Effects of Attention and Congruence on Judging True and False News Headlines

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Every year, fake news, or made-up stories and reports of events, is more and more prevalent in the United States. People suffer from many of its real-life consequences, some of which are lower trust in science, decreased empathy, greater inequality, and increasing polarization (Lewandowsky et al., 2017). These problems have greatly escalated with the outbreak of the COVID-19 pandemic in the U.S since March 2020. Fake news has contributed to federal responses' failure to address the severity of the virus and provide necessary strategies to contain the spread. It has also prevented countless Americans from perceiving COVID-19 as a threat or even as a real problem, and rather as a conspiracy. Such negative outcomes and a consequent sense of urgency have motivated us to carry out this study.

Previous studies about fake news have made limited attempts to study the role of attention in the perception of fake news to date. Pennycook et al.'s (2018) examination of the influence of prior exposure to fake news on perception of its accuracy is the most related analysis we can find. In this study, participants who previously saw false news headlines even once could accurately evaluate their validity both in the same session and seven days later. The researchers observed this "illusory truth effect" for fabricated headlines when they were not fully credible, verified, or consistent with participants' political ideologies. However, prior exposure and attention to a false piece of news are not identical to each other.

We argue that a plausible reason for this scarcity is the recent development of the research topic. According to Lewandowsky et al. (2017), synonyms of fake news, such as "post-truth" and "post-fact," were unfamiliar terms in 2012. However, four years later, "post-truth" became Oxford Dictionaries's international word of the year, given the Brexit vote and Donald Trump's victory in the 2016 presidential election (Flood, 2016). Many studies have

unanimously agreed that fake news spread quickly on social media, which allows easy, instantaneous content sharing. Vosoughi et al. (2018) reported that false news reached a greater number of Twitter users at a faster pace than real news, especially when the content was political.

The tasks we have given to our participants involve making judgements, which may depend on many factors like time-pressure and previous knowledge and opinions about COVID-19. We looked at a similar study by Bago et al. (2020), which focused on measuring the different levels of effectiveness of using either intuition or deliberation when judging the validity of true and false headlines. They performed this with 1,635 participants who were given a series of headlines and asked to respond with their initial response under time-pressure, after which they were asked to give a second answer with no time constraints (and allowing them to think more deeply). The findings revealed that participants believed more false headlines than true from their intuitive responses. They also found that deliberation leads to more corrections of previous nonrational (and false) beliefs, which suggests that deliberating before making a judgement will lead to more accurate beliefs that rely less on biases.

Divided attention and reaction time are important for our analysis because they may be able to reflect whether or not the amount of cognitive resources used at a given time will affect the accuracy level of each participants' judgement. Divided attention happens when more than one cognitive resource is being used at a given time. When practiced with certain tasks or problems, divided attention tends to lead to a higher error rate and a slower reaction time.

The congruence and incongruence between news sources and news headlines was another important variable in our experiment because some people rely on this to determine the validity of news. However, what some people may identify as a credible news source may differ from others, which depends on their own biases and previous knowledge (Edgerly & Vraga, 2019). We

want to pair true headlines with incongruent (or unreliable) news sources and visa versa, so that we can see if participants will make more or less errors if they depend on the news sources to make their judgement.

The main interest of this experiment lies in what contributes to our ability to distinguish between real and false news headlines and how much time we tend to spend making these judgements. We hypothesized that participants in our experiment who divide their attention with a mental arithmetic task will spend more time evaluating the validity of the news, make more errors in their identification of true or false news headlines, and experience more interference from news sources that are incongruent with the validity of the news headlines.

Method

Participants

We sent informal announcements and invitations to participate to students currently enrolled in two undergraduate psychology courses at Grinnell College, a liberal arts college in the Midwest. Besides, we recruited other student participants at the college by publishing Facebook posts in the student groups and sending out emails or texts. Snowball sampling was also applied by connecting our family members and friends because we had only one week to collect the data. We limited our sample to people who had spent most of their lives in the US, where news about the pandemic was still prevalent at the time of the study. All participants (N = 27) were also familiar with different common news sources and the concept of "fake news."

