Source Memory Is More Accurate for Opinions than for Facts

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Effective communication relies on consumers remembering, sharing, and applying relevant information. Source memory, the ability to link a claim to its original source, is an essential aspect of accurate recall, attitude formation, and decision making. We propose that claim objectivity, whether a claim is a fact or an opinion, affects memory for the claim's source. This proposal follows a two-step process: (i) opinions provide more information about sources than facts do; (ii) claims that provide more information about sources during information encoding are more likely to be accurately attributed to original sources during recall. Across 13 pre-registered experiments ($N = 7{,}510$) and a variety of consumer domains, we investigate the effect of claim objectivity on source memory. We find that source memory is more accurate for opinions than for facts, with no consistent effect on claim recognition memory. We find support for the proposed process by manipulating facts to be more informative about sources and opinions to be less informative about sources. When forming inferences and seeking advice from sources, participants rely more on previously shared opinions than on previously shared facts. Our results indicate that opinions are more likely to be accurately attributed to original sources than are facts.

Keywords: source memory, objectivity, memory, opinions, facts

In an information-rich world, consumers constantly encounter claims originating from a variety of different sources. Media outlets publish headlines, online reviewers share experiences, friends offer recommendations, and politicians disseminate narratives. Billions of dollars are spent every year on advertisements, slogans, and marketing campaigns as companies compete with one another for consumers' time, attention, and memory. Effective communication relies heavily on memory processes and consumers' ability to accurately recall previously encountered information (Bettman 1979; Johar and Pham 1999; Lynch and Srull 1982; Lynch, Alba, and Hutchinson 1991). Source memory, the ability to link a claim to its original source, is an essential aspect of accurate recall, attitude formation, and subsequent decision making. Source memory has consequential implications for persuasion (Kumkale and Albarracín 2004), consumer choice (Bettman 1979), and public health behaviors (Morgan et al. 2021).

However, as with other types of memory, source memory failures are common. In a pilot test with 98 participants on Amazon's Mechanical Turk (MTurk), 95% of participants (93 of 98) reported having experienced a source memory failure. Among participants who had experienced a source memory failure, 49% reported that it had been at least "moderately important" to recall the source, and 27% reported that it had been "very important" or "extremely important." It may then come as little surprise that 73% of

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participants were frustrated by their source memory failures, with 26% reporting that the experience was "very frustrating." Experiences rooted in source memory failures are reflected in online forums (e.g., the "/*r*/*tipofmytongue*" subreddit serves as a resource for frustrated consumers seeking help with source memory failures) and entertainment platforms (e.g., *Sporcle* features a myriad of games where users test their source memory on "Who Said It?" quizzes featuring quotes from movies and TV shows).

A constant feature of our daily lives, source memory failures can have important consequences for advertising efficacy. For instance, source memory misattributions resulted in consumers incorrectly identifying FedEx as the official sponsor of the 1998 Winter Olympics rather than the true sponsor, UPS (Johar and Pham 1999). After Energizer introduced commercials with their now-ubiquitous pink drumming bunny mascot in the late 1980s, reports claimed that up to 40% of consumers who praised the Energizer campaign inaccurately misattributed the pink drumming bunny mascot to competitor Duracell (Kent and Kellaris 2001; Krishnan and Chakravarti 2003).

Although source memory has received limited attention in consumer research, the causes of source memory failures have been a point of interest in cognitive science. Memory researchers have found that source memory accuracy is affected by the source of a claim (source effects), the recipient of a claim (individual differences), and by the context in which claims are encountered (context effects) (Bell, Mieth, and Buchner 2021; Cansino et al. 2019; Kassam et al. 2009). However, to our knowledge, whether features of the claims *themselves* (i.e., claim effects) might affect source memory accuracy has not been considered in the memory literature. Investigating how claim effects influence source memory can help both researchers and practitioners understand how the types of claims used to communicate with consumers affect information processing and belief formation.

In the present research, we investigate how one such claim feature, *claim objectivity*, affects source memory accuracy. While some claims are objective (reflecting verifiable truth or falsehood), other claims are subjective (reflecting opinions and beliefs). Claim objectivity affects how consumers view the world, influencing consumer beliefs about quality versus taste (Spiller and Belogolova 2016), and shaping our interpersonal communications. Whether people believe a claim to be objective or subjective frames the rigidity of disagreements: it affects how people collaborate and negotiate (Liberman et al. 2012; Ross and Ward 1995), it drives political polarization and inter-group conflict (Blatz and Mercier 2018; Johnson, Rodrigues, and Tuckett 2021; Skitka and Morgan 2014), and it contributes to the spread of misinformation (Penney 2020).

Claim objectivity plays a defining role in social cognition, affecting how much consumers learn about one another (Heiphetz et al. 2014; Heiphetz and Young 2017; Theriault et al. 2017). For instance, both young children (ages 8–10) and adults (ages 17–40) report learning more about a source when the source makes subjective claims (e.g., "Oranges are the tastiest fruit of all") than when the source makes objective claims (e.g., "George Washington was the first president of the United States") (Heiphetz et al. 2014). Opinions help us learn about other people. Neuroimaging results are aligned with the behavioral evidence, finding greater activity in brain regions associated with learning about other people when encoding subjective versus objective claims (Theriault et al. 2017). When we encounter information that helps us learn something new about a source, the associative links formed between that information and the source are reinforced, which improves subsequent source memory (Bell et al. 2012; Greene, Martin, and Naveh-Benjamin 2021; Kuhlmann et al. 2021). Building on this theoretical framework, the present research finds that a claim's objectivity affects how accurately consumers are able to recall its original source. This finding offers insights for both researchers and practitioners into how consumers learn about others, update their beliefs in light of new information, and seek advice from people learned to have relevant experience.

