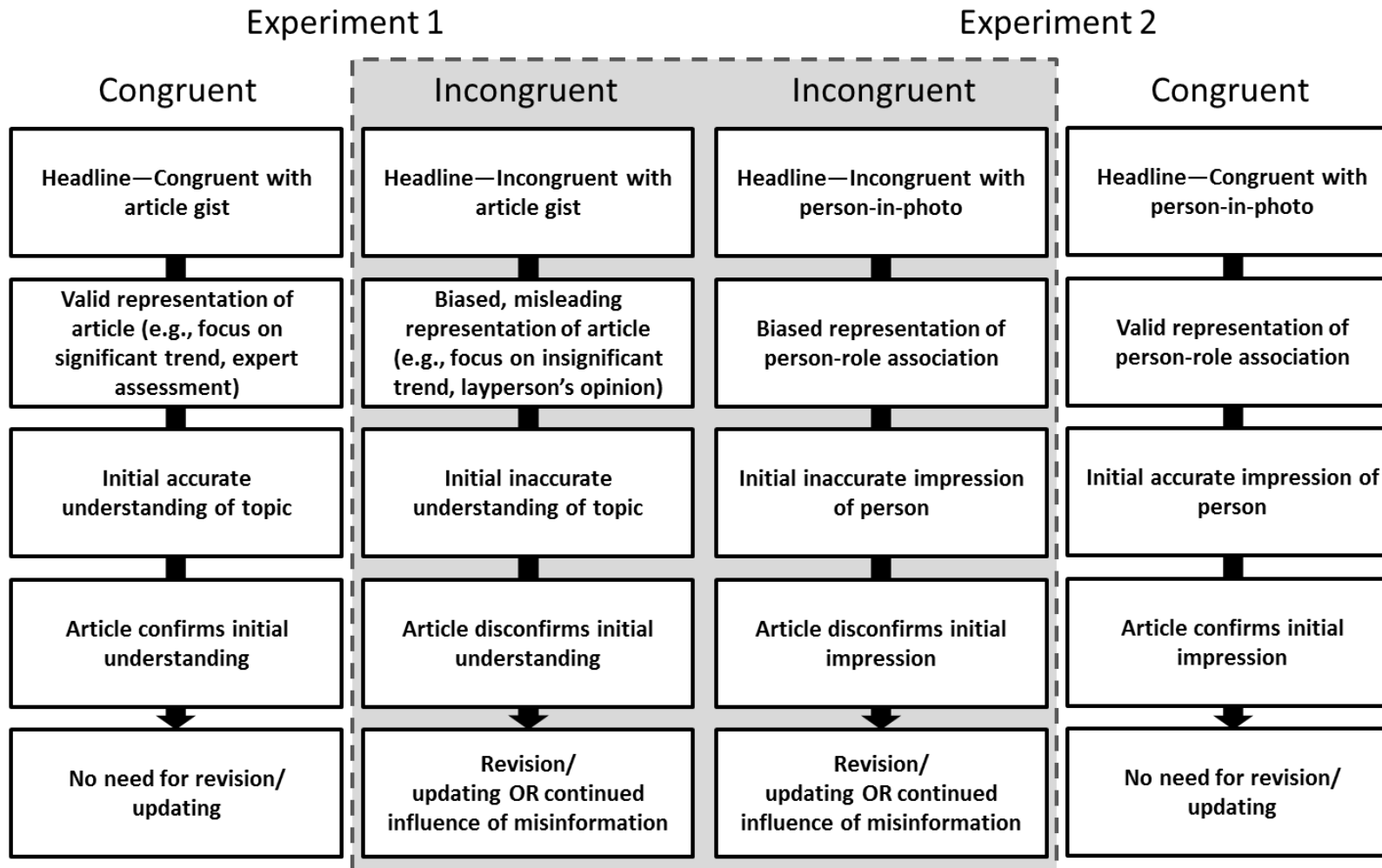


Figure 1. Chart showing the structural similarity between Experiments 1 and 2. Congruent and incongruent headline conditions are presented in separate box columns; time and associated processing steps go from top to bottom as indicated by the black arrows.