Materials

The task programs we created consisted of 48 news headlines (see Table 1) and 24 difficult math problems (see Table 2). We gathered 30 of these news headlines from a recent study by Pennycook et al. (2020), which used articles published between February and March

2020. The remaining 18 news headlines were from articles published between September and October 2020. There were two types of the news: real and fake, so our sample of news headlines included 24 true and 24 false headlines. We evaluated the validity of the news headlines we used in this experiment with FactCheck.org and Snopes.com and through consulting each other. The 24 math problems consisted of four-operation math questions at the 4th difficulty level, which was obtained from the Maths Question Generator of MathsBot.com.

To accommodate both PC and Mac users, we used two separate programs to design the task. People who had access to a PC computer carried out the task developed by Professor Gibson using the E-Prime 3.0 software (Psychology Software Tools, Pittsburgh, PA). This version included a response time tracker and a randomization process regarding the order and matching of news sources and news headlines. People with computers running other operating systems (e.g., macOS) received a Microsoft PowerPoint (Microsoft 365 2020, Version 16.42) version of the task. This version used a preset process and did not include a response time tracker. Despite certain differences, both versions consisted of the 48 news headlines with 24 alternating math problems and the pairings of reliable and unreliable news sources with real and false news headlines.

Procedure

Participants were randomly assigned to 4 different groups to control for order effects. We divided these groups by attention and congruence of news sources. For attention, two groups divided their attention first, working on 24 alternating math problems through the first half of the task. The others divided their attention later through the second half of the task. For example, in both the E-Prime Go task and PowerPoint task, a participant in the former two groups received one difficult math problem to solve within 30 seconds. After working out the solution, they saw a

news headline – such as “Vitamin C Protects Against Coronavirus” – paired with a source – “MICROTRACEMINERALS.COM.” Within a 10-second limit, they must decide whether what the headline conveyed was true or false. This participant saw another 23 sequences of math problems and news headlines, repeating the corresponding problem-solving processes as necessary. Afterwards, they only saw 24 news headlines paired with their sources. We used this same method to include the congruence of news sources as a variable so that there were no repeating news sources.

We sent emails to all participants with the instructions for their assigned groups. After completing either the E-Prime Go task or the PowerPoint task, participants submitted their data through an electronic survey, an email, or the E-Prime Go server. All the participants then received a debriefing form via email after we confirmed their completion of the task. One week later, we invited three participants to introspect about their thoughts at the time of the experiment through five questions (see Appendix). These informal interviews served to provide us with any possible explanations for our results.

Results

Accuracy

We conducted a 2 (news headline: real, fake) x 2 (attention: full, divided) x 2 (news source: congruent, incongruent) ANOVA with repeated measures to examine the number of accurate judgements about the validity of the news headlines presented under different conditions. We observed that on average, our participants correctly identified the truthfulness of approximately 4 ($M = 4.03$, $SE = 0.12$) in a block of 6 headlines. However, there was no significant main effect of news headline, $F < 1$, $p = .467$, and no significant interaction between it and attention, $F(1, 26) = 1.24$, $p = .276$. Instead, we found a significant main effect of not only

attention, $F(1, 26) = 20.49$, $p < .001$, $\eta^2_{\text{ppppppPp}} = .44$, but also news source, $F(1, 26) = 6.88$, $p = .014$, $\eta^2_{\text{ppppppPp}} = .21$. Dividing attention to two tasks ($M_{Divided} = 4.33$, $SE_{Divided} = 0.15$) surprisingly produced more correct identifications of news headline types than attending fully to the news headline evaluation task ($M_{Full} = 3.73$, $SE_{Full} = 0.12$). Greater accuracy was also observable for congruent pairings of headlines and sources ($M_{Congruent} = 4.25$, $SE_{Congruent} = 0.13$) than for incongruent ones ($M_{Incongruent} = 3.82$, $SE_{Incongruent} = 0.16$). The analysis also revealed significant two-way interactions between news headline and news source, $F(1, 26) = 5.93$, $p = .022$, $\eta^2_{\text{ppppppPp}} = .19$ (see Figure 1), and between news source and attention, $F(1, 26) = 9.95$, $p = .004$, $\eta^2_{\text{ppppppPp}} = .28$ (see Figure 2). The three factors surprisingly showed a significant three-way interaction as well, $F(1, 26) = 12.38$, $p = .002$, $\eta^2_{\text{ppppppPp}} = .32$ (see Figure 3).