A PRIMER ON SOURCE MEMORY

Theories of Source Memory Mechanism

Source memory is a form of associative memory, a critical function of human cognition that allows us to form, store, and remember associations between elements (Anderson 1983; Johnson, Hashtroudi, and Lindsay 1993). The formation and strength of these associative links (e.g., between a claim and its source) rely on the binding between an item and its surrounding features during the initial encoding of information (Bell, Mieth, and Buchner 2022; Chalfonte and Johnson 1996; Greene et al. 2021; Johnson et al. 1993; Mitchell and Johnson 2009; Mitchell and MacPherson 2017; Old and Naveh-Benjamin 2008). Remembering a situation involves both the encoding of the individual elements that make up the situation (e.g., what was said, who said it, in what context it was said, etc.) as well as the encoding of links binding these various individual elements to one another, forming a web of interconnected elements and relational constructs (Chalfonte and Johnson 1996; Meiser and Bröder 2002). Precisely *how* these links are formed, stored, and retrieved is a focus of ongoing research across a number of disciplines, aiming to identify the neural and cognitive mechanisms underpinning source memory processes (e.g., for a recent review, see Kuhlmann et al. 2021).

Dual-process models of item memory (memory for a previously seen focal item, e.g., what was learned) propose that accurate item recall can be driven by a recollection-based

process or by a familiarity-based process. In recollection-based recall, a person can explicitly remember the focal item as well as other details, such as the context in which it was learned. In familiarity-based recall, the learning episode and the contextual details are not explicitly recalled, but the focal item feels familiar and can still be accurately identified (Yonelinas 2002). Whether both recollection-based and familiarity-based processes can also drive accurate source memory (memory for features of the context in which a focal item was previously seen, e.g., when, how, and from whom something was learned) is an unresolved question with contradictory findings (Mayes, Montaldi, and Migo 2007; Mitchell and Johnson 2009; Staresina and Davachi 2006). Kuhlmann et al. (2021) suggest that these seemingly contradictory findings can be resolved by considering distinctions in what is classified as the focal item for a task (i.e., when sources are the focal point of attention at encoding, "source memory" may operate more like "item memory"). The specific processes underpinning source memory are an active focus of investigation.

When and Why Source Memory Fails

Memory—including source memory—often fails us as consumers. Source memory is of particular relevance for aging consumers, who experience declines in associative memory performance (Chalfonte and Johnson 1996; Hashtroudi, Johnson, and Chrosniak 1989; Law, Hawkins, and Craik 1998). Reduced source memory accuracy in older adults is attributed to weaker associative links formed during encoding between items and sources (Naveh-Benjamin 2000; Old and Naveh-Benjamin 2008).

When source memory recall is unsuccessful, consumers may try to reconstruct associations based on existing information or heuristics (Batchelder and Batchelder 2008; Kuhlmann and Touron 2011; Mieth et al. 2021; Schaper, Kuhlmann, and Bayen 2019). While this sort of informed guessing can sometimes help attenuate source memory failures (Batchelder and Batchelder 2008; Bell, Mieth, and Buchner 2020; Bell et al. 2021), it also makes consumers, particularly older consumers, increasingly reliant on stereotypes (Klauer and Meiser 2000; Mather, Johnson, and De Leonardis 1999; Sherman and Bessenoff 1999).

Strategies developed to assist older adults in source memory recall have targeted the encoding stage, aiming to strengthen the links formed between items and sources (Kuhlmann and Touron 2012). For instance, Glisky, Rubin, and Davidson (2001) ask participants to study the source–item relationship during encoding, finding that attributing greater attention to these relationships improves source memory at recall. These findings highlight the importance of source–item links formed during encoding as a key driver of source memory accuracy during recall (Chalfonte and Johnson 1996; Johnson et al. 1993).

CLAIM OBJECTIVITY AND SOURCE MEMORY

Variability in source memory accuracy is subject to differences across individuals, contexts, and sources. For instance, across individuals, source memory accuracy declines with age and associated neurological deficits (Cansino et al. 2019; Hashtroudi et al. 1989; Janowsky, Shimamura, and Squire 1989; Schacter et al. 1994; Simons et al. 2004). Across contexts, informational salience impacts source memory: source memory for claims is enhanced when people know beforehand that the information may be important later (Kassam et al. 2009). Across sources, factors such as how emotionally expressive a source is and how credible a source is can enhance source memory accuracy (Bell et al. 2021; Davidson, McFarland, and Glisky 2006). Prior research has focused primarily on individual differences, context effects, and source effects, and has not substantially addressed *claim effects*. In the current research, we aim to address this gap by investigating a claim effect, specifically the role of claim objectivity, on source memory.

The claims we encounter, and share, vary in their objectivity. Some claims are objective; they are factual statements that can be verified as either true or false (e.g., "Stockholm is the capital of Sweden"). Other claims are opinions; they are subjective assessments that cannot be verified as true or false, but people may agree or disagree with them (e.g., "Stockholm is more beautiful than Copenhagen"). Because opinions are subjective, they allow for inconsistent assessments: Jack may believe that Stockholm is more beautiful than Copenhagen, Jill may believe that Copenhagen is just as beautiful and yet, because neither one of them expresses a belief that can be considered objectively true or false, neither one is right or wrong. Factual statements, on the other hand, generally necessitate the existence of an objectively correct view: someone is either right or they are wrong.

We continuously encounter different claims from different sources—how do we stay on top of ongoing discussions and maintain relationships with others, keeping track of who has read an intriguing new book, recommended a good movie, or can offer us advice on a specific topic? Our ability to pinpoint the original source of a particular claim is affected primarily by how strong an association we formed between the claim and the source when first exposed to them (Greene et al. 2021; Mitchell and Johnson 2009; Mitchell and MacPherson 2017; Pham and Johar 1997). It is during the initial encoding of information that these associative links are formed in memory (Greene et al. 2021), and it is these associative links that we rely on to recall the original source of a claim (for a review, see Mitchell and Johnson 2009). As a result, the information we encounter during our first exposure to it, how we

process and encode it, and what associations we form, all matter for source memory.

