# Effects of Explanation and Visual Cues on Judgment Accuracy

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Project repository: https://github.com/WAWQAQMAKABAKA/5243Project3_team6
STATGR5243: Applied Data Science Team 6

**Team Contributions:**
**Anqi Wu:** App deployment and design, data analysis, report writing (Sections 1, 2, 3, 4, 6) **Keito Taketomi:** App design, survey distribution, data analysis, report writing (Sections 5, 7) **Yixin Xiao:** Survey distribution, revisions on report **Ziyue Gao:** Survey distribution

## 1 Introduction & Research Question

When was the last time you shared a fun fact or a piece of news online? The ease of sharing and accessing information has become central to how we learn and communicate, but it also opens the door to misinformation. Defined in psychology as information that turns out to be false [1], misinformation is increasingly prevalent, with more than a third of news consumers in the US reporting having shared false content on social media [2].

Among the factors that influence belief in misinformation, the presence of photos - even when irrelevant - is highlighted. Previous work [3, 4] has shown that non-probative photos - those that do not provide factual support - can still increase the truthfulness of a claim. This "truth bias" is believed to emerge because photos make statements feel easier to process, which in turn leads people to accept them as true [5].

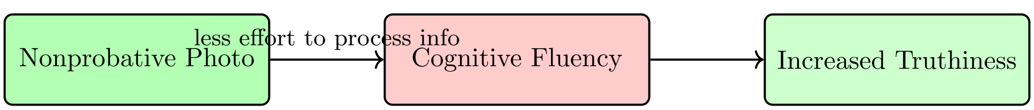


Figure 1: Baseline model: Nonprobative photos facilitate cognitive fluency, increasing perceived truth.

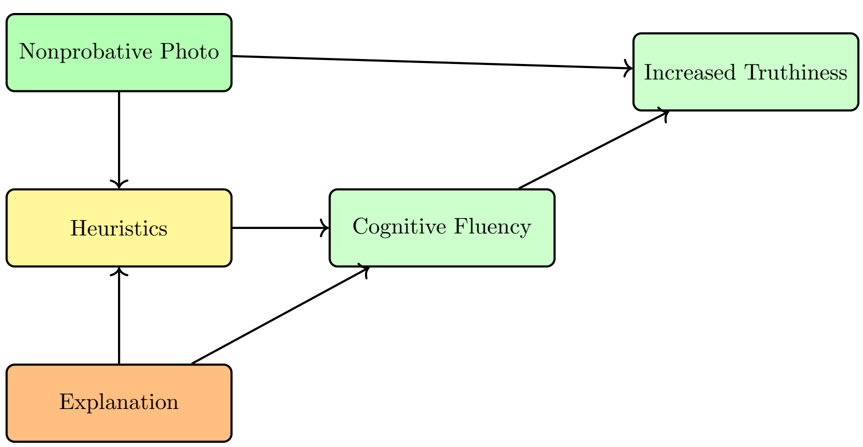


Figure 2: Extended model: Explanation disrupts heuristic shortcuts and cognitive fluency, reducing the photo-induced truthiness effect.

This reliance on visual cues reflects a broader tendency for people to use mental shortcuts, or heuristics, when making judgments. When information is easy to process, it often feels more familiar or credible, even if it is false. This is known as the fluency heuristic, where the ease of understanding substitutes. Nonprobative photos tap into this by making statements feel more intuitive or fluent to evaluate.

Our study builds on this by asking a simple but important question: can requiring participants to explain their judgments interrupt this process? Explanation involves deeper cognitive engagement and may act as a friction point, disrupting the fluency that photos provide. Rather than making a direct prediction, we are interested in exploring whether this explanatory demand changes the way people respond to trivia claims paired with nonprobative images, and whether it weakens their influence.

This study also extends prior lab-based findings by testing whether the photo effect generalizes to a fully remote, web-based environment, increasing ecological validity.

# 2 Experimental Design

In this study, participants evaluated a series of trivia statements—some paired with nonprobative photos and others presented as text-only. To explore whether explanation disrupts the influence of these photos, we randomly assigned participants to one of two conditions. The Explain group was prompted to write out their reasoning for each judgment, encouraging more analytical engagement. The Emotion group, by contrast, described how each statement made them feel, which typically involves less deliberate processing.