Response Time

Because we carried out the experiment virtually, we could not provide access to PC computers to our participants. As a result, few of them could use E-Prime Go to submit data including their response time to us ($n = 9$). We then performed a similar 2 (news headline: real, fake) x 2 (attention: full, divided) x 2 (news source: congruent, incongruent) ANOVA with repeated measures to examine the time participants spent on the task in different conditions. A typical participant in our sample spent around 5 seconds evaluating the news headlines ($M = 4{,}861$, $SE = 212$). The analysis presented no significant main effect of or interaction between the three factors.

Order Effects

It was also important for us to check for order effects due to the within-subjects design of our experiment. In other words, we required some participants to look at a long series of news

headlines with alternating math problems early in the experiment, while others experienced the interruption with math later. Therefore, practice effects and fatigue effects, for example, were potential threats to our results. We decided to run the same ANOVA with an additional, between-subjects variable – order (math first, math later) – to examine whether accuracy rates varied across the two groups. The main effect for order was not significant, $F(1, 25) < 1$, $p = .615$, so the order at which math problems interfered with news headline evaluation trials did not matter in our experiment.

Discussion

We hypothesized that the divided attention caused by the judgement-making and mental arithmetic tasks would lead to increased reaction time and more errors during the judgement-making process. We reasoned this because divided attention depletes more cognitive resources than full attention, which is why participants would have slower response time and greater errors in their validity judgements. However, we could not find support for both of these hypotheses. There was no significant difference in participants' response time between the two conditions of news headline, attention, or news source. The rate of accuracy did not vary significantly between the participants who divided their attention at the beginning or those who divided at the end. However, they made more correct judgements when completing the tasks simultaneously (dividing their attention) than when they focused on only a series of news headlines (with full attention). We obtained partial support for our hypothesis about greater interference from incongruent headline-source pairs with multitaskers' performances than from their congruent counterparts. Specifically, dividing attention facilitated greater accuracy when news headlines were paired with congruent sources far more than when participants had full

attention. When people saw headlines appear with incongruent sources, dividing attention was also more beneficial, but the difference was not as significant.

It is important to note that there was a phenomenon beyond our prediction that emerged in this study. Pairing false news headlines with reliable news sources significantly caused performance to suffer, while pairing true headlines with unreliable sources saw a slight improvement in performance. We recorded this finding only when participants could pay full attention to the main task. Conversely, when participants had to take on two tasks, incongruently matched sources generated more errors than congruent pairings.

These unexpected events indicate to us that participants did not consider sources while examining the headlines. However, we have ruled out this explanation because it presents conflicting evidence concerning participants' responses to pairs of false headlines and reliable sources. In other words, we propose that participants took the reliable source into account when judging an unknowingly false headline. This approach suited them – the cognitive misers – because it prompted them to fall back on the sources they perceived as reliable (in order to make a decision) when given a headline they felt uncertain about. If participants did not adopt this approach during their judgement-making process, their confusion or uncertainty under the time pressure could use up more cognitive resources quickly. In this regard, another possible interpretation of the observations above is that a news source carries more authority when its accompanying headline is false than when it is true. This interpretation also appeared out of our post-hoc interviews with three participants to understand their thought processes during the experiment. Some of these participants shared that they included the supplemental news sources in their problem space only when they felt uncertain about the validity of the false news

headlines. In other words, if they had a low level of confidence in their initial judgement, they were more likely to fall back on their knowledge of the news source as a last resort.