Why might we predict that claim objectivity can affect the associative links between sources and claims formed during the encoding of information? In interpersonal communication, opinions hold particular informational value. Because opinions are subjective assessments about which there may be disagreement, an expressed opinion typically implies something about the speaker, whereas an expressed factual statement does not—or at least not to the same extent. Indeed, research in developmental psychology has found that, from as young as 8 years of age and into adulthood, people report learning more about others from opinions than from facts. Moreover, people believe that when others share their opinions, they intend to share more about themselves than when they share facts (Heiphetz et al. 2014). Evidence of learning more about others from opinions has not been limited to behavioral outcomes. Compared to facts, the encoding of opinions is associated with greater activation in regions of the brain implicated in theory of mind, the ability to form representations of others' thoughts, beliefs, and mental states (Amodio and Frith 2006; Saxe, Carey, and Kanwisher 2004; Schurz et al. 2014; Theriault et al. 2017). The development of theory of mind is critical not only for social cognition but also for properly functioning source memory (Bright-Paul, Jarrold, and Wright 2008; Lind and Bowler 2009).

Learning about other people helps consumers form relationships, make decisions, and communicate (Bell et al. 2012, Berger 2014). During encoding, new information that is associated more strongly with a source forms stronger associative links with that source, improving downstream source memory recall (Greene et al. 2021; Kuhlmann et al. 2021). When encoding opinions, consumers learn more about a source than when encoding facts. As a result, in the present research, we predict that the associative links formed during encoding are stronger between sources and opinions than between sources and facts. We expect that consumers will be more likely to correctly identify the original source of a claim when the claim is an opinion than when the claim is a fact. This investigation deepens our understanding of how consumers remember information, shedding light on one of the processes underpinning interpersonal communication, with broader implications for how consumers learn about others, update their beliefs in light of new information, and seek advice on specific issues or topics.

OVERVIEW OF EXPERIMENTS

In 13 pre-registered experiments, we examine the effect of claim objectivity on source memory across different consumer environments. In experiments 1, 2a, 2b, 2c, and 2d, we establish the main effect. In experiment 3, we examine whether source expertise moderates this effect, finding no such evidence. In experiments 4 and 5, we identify process evidence by making facts more informative about a source (experiment 4) or opinions less informative about a source (experiment 5). In experiments 6a and 6b, we consider two implications of the effect of claim objectivity on source memory beyond source memory accuracy. In experiment 6a, we find that consumers are better able to draw appropriate inferences about a source at a delay when the focal claim is an opinion rather than a fact. In experiment 6b, we find that consumers have greater intention to seek advice from topically relevant sources who had shared opinions rather than facts. In the general discussion, we note three experiments in which we did not find an effect of claim objectivity on source memory.

Each experiment used a similar design and method, so we describe that overall approach first before describing each experiment in detail. This research was certified exempt by the home institutions' IRBs. All anonymized data, code, materials (including a full list of sources and claims), and pre-registrations are available on Research Box (https://researchbox.org/501).

Method Across Experiments

For each experiment, we recruited a convenience sample of participants from MTurk. Sample sizes were large enough to provide at least 80% power to detect a within-subject difference of 0.15 standard deviations in our target measure of source memory for opinions versus facts. The overall experimental design used in each experiment was based on the source memory literature (Kassam et al. 2009) (appendix figure A1). Each experiment was composed of three stages.

First was the encoding stage. A set of sources—individuals with names and photographs—was shown sequentially to participants. Each source was accompanied by four claims: two factual statements and two opinions (experiment 4 used six claims per source, with four factual statements and two opinions). Participants were presented with an engagement task and asked to rate each source for likeability, knowledgeability, or usefulness; the specific prompt varied across experiments (experiment 2c removed the engagement task entirely). To address potential stimulus effects, the particular set of claims shown to each participant during the encoding stage was counterbalanced across participants (experiments 1 and 4 used a single set of claims for all participants). Source images were created using a generative adversarial network via a publicly available artificial face generation tool (Karras, Laine, and Aila 2019).

Second was the filler stage, during which participants reported basic demographics. The primary purpose of this stage was to separate the encoding stage from the recall stage. Including a period of delay after encoding is commonplace in source memory research; subsequent memory tests are more likely to rely on recall processes rather than

on information active in working memory (for a recent review of source memory procedures, see Kuhlmann et al. 2021).

Third was the recall stage, which tested participants' source memory and claim recognition memory. In each experiment, the memory tests in the recall stage provided our key dependent measures. Participants were tested on the information (claims and sources) that was previously presented during the encoding stage of each experiment. To test source memory, participants were sequentially presented with previously seen claims (half factual statements, half opinions) and asked to identify the original source that had accompanied each claim from a multiple-choice list of sources. The multiple-choice list of sources (including both photographs and names of each source) included all of the original sources seen in the encoding stage as well as an equal number of filler sources not previously seen. To test recognition memory, participants were sequentially presented with claims and asked to identify whether each claim had been shown to them earlier or not. In the recognition memory test, half of the claims participants were tested on had been previously presented to them (during the encoding stage of an experiment, with an equal number of previously seen opinions and previously seen facts tested). The other half of the claims participants were tested on had not been previously presented to them (with an equal number of opinions and facts tested). Participants' performance on the claim recognition memory task was used to identify inattentive participants, based on at or below-chance performance as pre-registered across experiments.

Across experiments, we also controlled for the particular subset of claims that was used to test for source memory versus recognition memory. Each participant saw a set of claims during the encoding stage. In the recall stage, half of the claims from the encoding stage were used to test source memory and the other half of the claims from the encoding stage were used to test recognition memory. Which half of the claims from the encoding stage were used to test source memory versus recognition memory was counterbalanced across participants.