In addition to judgment accuracy, we recorded response time as a behavioral indicator of cognitive effort. Prior research suggests that faster decisions often reflect intuitive, heuristic-based thinking, while slower responses tend to indicate more reflective reasoning [6].

This setup formed a 2 (Photo-Present vs. Photo-Absent) $\times$ 2 (Explain vs. Emotion) mixed factorial design. The presence of a photo was manipulated within subjects, while the type of prompt (explanation vs. emotion) was manipulated between subjects. Our dependent variables were accuracy (i.e., identifying whether each statement was true or false) and response time. This mixed design enabled both within-subject (Photo vs. No Photo) and between-subject (Explain vs. Emotion) comparisons, allowing for a nuanced analysis of processing differences across conditions.

Based on this structure, we predicted the following patterns:

- **Emotion group**:
  - *Response time*: A larger difference between photo and no-photo trials, reflecting the fluency effect – i.e., photos make statements easier to process and thus quicker to judge.
  - *Accuracy*: A stronger truth bias in the photo-present condition, leading to reduced accuracy when evaluating false statements accompanied by photos.
- **Explain group**:
  - *Response time*: A smaller difference between photo and no-photo conditions, suggesting that explanation interrupts the fluency effect and prompts more effortful processing.
  - *Accuracy*: A smaller difference in accuracy between conditions, indicating that explanatory effort helps participants remain more consistent in evaluating statements regardless of photo presence.

# 3 Methodology

## 3.1 Participants

A total of 34 participants completed the study. Participants were recruited from the researcher's peer network, including undergraduate and graduate students of similar age. The study was conducted remotely using a custom-designed Streamlit web application, which was distributed via email and messaging platforms. Participants completed the study on their personal devices at their own pace.

To ensure data quality, the app was programmed to only save responses upon full completion of the task. As participation was entirely voluntary, only completed responses were included in the final analysis.

All participation was anonymous, and informed consent was provided at the beginning of the survey. A debriefing section was included at the end of the app to explain the study's purpose. While no formal IRB approval was obtained, the project was conducted for educational purposes, and all procedures adhered to ethical guidelines for minimal-risk behavioral research. Peer feedback and informal review ensured that participants' rights and well-being were respected throughout.

### 3.2 Materials & Procedures

The study included 46 trivia statements, spanning topics from biology to pop culture, designed to test participants' ability to assess truthfulness—modeled after materials used in Newman et al. [3] Of these, 30 statements were false and 16 were true. Each statement was paired with a thematically related but nonprobative image (i.e., an image that is visually relevant but provides no factual evidence).

For counterbalancing, the statements were randomly organized and matched across conditions for difficulty. Each participant evaluated a subset of 16 statements: 8 true and 8 false. Within each truth category, half of the statements were presented with an image and half without, ensuring that each participant experienced all conditions.

For each statement, participants were asked to judge its truthfulness by selecting either "true" or "false." Immediately after their response, participants in the Explain condition saw the prompt:

> "Provide a brief explanation of why you think the statement is true or false."

Meanwhile, participants in the Emotion condition saw the prompt:

> "How does this statement make you feel?"

This prompt appeared after every statement and was designed to induce different levels of cognitive processing across groups.

All stimuli were managed through a structured `stimuli.json` file, which included metadata for each statement (e.g., content, truth label, photo condition). For example, a typical trivia item in the "photo + truth" condition might display the sentence: "Sharks are mammals." alongside a photograph, where the correct answer is "False". Images were stored in a GitHub folder and named according to their associated item IDs (e.g., F4.png), allowing the web app to dynamically display the appropriate image on each trial.

## 4 Data Collection

Data were collected through a custom-built Streamlit web application, which presented participants with a series of trivia statements. For each statement, the app recorded:

- **Participant ID (id)** – a unique, anonymized identifier;
- **Experimental Group (explain/emotion)** – whether the participant was asked to provide an explanation or describe an emotional response;
- **Truth Value (true/false)** – whether the trivia statement was factually correct;
- **Photo Condition (showing picture or not)** – whether the statement was accompanied by a nonprobative image;
- **Participant Response (user answer)** – whether the participant judged the statement as "True" or "False";
- **Justification Text (user response)** – the explanation or emotion provided, depending on the group;
- **Response Time (response time)** – the time taken (in seconds) from the statement's appearance to final submission.