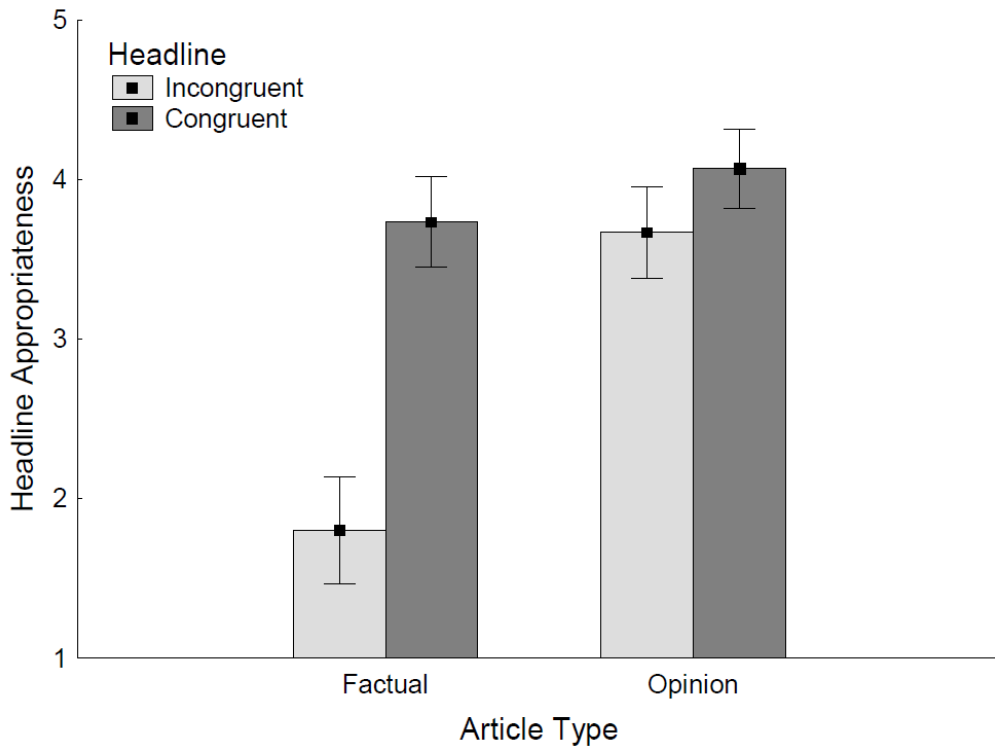


Figure 2. Appropriateness rating (1-5 scale) for headlines used in Experiment 1. Error bars denote within-subject standard errors of the mean.

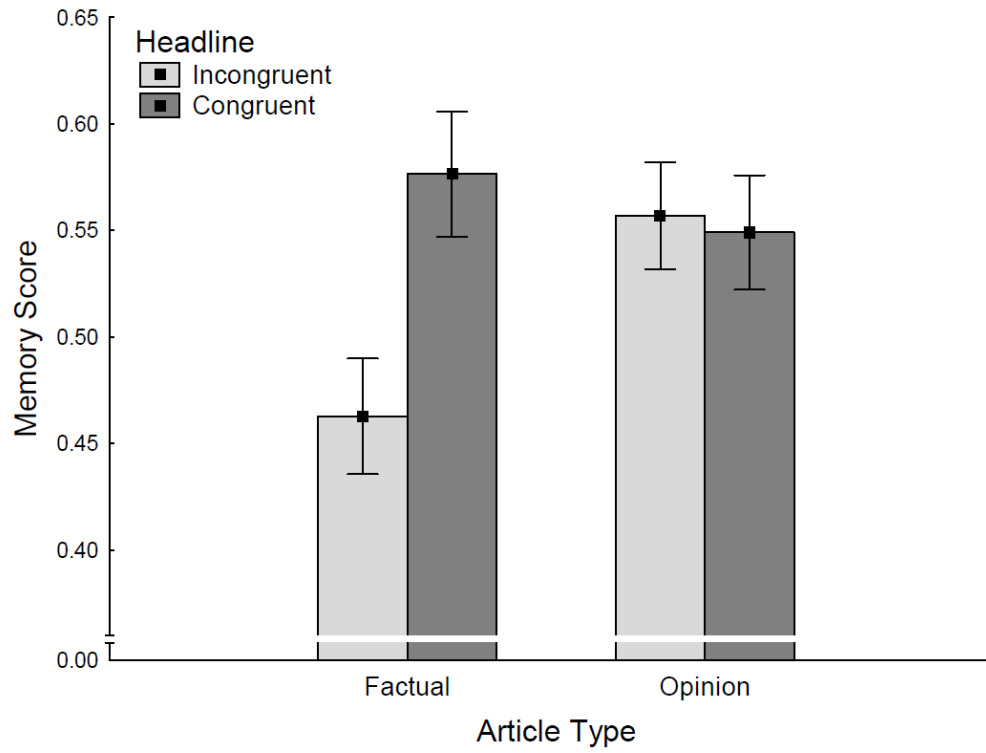


Figure 3. Memory performance (0-1 scale) in Experiment 1. Error bars denote within-subject standard errors of the mean.