The primary measure of interest was the effect of claim objectivity on source memory. For each participant, the key dependent variable was the within-subject difference between the percentage of opinions that the participant correctly attributed to their original sources and the percentage of facts that the participant correctly attributed to their original sources. This within-subject difference reflected the effect of claim objectivity on source memory. In each experiment, we regressed the key dependent variable on an intercept (the key estimate) and a complete set of contrast-coded variables (to account for baseline differences between different subsets of claims and sources that were counterbalanced between participants). The intercept represented the key estimate of interest: the difference in source memory for opinions versus facts. The contrast-coded variables allowed us to control for variations in the stimuli. We used a similar approach to analyze recognition memory as a control variable.

EXPERIMENT 1

Experiment 1 lays the groundwork for the three-stage experimental design. Subsequent experiments followed this paradigm closely, extending the findings of experiment 1 across a variety of consumer contexts. Experiment 1 was pre-registered on AsPredicted. See Research Box for a complete list of stimuli and sources.

Method

In the encoding stage, participants ($N = 399$) were presented with 32 general claims about the world from 8 sources. Data were collected on AMT using CloudResearch's "block low quality participants" filter (Litman, Rosenzweig, and Moss 2020). Each source was accompanied by a name, a photograph, and four claims: two factual statements (e.g., "Aristotle was a Greek philosopher") and two opinions (e.g., "Chocolate ice cream tastes better than zucchini"), drawn from prior literature (Fazio et al. 2015; Goodwin and Darley 2008; Pennycook and Rand 2019). For each presented source, participants were asked to provide a rating for how much they like the source on a scale from (1) Dislike to (5) Like.

In the filler stage, participants were presented with a set of demographics questions. The primary purpose of the filler stage was to separate the encoding and recall stages.

In the recall stage, participants were presented with claims seen in the encoding stage. Claims from half of the sources were used to test source memory. Participants were asked to identify each claim's source from a panel of 16 sources (with names and photographs), including the 8 sources seen in the encoding stage and 8 novel sources not previously seen. Claims from the other half of the sources were used to test claim recognition memory. Using binary yes/no measures, participants were asked whether or not they had seen each of 32 claims (8 factual statements and 8 opinions from the encoding stage; 8 filler factual statements and 8 filler opinions not seen previously).

Results

The recall stage provided us with our measures of interest. Our within-subject dependent variable was the difference between the percentage of opinions that the participant correctly attributed to their original sources and the percentage of facts that the participant correctly attributed to their original sources. This within-subject difference reflected the effect of claim objectivity on source memory. This within-subject difference score was regressed on a contrast-coded variable (−1, +1) representing the between-subject counterbalancing of claims used to test source memory versus

recognition memory.[1] This variable was intended to merely be a nuisance variable to account for differences in baseline tendencies between sets. The intercept was the key test of interest, representing the within-subject main effect of claim objectivity on source memory, averaged across counterbalanced groups. Seventy-six participants were excluded from the analysis of experiment 1 for scoring at or below chance on the recognition memory task, suggesting inattentiveness.[2]

Participants correctly identified the source for 46.8% of opinions and for 34.3% of factual statements. Source memory accuracy was greater for opinions than for factual statements ($b = 12.47$, $t(321) = 10.54$, $p < .001$)[3] (figure 1 and table 1). As a benchmark for source memory accuracy, because participants are presented with 16 sources during the source memory test, a naïve participant selecting sources purely at random would have correctly identified the sources for 6.3% of claims. If a more sophisticated participant selected at random from one of the eight non-filler sources, they would have correctly identified the sources for 12.5% of claims. Thus, participant performance on this task is substantially better than chance.

A secondary measure of interest was the effect of claim objectivity on claim recognition memory. The key dependent variable for this measure was the participant-level within-subject difference between the percentage of opinions that the participant correctly identified as having been presented earlier or not and the percentage of factual statements that the participant correctly identified as having been presented earlier or not. Participants correctly recognized whether 86.2% of opinions had been presented earlier and correctly recognized whether 82.5% of factual statements had been presented earlier. Although in experiment 1 recognition memory was more accurate for opinions than for factual statements ($b = 3.73$, $t(321) = 6.08$, $p < .001$), in the experiments that follow, we do not find a systematic effect of claim objectivity on recognition memory. We discuss this further in the general discussion.

1 In experiment 1, all participants encoded the full stimulus set (32 claims across 8 sources), removing the need for contrast-coded variables to account for stimulus subset assignment. In most subsequent experiments, both the filler faces (in the source memory test) and the filler claims (in the recognition memory test) were counterbalanced. Exceptions are noted.

2 Although these exclusion criteria were not pre-registered for experiment 1, they are consistent with the exclusion criteria pre-registered for a majority of the following experiments. The results of analyses that do not exclude inattentive participants do not lead to qualitatively different inferences. See web appendix for robustness checks including inattentive participants.

3 The difference between opinions and facts also varied across counterbalanced groups, as indicated by the test of the nuisance contrast code: $b = 7.28$, $t(321) = 6.15$, $p < .001$. We also reanalyzed the data allowing for random effects for claim (Judd, Westfall, and Kenny 2017). The coefficient on objectivity remained the same ($b = 12.47$), given this less powerful test: $t = 4.53$.