A third account of the unexpected findings comes from congruence between the source and the reader's political ideology. Edgerly and Vraga (2019) listed the ambiguity of a Twitter news account and the congruence between it and participants' political affiliations as determinants of participants' trust in that account. Additionally, the researchers suggested that the verification marks commonly seen alongside some Twitter accounts did not matter in credibility assessment as much as people thought, suggesting a need for Twitter to make those marks more salient or communicate more information to its users. Oyedeji (2010) also found this congruence important in how people perceived the credibility of news media outlets and their messages. By examining participants' perceptions of CNN and Fox News Channel, the author found support for the "credible brand model," which postulated that perceived customer-based brand equity and perceived congruence between the worldview of a person and that of the news media outlet determine the person's trust for the media outlet and its stories. In the current study, we did not check for this congruence between news sources and the participants' political views because of two reasons. First, time constraints on material preparation have prevented us from investigating individual differences in preference for certain political parties through exploratory analyses, which were performed by past studies (Edgerly & Vraga, 2019; Pennycook et al., 2020; Oyedeji, 2010). Besides, our study focuses only on the cognitive processes involved in carrying out the news headline evaluation task. However, we believe that these social factors, which contribute to the perception of credibility for the news, are important for us to keep in mind regarding the relevant content of our study. Therefore, future studies on fake news should ensure a careful examination of such differences to explain their results more fully.

Another likely limitation of our study is the inconsistency in our selection of news sources. According to one interviewed participant, some headlines could have allowed people to judge their validity more easily than others because the former had a nonstandard or special phrasing that is characteristic of fake news (e.g., multiple exclamation marks and irregular capitalizations). This problem could stem from our not laying down strict criteria for the content and the source of news in advance. Consequently, it could lead to better detection of false content in the news when people are doing multiple tasks at the same time and become cognitively busy. In such circumstances, superficial processing of the news is more likely than semantic processing because the former requires less mental effort than the latter. For superficially processed headlines, their inconsistency in formatting might be quickly recognizable, serving as one of many mental representations of fake news. Once this representation gets activated, it also prompts activation of the concept of fake news or falsehood. Nevertheless, this is not what we have observed. Detecting false news headlines was less successful when participants had to solve math problems than when they performed only the main task. This result indicates that our manipulation, though incomprehensive, did not have serious effects on the experiment. Having said that, other researchers should seek to control not only what all of the collected headlines convey but also how they look to a typical reader.

Conclusion

Our study is the first to analyze how divided attention and the congruence of news headlines and news sources affect identification of fake and real news about the COVID-19 pandemic. We have extended this line of research about fake news to include attention and perceived similarity between the content and source of news. Certain patterns of results show that divided attention leads to more correct judgements with congruently matched headlines and

sources and with incongruent matchings of false headlines and reliable sources. These findings turn out to be more complex than we have anticipated, and our possible explanations vary between individuals (as seen from our informal post-hoc interviews). It follows that individual differences play an important role when it comes to making judgements about the validity of news headlines. Therefore, understanding how individuals use their problem space when evaluating important news may be helpful to explore in future studies.