Each row in the dataset represents a single participant's response to one trivia statement. Minimal pre-processing was needed because the app was pre-programmed to capture clean, structured outputs. Responses were only stored upon full completion of the study, and trials with extremely short response times (under 1 second) were automatically excluded.

The app was deployed via Streamlit Cloud and integrated with both GitHub and Google Cloud (via Google Sheets), enabling real-time data synchronization and collection. This automated setup ensured that all responses were consistent, securely recorded, and accessible for analysis without requiring post-hoc cleaning.

This structure allowed for both within-subject comparisons (photo vs. no-photo conditions) and between-group comparisons (Explain vs. Emotion), with detailed tracking of both accuracy and cognitive effort.

# 5 Statistical Analysis & Results

## 5.1 Data Overview

The final dataset included 544 responses from participants, each providing judgments on trivia statements under varying conditions. The experiment featured two main factors:

- **Prompt condition (between-subject factor):** Participants either explained their reasoning ("Explain") or described their emotional reactions ("Emotion").
- **Photo presence (within-subject factor):** Statements were presented either alongside a non-informative photo ("Photo") or without a photo ("No Photo").

Participants indicated whether statements were true or false (measuring accuracy) and their response times (RTs) were recorded.

## 5.2 Data Preparation

Responses initially recorded as boolean values were converted into clear labels ("TRUE" or "FALSE") for analysis. Each participant's accuracy per trial was scored as correct (1) or incorrect (0) based on matching their response with the actual truth value.

Incomplete data entries, especially where participants had not completed both photo and no-photo conditions, were identified. Such incomplete cases were excluded from specific repeated-measures analyses, reducing the number of fully analyzable participants.

Participant responses were grouped by participant ID, prompt condition, and photo presence. Average accuracy and RT were calculated for each condition.

## 5.3 Accuracy Results

Table 1: Mean Accuracy by Photo Presence and Prompt Condition

| Prompt Condition | Photo Presence | $n$ | Mean | SD | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | LL | UL |
| Emotion | False | 17 | 0.507 | 0.5018 | 0.422 | 0.592 |
| Emotion | True | 17 | 0.537 | 0.5005 | 0.452 | 0.622 |
| Explain | False | 17 | 0.522 | 0.5014 | 0.437 | 0.607 |
| Explain | True | 17 | 0.493 | 0.5018 | 0.408 | 0.578 |

*Note.* Accuracy was calculated as the proportion of correct responses to the total number of false statements presented. Each correct response was scored as 1 and incorrect responses as 0. Confidence intervals assume a $t$-distribution with $n-1$ degrees of freedom.

We first analyzed participants' ability to correctly identify false statements across conditions. A 2 (Photo: Present vs. Absent) $\times$ 2 (Prompt: Explain vs. Emotion) mixed ANOVA was conducted on mean accuracy scores.

There was no significant main effect of prompt type, $F(1, 32) = 0.086$, $p = .771$, partial $\eta^2 = .003$, nor any significant effect of photo presence, $F(1, 32) = 0.000$, $p = 1.000$, partial $\eta^2 < .001$. The interaction between prompt and photo condition was also non-significant, $F(1, 32) = 0.350$, $p = .558$, partial $\eta^2 = .011$.

Visually, there was little separation between conditions in mean accuracy, supporting the statistical finding that nonprobative photos did not influence truth judgments in a meaningful way, regardless of whether participants explained or reflected on their feelings.