EXPERIMENTS 2A, 2B, 2C, AND 2D

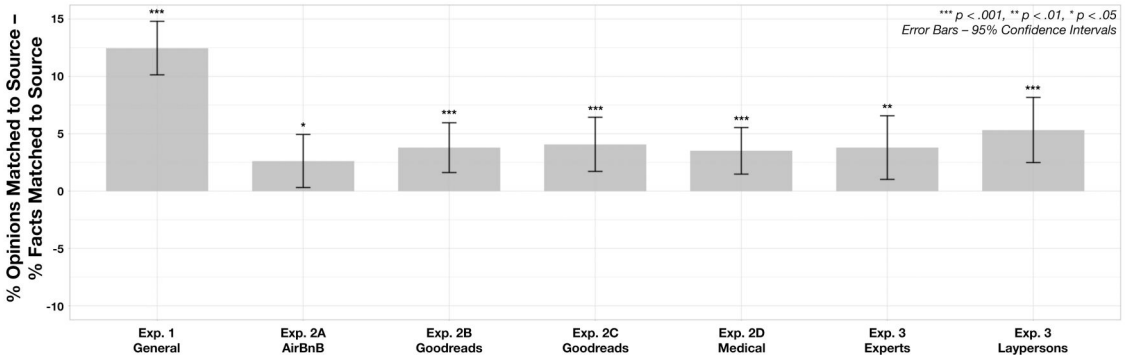
Experiments 2a, 2b, 2c, and 2d aimed to replicate the findings of experiment 1, expanding the observed main effect into the consumer domain of online reviews across three distinct contexts: reviews for AirBnB rentals for apartments in New York City (experiment 2a), book reviews from a popular online book review platform, Goodreads (experiments 2b and 2c), and medical guidance for a fake disease based on recent public health literature (experiment 2d). The methodology used for all four experiments was largely the same, building on the design of experiment 1 while employing considerably larger stimulus sets in order to increase power and robustness. In experiments 2a–d, the stimulus set for each experiment consisted of 24 sources and 96 claims divided into four between-subject groups, such that each participant was presented with one of four unique sets of 6 sources and 24 claims. The stimulus set of 96 claims for each experiment was selected from a larger set of claims, pretested using the same population on AMT. Claim pretesting helped verify that participants perceive factual claims as objective and opinions as subjective. Pretesting also helped to minimize differences in claim emotionality, valence, or arousal. A complete list of stimuli, sources, and pretested values for possible claim confounds are available on Research Box. Additionally, rather than asking participants to rate each source for likability during the encoding stage (as in experiment 1), in experiments 2a, 2b, and 2d, participants were instead asked to provide a rating for how useful the reviews from each source are. This change ensured that participants were not inadvertently directed to differentially attend to opinions over facts as a result of the likeability engagement task. To ensure that an engagement task was not a critical driver of differential encoding, in experiment 2c, the engagement task was removed and replaced with a timed delay (participants were exposed to stimuli for 10 seconds before being allowed to advance). Experiments 2a, 2b, 2c, and 2d were each pre-registered on AsPredicted.

Method

Experiment 2a ($N = 501$) used a full set of 24 sources and 96 claims drawn from AirBnB reviews for apartment rentals in New York City, including 48 factual statements (e.g., "The room had black curtains") and 48 opinions (e.g., "The room had tasteless curtains"). The stimulus set was randomly distributed across four between-subject groups such that each participant was exposed to one of 4 sets of 6 sources and 24 claims (12 factual statements and 12 opinions). Data were collected on AMT using CloudResearch's "block low quality participants" filter. In the encoding stage, each participant was sequentially presented with six sources. Each source was accompanied by four claims (two factual statements, two opinions), and participants were asked to provide a rating for how useful the reviews from the source

FIGURE 1

SOURCE MEMORY IN EXPERIMENTS 1–3: MAIN EFFECT



NOTE.—Source memory is more accurate for opinions than for factual statements in the context of general claims (experiment 1), AirBnB reviews (experiment 2a), Goodreads reviews (experiments 2b and 2c), and medical claims (experiments 2d and 3). In experiment 3, this effect holds for medical claims from expert sources as well as for medical claims from layperson sources.

TABLE 1

SUMMARY STATISTICS: ALL EXPERIMENTS

		Source memory			Recognition memory		
Experiment	*N*	Opinions (%)	Facts (%)	Opinions—Facts *(95% CI)*	Opinions (%)	Facts (%)	Opinions—Facts *(95% CI)*
1	399	46.76	34.29	12.47 *(10.14, 14.80)*	86.20	82.46	3.73 *(2.52, 4.94)*
2a (AirBnB)	501	43.13	40.36	2.77 *(0.45, 5.09)*	83.80	85.40	−1.60 *(−2.87, −0.33)*
2b (Goodreads)	504	36.63	32.84	3.79 *(1.62, 5.96)*	77.66	77.64	0.03 *(−1.31, 1.36)*
2c (Goodreads)	503	47.89	43.81	4.08 *(1.72, 6.44)*	82.68	82.78	−0.10 *(−1.39, 1.20)*
2d (Medical)	501	36.44	32.93	3.51 *(1.48, 5.54)*	84.68	85.22	−0.54 *(−1.82, 0.74)*
3 (Layperson)	606	37.93	32.60	5.33 *(2.49, 8.17)*	80.82	77.63	3.19 *(0.65, 5.72)*
3 (Expert)		36.37	32.57	3.79 *(1.02, 6.57)*	81.83	80.05	1.78 *(−0.64, 4.20)*
4 (World facts)	403	41.11	38.18	2.93 *(0.66, 5.20)*	80.57	79.00	1.57 *(0.21, 2.93)*
4 (Source facts)[a]		41.11	42.18	3.99 *(1.74, 6.24)*	80.57	75.18	−3.83 *(−5.24, −2.42)*
5 (Authors)	1,213	36.76	33.50	3.26 *(1.40, 5.12)*	78.53	78.19	0.34 *(−0.95, 1.63)*
5 (Re-tellers)		27.55	26.55	1.00 *(−0.87, 2.87)*	77.33	78.17	−0.84 *(−2.14, 0.46)*
6a (Inferences)	640	40.65	36.58	4.07 *(2.07, 6.06)*	87.31	85.62	1.69 *(0.61, 2.77)*
6b (Advice seeking)	639	40.96	38.18	2.78 *(0.69, 4.88)*	87.89	85.75	2.13 *(1.10, 3.17)*
S1 (Metacritic)	499	20.38	21.06	−0.67 *(−2.04, 0.70)*	68.12	70.83	−2.71 *(−3.99, −1.44)*
S2 (Cued recall)	501	31.80	31.77	0.03 *(−2.15, 2.21)*	69.82	70.35	−0.53 *(−2.10, 1.05)*
S3 (Media sources)	601	26.84	27.73	−0.89 *(−2.93, 1.15)*	85.71	84.49	1.22 *(−0.04, 2.48)*

[a]Effect size estimates for Experiment 4 (Source Facts), reflect the difference between facts about the source and facts about the world.

are on a scale from (1) Not at all useful to (5) Very useful. As pre-registered, 84 participants were excluded from the analysis of experiment 2a for scoring at or below chance on the recognition memory task, suggesting inattentiveness.