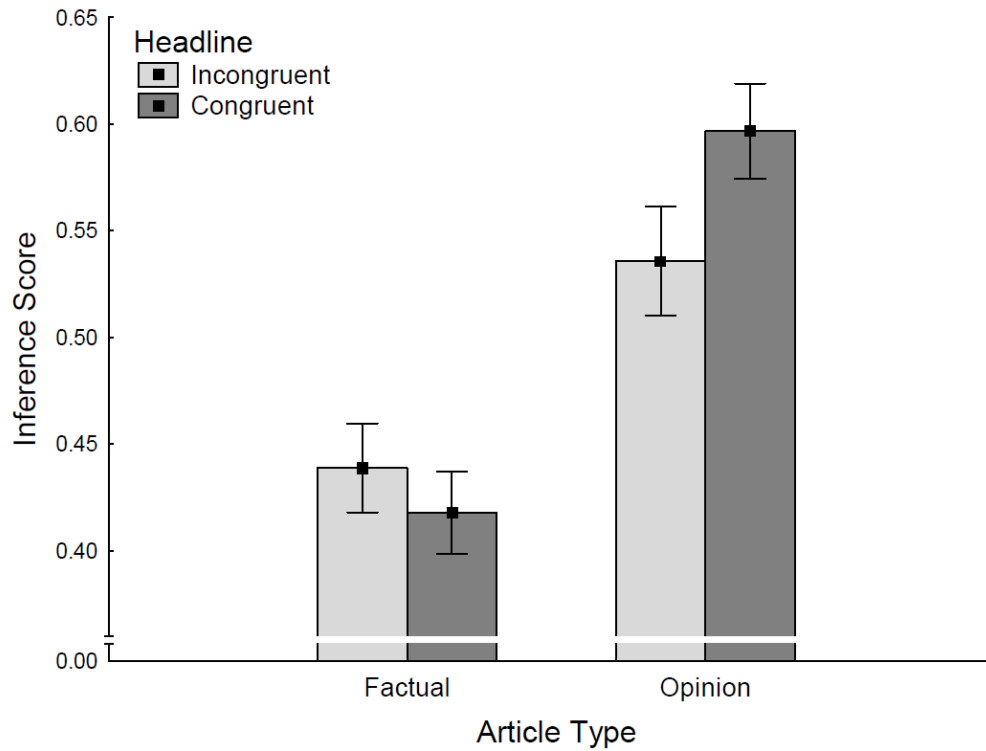


Figure 4. Inference scores (0-1 scale, where higher values indicate more reliance on the article gist) in Experiment 1. Error bars denote within-subject standard errors of the mean.

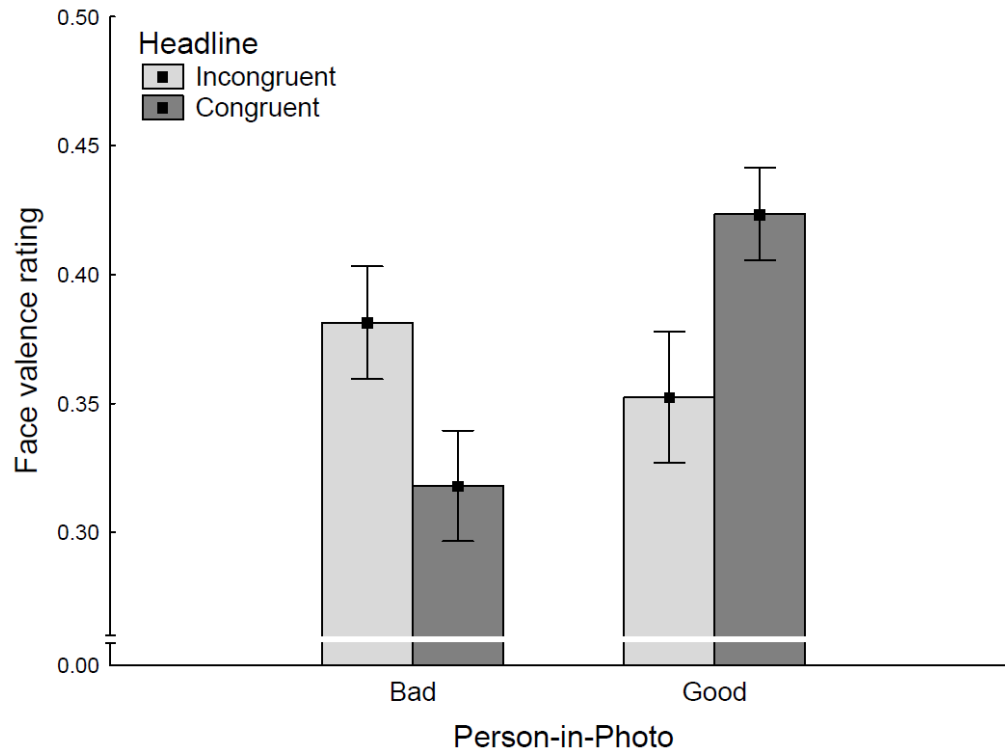


Figure 5. Face-rating scores on valence traits (0-1 scale) in Experiment 2. Error bars indicate within-subject standard errors of the mean.