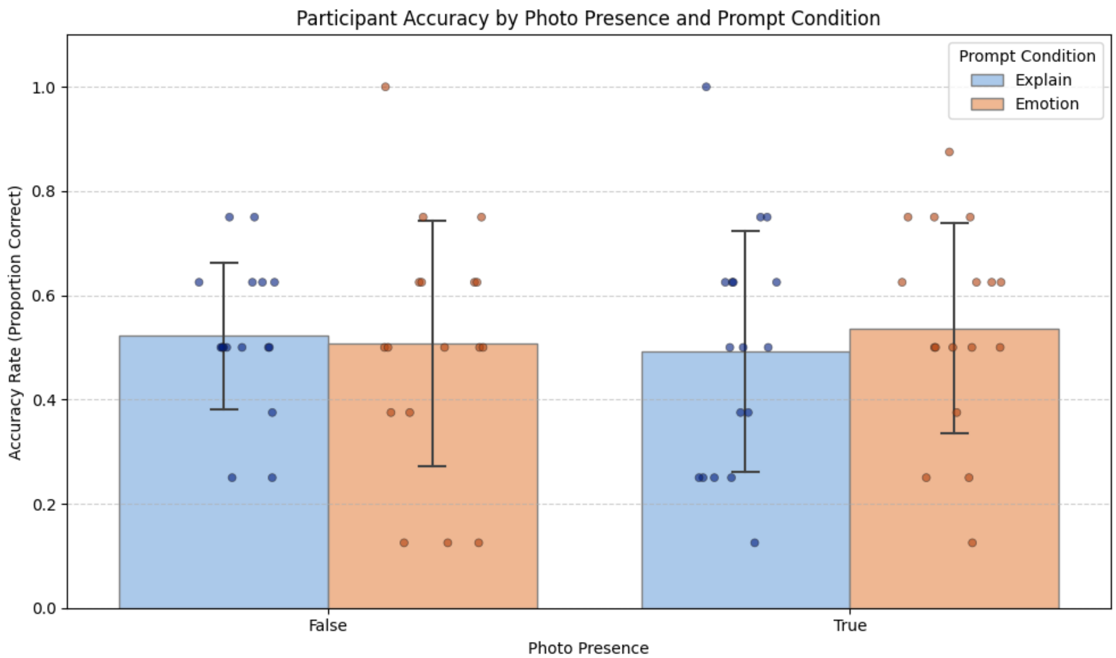


Figure 3: Participant accuracy by photo presence and prompt condition. Bars represent mean accuracy (proportion correct), and error bars indicate standard deviations.

## 5.4 Response Time Results

Additionally we analyzed average response time as a proxy for cognitive effort. The same $2 \times 2$ ANOVA structure was applied.

Here again, there were no significant effects: prompt type, $F(1, 32) = 0.467$, $p = .499$, partial $\eta^2 = .014$; photo presence, $F(1, 32) = 0.289$, $p = .595$, partial $\eta^2 = .009$; and their interaction, $F(1, 32) = 0.066$, $p = .799$, partial $\eta^2 = .002$.

These results suggest that neither the presence of photos nor the prompt type (explanation vs. emotion) meaningfully affected how long participants took to decide. Even though photos were expected to ease processing and explanation was expected to increase it, this difference was not reflected in response time.

## 5.5 Post-Hoc Tests

Follow-up pairwise comparisons also found no meaningful differences between conditions. All comparisons yielded non-significant results, confirming the absence of notable differences suggested by the main analyses.

Table 2: Mean Response Time by Photo Presence and Prompt Conditio

| Prompt Condition | Photo Presence | $n$ | Mean | SD | 95% CI | |
|---|---|---|---|---|---|---|
| | | | | | LL | UL |
| Emotion | False | 17 | 300.355 | 295.7483 | 250.201 | 350.510 |
| Emotion | True | 17 | 310.171 | 307.1891 | 258.076 | 362.266 |
| Explain | False | 17 | 245.265 | 302.3183 | 193.996 | 296.534 |
| Explain | True | 17 | 248.738 | 306.9640 | 196.682 | 300.795 |

*Note.* Response time (in seconds) was measured from the moment the statement was displayed until the participant submitted their response. Confidence intervals assume a $t$-distribution with $n - 1$ degrees of freedom.