Experiment 2b ($N = 504$) used a full set of 24 sources and 96 claims drawn from public book reviews on Goodreads. Data were collected on AMT using CloudResearch's "block low quality participants" filter. As in experiment 2a, the stimulus set was divided into four between-subject groups, with assignment of group counterbalanced across participants. Participants were presented with a set of six sources, each of which was accompanied by two factual statements (e.g., "The Walmart Book of the Dead, *inspired by ancient Egyptian funerary texts, has shoplifters, greeters, and circuit court judges wander Walmart unknowingly consigned to their afterlives*") and two opinions (e.g., "The Walmart Book of the Dead *is a profoundly original look into an afterlife where people wander Walmart, it is full of profound character studies, glowing prose, and sweet sincerity*"). As pre-registered, 56

participants were excluded from the analysis of experiment 2b for scoring at or below chance on the recognition memory task, suggesting inattentiveness.

Experiment 2c ($N = 503$) used the same stimulus set and a nearly identical design as Experiment 2b, save for the lack of an engagement task during the initial encoding stage. During the encoding stage, instead of an engagement task, participants were shown each set of sources and reviews for 10 seconds before being allowed to advance to the next task. Data were collected on AMT using CloudResearch's "approved participants" filter (Litman et al. 2020). As pre-registered, 60 participants were excluded from the analysis of experiment 2c for scoring at or below chance on the recognition memory task, suggesting inattentiveness.

Experiment 2d ($N = 501$) used a full set of 24 sources and 96 claims about a fictional disease, NKV, drawn from a protocol developed for clinical research (Morgan et al. 2021). Just as in experiments 2a, 2b, and 2c, the full stimulus set was divided into four between-subject groups, with participants randomly assigned to one of four claim subsets. Participants were presented with six sources, each of which was accompanied by two factual statements (e.g., "NKV medications come in pill and liquid form") and two opinions (e.g., "NKV medications are more pleasant in pill than in liquid form"). Data were collected on AMT using CloudResearch's "approved participants" filter (Litman et al. 2020). As pre-registered, 29 participants were excluded from the analysis of experiment 2d for scoring at or below chance on the recognition memory task, suggesting inattentiveness.

Of the 24 claims each participant saw in the encoding stage, 12 claims were used to test source memory (6 factual statements, 6 opinions). To test source memory, participants were asked to identify each claim's source from a panel of 12 sources (with names and photographs), including all six sources that the participant saw in the encoding stage as well as six novel (filler) sources not previously seen. The remaining 12 claims not used to test source memory were instead used to test claim recognition memory. Participants were asked whether they had previously been shown each of the 12 claims (6 factual statements and 6 opinions) along with 12 novel claims not previously seen (6 filler factual statements, 6 filler opinions). The particular subsets of 12 claims used to test source memory versus the subsets of 12 claims used to test recognition memory were counterbalanced across participants.

Results

As in experiment 1, the key test of interest in experiments 2a, 2b, 2c, and 2d was a within-subject participant-level difference in source memory accuracy for opinions and source memory accuracy for facts. In each experiment, the stimulus set was divided into four between-subject groups, with assignment of group counterbalanced across participants, such that every participant saw one of four randomly assigned sets of 24 claims and 6 sources. Of the 24 claims that each participant saw, the particular subset of 12 claims that was used to test source memory versus claim recognition memory was also counterbalanced between-subjects. In each experiment, this 4 × 2 counterbalancing resulted in 8 between-subject groups.

For each experiment, the key dependent variable was regressed on the complete set of 7 contrast-coded variables (−1, +1) representing the 8 between-subject groups. These were intended to merely be nuisance variables. In each experiment, the intercept was the key test of interest, representing the main effect of claim objectivity on source memory.

In experiment 2a, participants accurately identified the source for 43.1% of opinions and for 40.4% of factual statements ($b = 2.77$, $t(409) = 2.35$, $p = .019$). In experiment 2b, participants accurately identified the source for 36.6% of opinions and for 32.8% of factual statements ($b = 3.79$, $t(440) = 3.43$, $p < .001$). In experiment 2c, participants accurately identified the source for 47.9% of opinions and for 43.8% of factual statements ($b = 4.08$, $t(435) = 3.40$, $p < .001$). In experiment 2d, participants accurately identified the source for 36.4% of opinions and for 32.9% of factual statements ($b = 3.51$, $t(464) = 3.40$, $p < .001$).

In all four experiments, we find that source memory is more accurate for opinions than for factual statements[4] (figure 1). Selecting sources purely at random would have allowed participants to correctly identify the sources for 8.33% of claims (or, if they chose at random from previously seen sources, for 16.67% of claims). In experiments 2a–d, participants' source memory accuracy for both factual statements and for opinions is much better than would be expected by purely random chance performance.