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Table 1

List of News Sources and Their Corresponding Media Outlets

Source	News Headline	News Media Outlet	Type
O	Spread of coronavirus in U.S. appears inevitable, health officials warn, as Trump defends response	WASHINGTONPOST.COM	R
O	Trump spent the past 2 years slashing the government agencies responsible for handling the coronavirus outbreak	BUSINESSINSIDER.COM	R
O	Coronavirus Infections Increase in Italy	WSJ.COM	R
O	Why airport screening won't stop the spread of coronavirus	SCIENCEMAG.ORG	R
O	Europe's Coronavirus Outbreak Worsens, With Italy at Forefront	NYTIMES.COM	R
O	Coronavirus: 'Many People' In U.S. Will Be Exposed To Virus At Some Point, CDC Says	NPR.ORG	R
O	Coronavirus spread could last into next year, but impact could be blunted, CDC official says	STATNEWS.COM	R
O	Coronavirus: Israel to bring in 14-day quarantine for all arrivals	BBC.COM	R
O	Coronavirus poses tough challenge for economic policymakers	APNEWS.COM	R
O	Scientists warn nCoV more infectious than SARS, but experts have doubts	CIDRAP.UMN.EDU	R
O	Coronavirus: We need to start preparing for the next viral outbreak now	THECONVERSATION.COM	R
O	Amazon plans to prosecute sellers for price gouging during coronavirus outbreak	CNET.COM	R
O	$425M in World Bank catastrophe bonds set to default if coronavirus declared a pandemic by June	WASHINGTONEXAMINER.COM	F
O	Is Colloidal silver a cure for coronavirus?	FILMDAILY.CO	F
O	Coronavirus: North Korea's First Confirmed Patient Shot Dead	NAIJALIVETV.COM	F
O	Coconut Oil's History in Destroying Viruses, Including Coronaviruses	HEALTHIMPACTNEWS.COM	F
O	Governor Cuomo Signs Law Using Coronavirus as an Excuse to Take 'Temporary' Dictatorial Powers	BLUNTFORCETRUTH.COM	F
O	With Coronavirus Concerns Heightened, 328 Chinese Nationals Caught at Southern Border Trying to Enter U.S. Illegally	TEXASINSIDER.ORG	F

Source	News Headline	News Media Outlet	Type
O	Vatican confirms Pope Francis and two aides test positive for Coronavirus	CBN2.COM	F
O	Florida hospital reports a coronavirus ‘infestation’ with multiple confirmed patients	NEWSBREAK.COM	F
O	Coronavirus in China: 23 Million QUARANTINED, 2.8 Million Infected; 112,000 DEAD	HALTURNERRADIOSHOW.COM	F
O	Vitamin C Protects Against Coronavirus	MICROTRACEMINERALS.COM	F
O	University of Tennessee scientists may have found coronavirus cure	FOX46.COM	F
O	Unbelievable — Gates Foundation Predicted 65 Million Deaths Via Coronavirus 3 Months Ago!!!	COERCIONCODE.COM	F
O	Amid coronavirus outbreak, Carnival Cruise Line offers on-ship credits to passengers who don't reschedule	FOXNEWS.COM	R
O	Iran now has the highest coronavirus death toll outside of China, threatening the wider Middle East	CNBC.COM	R
O	Police Departments Are Spreading Coronavirus Misinformation As A Joke	BUZZFEEDNEWS.COM	R
N	Corona-sniffing dogs start work at Helsinki Airport	YLE.FI	R
N	Coronavirus latest: Florida paves way for full capacity in restaurants and bars	FT.COM	R
N	Science academies sound alarm on political interference	POLITICO.COM	R
N	With Daily Infections Hitting a Record-High, Critics Say the U.K. Hasn't Learned From Its Mistakes	TIME.COM	R
N	Odds of coronavirus infection greatly increase with poverty, CDC says	NEWS.YAHOO.COM	R
N	Covid Antibodies Endure Over Six Months in China Trial Subjects	BLOOMBERG.COM	R
N	US health officials quietly modify COVID testing guidelines, sparking a wave of confusion and bewildering experts	CHICAGOTRIBUNE.COM	R
N	Recent rise in COVID-19 cases threatens to slow L.A. reopening, mayor says	LATIMES.COM	R
N	Black Americans, suffering disproportionately from COVID-19, face a mounting mental health crisis	BOSTONGLOBE.COM	R
O	FEMA Proposes Martial Law to Contain	BEFOREITSNEWS.COM	F