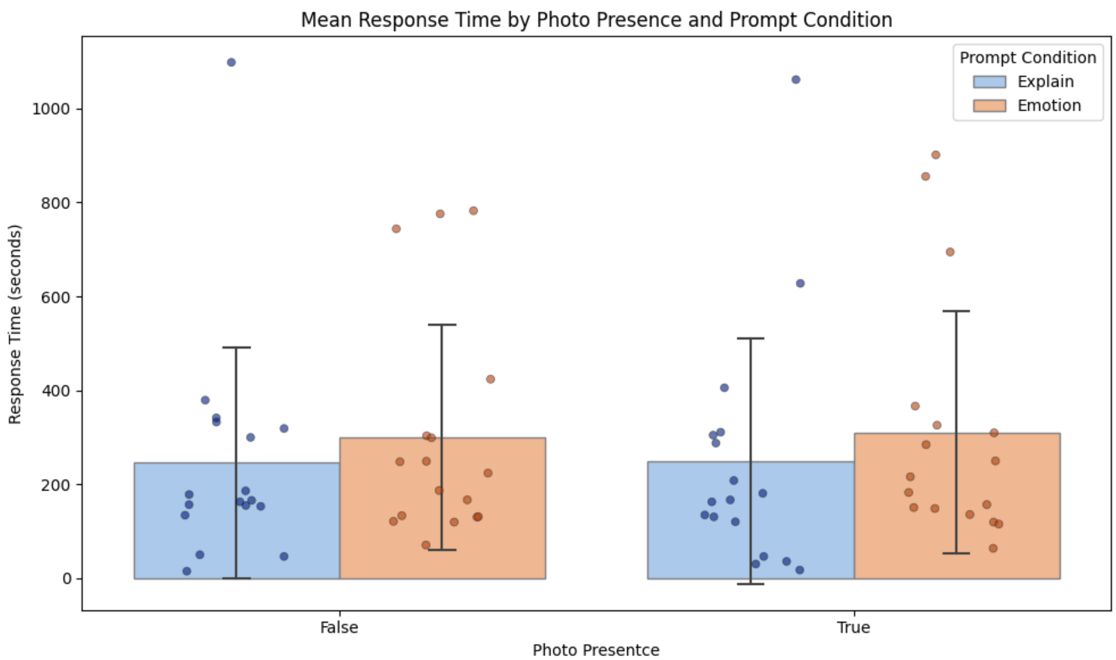


Figure 4: Mean response time by photo presence and prompt condition. Bars represent mean response times in seconds, with error bars reflecting standard deviations.

# 6 Interpretation & Conclusion

Our study set out to explore whether requiring participants to explain their judgments could interrupt the influence of nonprobative photos on how believable trivia claims felt. We predicted that participants asked to explain would be less susceptible to the fluency effects triggered by irrelevant images—leading to both better accuracy and longer, more effortful response times compared to participants who simply expressed how each statement made them feel. But our results didn't support these predictions.

We found no significant effects of photo presence (*Photo Presence*) or explanation requirement (*Prompt Condition*) on accuracy. That is, neither the presence of an image nor the demand for explanation significantly altered participants' ability to judge the truthfulness of trivia statements. Similarly, there were no significant differences in response time across conditions. Whether participants were explaining or reporting emotions, and whether photos were present or not, their decision speed stayed roughly the same.

# 7 Limitations & Considerations

While our study offers valuable insight into the influence of visual cues and explanatory prompts, several challenges emerged that should be acknowledged. First, our null findings might reflect the fragility or context-dependence of the photo effect. Prior work showing strong effects often took place under lab-controlled conditions. In contrast, our remote, web-based study allowed participants to complete the task in varied and uncontrolled environments. We noticed considerable variation in how long participants spent on the task—from a few minutes to nearly an hour—which could have weakened the sensitivity of our manipulations.

Another key issue lies in how participants interpreted the prompts. Although we intended for the Emotion group to rely on intuitive reactions and the Explain group to engage in more deliberate reasoning, many Emotion responses resembled justifications or rationales. This overlap suggests that our manipulation might not have been as distinct as we hoped, potentially reducing the expected contrast in cognitive processing styles.

There's also a chance that our materials—particularly the trivia items—reduced the effectiveness of the photo manipulation. According to Zhang et al.[7], photos are more likely to influence beliefs when paired with information that is hard to visualize. If our statements were already easy to picture, the presence or absence of a photo might have made little difference.

We also faced some practical constraints. Not all participants completed both photo conditions, which limited the number of full cases available for within-subject comparisons. The final sample size (N = 34) was relatively small, which may have reduced our statistical power to detect subtle differences.

Additionally, we coded participant accuracy using exact text match logic. This means some partially correct or ambiguously worded answers may have been marked incorrect, despite reflecting reasonable understanding.

Lastly, because the study was fully online, we couldn't control participant attention or context. To improve future implementations, researchers could add attention checks, use time limits to discourage disengagement, or include behavioral markers (e.g., screen activity) to monitor participant engagement.

In sum, while our results didn't show strong photo or prompt effects, they underscore the complexity of studying cognitive fluency in ecologically valid settings—and the importance of refining both experimental design and implementation when working in the wild.

# References


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