As in experiment 1, we analyzed recognition memory using the same analysis approach as for source memory. In experiment 2a, on average, participants correctly recognized whether or not 83.8% of opinions and 85.4% of factual statements had been presented earlier ($b = -1.60$, $t(409) = -2.48$, $p = .014$). In experiment 2b, on average, participants correctly recognized 77.7% of opinions statements and 77.6% of factual statements ($b = .03$, $t(440) = .04$, $p = .968$). In experiment 2c, on average, participants correctly recognized 82.7% of opinions statements and 82.8% of factual statements ($b = -.10$, $t(435) = -.15$, $p = .882$). In experiment 2d, on average, participants correctly recognized 84.7% of opinions and 85.2% of factual statements ($b = -.54$, $t(464) = -1.02$, $p = .768$). In contrast to

4 The magnitude of the main effect differed across stimuli sets in experiment 2a ($F(7, 409) = 2.54$, $p = .014$), experiment 2b ($F(7, 440) = 2.43$, $p = .019$), and experiment 2c ($F(7, 435) = 4.48$, $p < .001$). In experiment 2d, results did not significantly differ across stimuli sets ($F(7, 464) = 1.14$, $p = .338$). We also reanalyzed the data allowing for random effects for fact–opinion claim pairs (Judd et al. 2017). The coefficients on objectivity remained the same, given these less powerful tests: experiment 2a $t = 1.29$, experiment 2b $t = 2.20$, experiment 2c $t = 1.78$, and experiment 2d $t = 2.07$.

the results of experiment 1, recognition memory was less accurate for opinions than for factual statements in experiment 2a and no different in experiments 2b, 2c, and 2d. For experiments 3, 4, 5, 6a, and 6b, the analyses for recognition memory can be found in the web appendix. See figure 4 for more information and table 1 for summary statistics.

Experiments 2a–d expanded upon the main effect initially observed in experiment 1. Using nearly 200 claims from online review platforms AirBnB and Goodreads, experiments 2a, 2b, and 2c find that participants are better able to accurately identify the original source of a review claim when it is an opinion than when it is a fact. Experiment 2c confirmed that this effect is not a result of a specific elicitation or engagement task during the initial encoding of information. Experiment 2d finds that this effect is robust using 96 claims of medical advice about a fake disease. Even in a medical context, source misattributions were more frequent for factual claims than they were for opinions. Given the importance of public health literacy, experiment 3 builds on the findings of experiment 2d with an additional focus on the role of source expertise.

EXPERIMENT 3

In experiment 3, we expand upon the finding of experiment 2d in a medical context to consider effects of source expertise. Source expertise plays an important role in effective communication, persuasion, and credibility, and so is of particular relevance in a medical context for promoting health literacy. Given prior findings that consumers pay closer attention to information when it comes from experts (Heesacker, Petty, and Cacioppo 1983; Tobin and Raymundo 2009), it is important to assess whether the effects of claim objectivity on source memory are attenuated by source expertise. If the effect persists for expert sources, the consequences for source memory errors may be higher than if the effect only holds for layperson sources. As with all experiments, experiment 3 was preregistered on AsPredicted. Data were collected on AMT using CloudResearch's "approved participants" filter.

Method

Experiment 3 used the same design and stimulus set as was used in experiment 2d, with an added element of varying source expertise. Source expertise was manipulated by presenting participants ($N = 606$) with two distinct types of sources: medical professionals (experts) and laypersons (non-experts). Source expertise was signaled to participants by sources' names (e.g., "*Dr* Alan, MD" vs. "Alan") as well as by the presence or absence of a prominent red medical stethoscope logo on source photos, present during both encoding and recall stages; the subset of sources who were labeled as experts was counterbalanced across participants. In the encoding stage, each participant was presented with six sources (three medical experts, three laypersons), with each source accompanied by four claims (two factual statements, two opinions), as in experiment 2d. See Research Box for a complete list of stimuli and sources.

As in prior experiments, source memory was tested using a subset of half of the claims presented in the encoding stage (six factual statements and six opinions). Participants were asked to identify each claim's source from a panel of 12 sources (with names and photographs), including the three expert sources that were seen in the encoding stage, the three layperson sources that were seen in the encoding stage, and six filler sources (three layperson sources, three expert sources) not previously seen.

Results

Source expertise introduced an additional within-subject manipulation, creating a 2 within-subject (fact vs. opinion claim) × 2 within-subject (expert vs. layperson source) × 4 between-subject (assignment of one of four stimulus sets) × 2 between-subject (subset of claims tested for source memory vs. recognition memory) × 2 between-subject (subset of sources as experts) design. The key tests of interest were the difference between the percentage of opinions versus facts correctly attributed to their expert sources and the difference between the percentage of opinions versus facts correctly attributed to their layperson sources. We regressed the key measures of interest on a complete set of 15 contrast-coded variables (−1, +1) representing the 16 between-subject groups. The intercepts were the key tests of interest, representing the simple effect of claim objectivity on source memory for expert sources and layperson sources, respectively. The contrast-coded variables representing the between-subject groups and their interactions were intended to merely be nuisance variables to account for differences in baseline tendencies between sets. As preregistered, 30 participants were excluded from the analysis of experiment 3 for scoring at or below chance on the claim recognition memory task, suggesting inattentiveness.

Replicating the results of experiment 2d, we find that source memory is more accurate for opinions than for factual statements when claims originated from layperson sources ($b = 5.33$, $t(560) = 3.68$, $p < .001$). Participants accurately identified the source for 37.9% of opinions from layperson sources and for 32.6% of factual statements from layperson sources. Extending the replication, when sources are denoted as medical experts, source memory is also more accurate for opinions than for factual statements ($b = 3.79$, $t(560) = 2.69$, $p = .007$) (figure 1). Participants accurately identified the source for 36.4% of opinions from expert sources and for 32.6% of factual statements from expert sources. The difference between these two differences was not significant ($b = 1.53$, $t(560) = 0.73$, $p = .465$), indicating there is no evidence that the effect of claim objectivity on source memory is moderated by source

expertise.[5] In additional exploratory analyses, we conducted a detailed examination of types of misattribution. When claims originated from layperson sources, participants were more likely to misattribute facts to expert sources than they were to misattribute opinions to expert sources. In contrast, when claims originated from experts, participants were no more likely to misattribute facts to layperson sources than they were to misattribute opinions to layperson sources. See the web appendix for more details.