Coronavirus

Source	News Headline	News Media Outlet	Type
O	COVID-19 is Now Mutating Into Something Indescribable That is Now Found in Brazil!	TECHTIMES.COM	F
O	Experts think bats are the source of the Wuhan coronavirus. At least 4 pandemics have originated in these animals.	BUSINESSINSIDER.COM	F
N	American scientists say they've found potential COVID-19 cure	CANOE.COM	F
N	China's Massive Amount of Immunotoxic 5G Networking and the Wuhan Coronavirus: The Emperor's New Virus	FREEPRESS.ORG	F
N	Study finds hydroxychloroquine helped coronavirus patients survive better	MSN.COM	F
N	New Jersey COVID Numbers Remain Low, Governor Reports	TAPINTO.NET	F
N	Vitamin D Levels Impact COVID-19 Mortality Rates	HOMECEUCONNECTION.COM	F
N	CDC Says COVID Vaccine May be Distributed in Nov.	WEBMD.COM	F
N	Coronavirus: Combination of antimalarial medication and antibiotics could shorten COVID-19, researchers say	ORTHOSPINENEWS.COM	F
N	By the numbers, it's hard to see how lockdowns saved many lives	NYPOST.COM	F
N	New COVID-19 Mutation Is Thought To Be So Contagious That It May Bypass Social Distancing And Mask-Wearing Efforts	BROBIBLE.COM	F

Note. O represents news headlines and their corresponding sources that were from Pennycook et al.'s (2020) materials. N represents news headlines and their corresponding sources that were gathered by two authors of the current study. R represents true news headlines. F represents false news headlines. News headlines appear in the same order here as in the condition when participants started with divided attention to mental arithmetic tasks and news headline evaluation ones.

Table 2

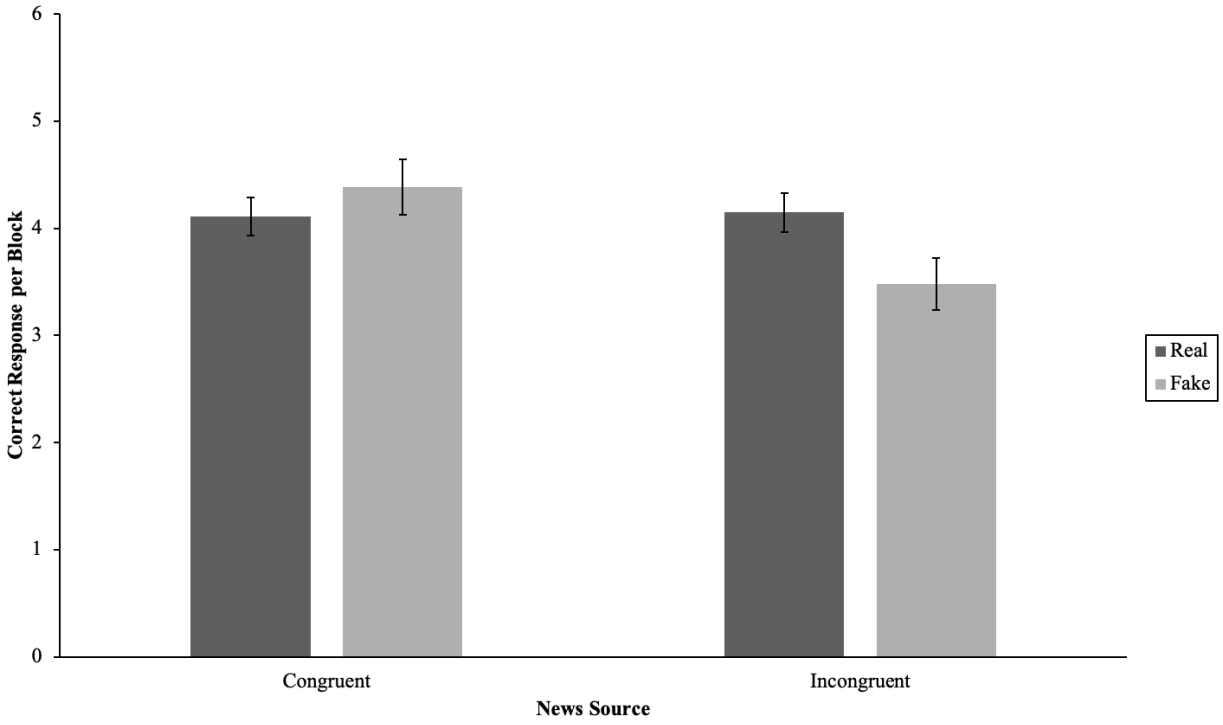
List of Math Problems and Their Corresponding Answers

Math Problem	Answer
2064 ÷ 3	688
37 x 75	2775
615 - 277	338
266 - 187	79
961 - 784	177
4977 ÷ 9	553
3732 ÷ 6	622
821 + 428	1249
1908 ÷ 2	954
6580 ÷ 7	940
72 x 88	6336
482 - 419	63
3550 ÷ 5	710
84 x 58	4872
178 + 568	746
518 - 221	297
68 x 90	6120
401 + 380	781
158 - 106	52
2991 ÷ 3	997
2940 ÷ 4	735
932 - 169	763
978 + 638	1616
314 + 654	968

Note. Math problems and their corresponding answers were obtained from Maths Question Generator (Strand: “Number,” Topic: “Arithmetic: Four operations,” and Difficulty: “4”) on MathsBot.com.

Figure 1

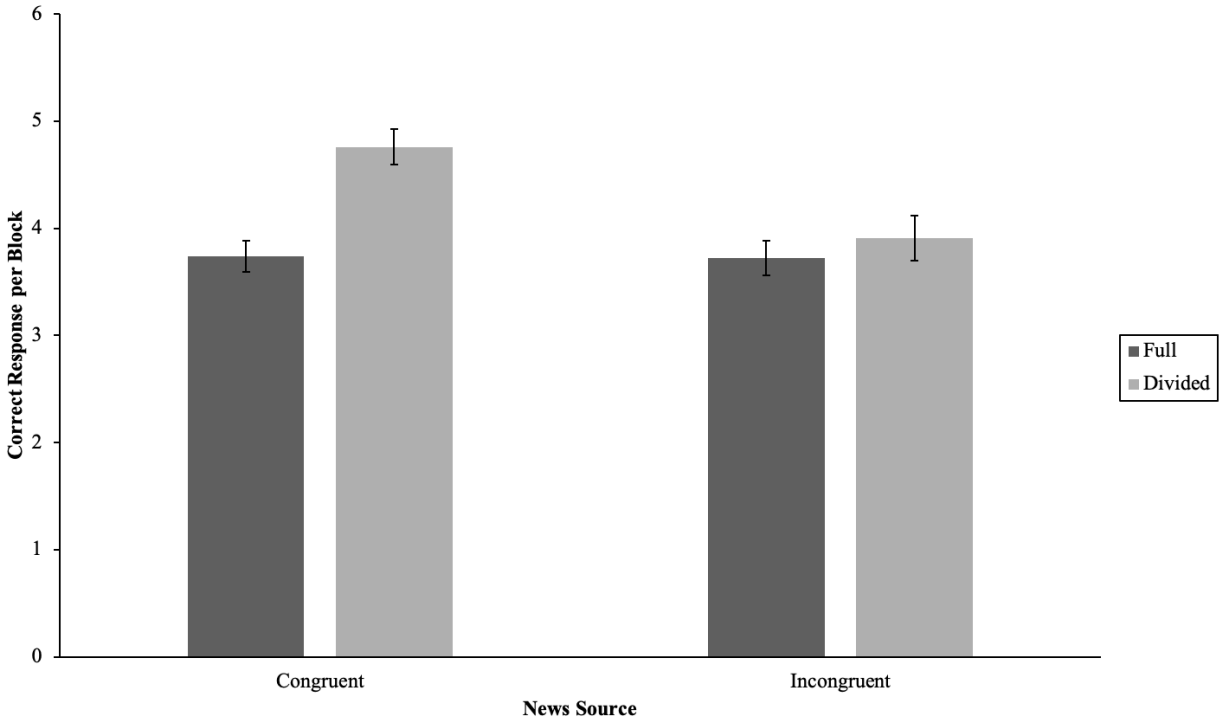
Correct Responses per Block for Different Types of News Headlines and News Sources



Note. Correct responses per block to congruent and incongruent news sources are shown for real and fake news headlines (error bars show standard errors).

Figure 2

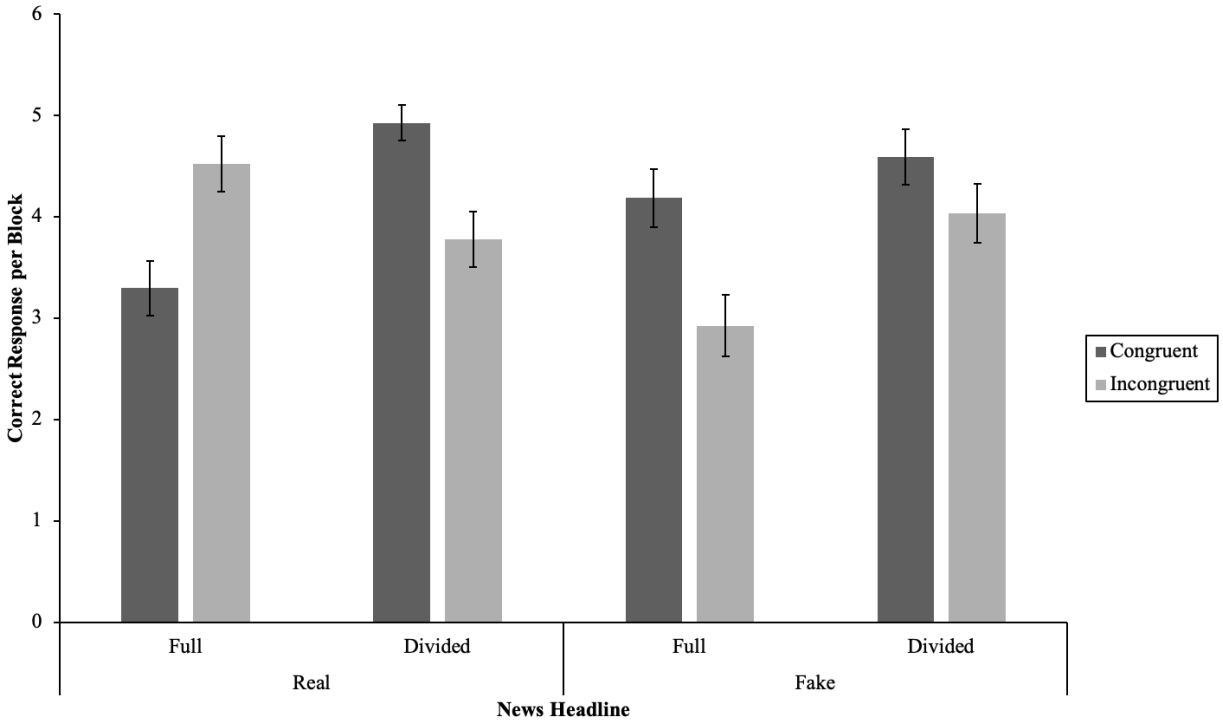
Correct Responses per Block for Different Types of Attention and News Sources



Note. Correct responses per block to congruent and incongruent news sources are shown for full and divided attention (error bars show standard errors).

Figure 3

Correct Responses per Block for Different Types of News Sources, News Headlines, and Attention



Note. Correct responses per block to congruent and incongruent news sources are shown for real and fake news headlines and for full and divided attention (error bars show standard errors).

Appendix

Post-Hoc Interview Questions

1. Did you find that making judgements was generally easy or difficult, or a mix of both?
    a. What made certain news headlines more difficult/easy to judge?
2. How did you make your decisions about the validity of the news headlines (describe thought process)?
3. Did you consider news sources in your thought process? If so, how?
    a. Did you use news sources for every news headline, or only the easy/hard ones?
    b. How did the news sources impact your judgement?
4. Did the math problems make it easier/harder for you to make a news headline judgement?