Prior work finds that consumers pay greater attention to information shared by sources with greater expertise (Heesacker, Petty, and Cacioppo 1983; Tobin and Raymundo 2009). The present findings are compatible with this prior result: consumers may pay more attention to experts than to laypersons when encountering new information, and the objectivity of the information may still affect the strength of the encoded associative links between the information and the source. In experiment 3, we find that source memory is more accurate for opinions than it is for facts, an effect that replicates regardless of the source's expertise.

EXPERIMENT 4

Whereas experiments 1–3 found the main effect across a variety of claim types, consumer contexts, and levels of source expertise, experiments 4 and 5 aimed to investigate process for the observed difference in source memory accuracy between opinions and factual statements. We proposed that source memory would be more accurate for opinions than for facts because (1) source–claim binding during encoding affects source memory during recall, and (2) opinions provide more information about sources than do facts, thereby strengthening source–claim binding. Based on this prediction, the observed difference in source memory accuracy between opinions and facts may be affected by how informative claims are about sources (and vice-versa; regardless of the directionality of this effect, a stronger source–claim association at encoding would be expected to result in more accurate source memory for the claim at recall).[6] In experiment 4, we test this process by making facts more informative about a source. In experiment 5, we test this process by making opinions less informative about a source.

Experiment 4 included a new type of claim—*facts about the source*. Facts about the source are objective claims that provide substantially more information about the source (on par with opinions) than do facts about the world. Thus, the introduction of facts about the source allowed for an investigation of whether the effect of claim objectivity on source memory accuracy may be driven by the extent to which claims provide information about their sources. Experiment 4 was pre-registered on AsPredicted. See Research Box for a complete stimulus set as well as pretest data.

Method

Using a set of 48 claims and following the design used in experiment 1, participants in experiment 4 ($N = 403$) were exposed to a set of eight sources, each of which was accompanied by two facts about the world (e.g., "Canberra is the capital of Australia"), two opinions (e.g., "sunrises are prettier than sunsets"), and two facts about the source (e.g., "I play tennis every Monday"). The stimulus set was selected from a larger set of claims that were pretested, using the same population on AMT, to help identify factual claims perceived to be informative about the world, factual claims perceived to be informative about the source, and to minimize differences in arousal and valence between all three types of claims. As in prior experiments, source memory was assessed using a subset of half of the claims presented in the encoding stage (eight facts about the world, eight opinions, eight facts about the source). Participants were asked to identify each claim's source from a panel of 16 sources (with names and photographs), including the 8 sources that were seen in the encoding stage and 8 novel sources not previously seen. When tested for recognition memory, we included a set of 24 filler claims (including all 3 types of claims) not previously seen in addition to the counterbalanced subset of 24 claims previously presented.[7] Data were collected on AMT using CloudResearch's "block low quality participants" filter.

Results

In experiment 4, our key dependent measures were (a) the difference between the percentage of opinions correctly matched to their initially presented sources and the percentage of factual statements about the world correctly matched to their initially presented sources (as in all experiments), and (b) the difference between the percentage of factual statements about the source correctly matched to their initially presented sources and the percentage of factual statements about the world correctly matched to their initially presented sources. These measures reflect the effect of claim objectivity on source memory, as well as the effect of information about the person versus information about the world on source memory. We included a contrast-coded variable (1, −1) reflecting the counterbalanced assignment of the

5 The magnitude of the main effect differed across stimuli sets in experiment 3 both for layperson sources ($F(15, 560) = 2.25$, $p = .004$) and for expert sources ($F(15, 560) = 1.94$, $p = .018$). We also reanalyzed the data allowing for random effects for fact–opinion claim pairs (Judd et al. 2017). The coefficient on objectivity remained the same, given a less powerful test, $t = 2.99$, for the overall main effect.

6 We thank an anonymous reviewer for their insight on the bidirectionality of link formation.

7 As in experiment 1, the same filler claims were used for all participants in the recognition memory test and the same filler sources were used for all participants in the source memory test.

stimulus subset used to test source memory and account for differences in baseline tendencies between tested stimulus subsets. The intercepts were the key tests of interest, representing (a) the main effect of claim objectivity on source memory and (b) the effect of a claim's informativeness about a source on source memory for objective claims. Ninety-six participants were excluded from the analysis of experiment 4 for scoring at or below chance on the recognition memory task, suggesting inattentiveness.[8]

We replicated the findings of experiments 1–3. Participants accurately identified the source for 41.1% of opinions, for 38.2% of facts about the world, and for 42.2% of facts about the source. Source memory was significantly more accurate for opinions than for facts about the world ($b = 2.93$, $t(305) = 2.54$, $p = .012$). Moreover, consistent with the proposed process, source memory was significantly more accurate for facts about the *source* than for facts about the *world* ($b = 3.99$, $t(305) = 3.49$, $p < .001$).[9] Source memory for facts about the source was not significantly different from source memory for opinions ($b = 1.06$, $t(305) = 0.99$, $p = .322$) (figure 2). In experiment 4, as a benchmark for source memory accuracy, a participant selecting sources purely at random would have correctly identified the sources for 6.25% of claims (or, if choosing at random from previously seen sources, for 12.5% of claims).

Experiment 4 provided initial evidence for the proposed process, finding that source memory is more accurate for claims that provide more information about a source. This offers insight into the observed difference in source memory accuracy between opinions and factual statements, given the baseline differences in informativeness about a source that claim objectivity often signals. In experiment 4, source memory was more accurate for factual statements when they were more informative about a source. In experiment 5, we instead investigate the effect of source memory on opinions that are not informative about a source. When opinions do not provide information about a source, we would expect that the source–claim links formed during encoding between a source and an opinion are no stronger than the source–claim links formed during encoding between a source and a factual statement, reducing any differences we might have expected in source memory accuracy.

8 Although these exclusion criteria are pre-registered for most other experiments, experiments 1 and 4 were conducted prior to other experiments and as such did not yet include these exclusion criteria in their pre-registrations. See web appendix for robustness checks that do not exclude inattentive participants; the results are not qualitatively different from those presented.

9 In experiment 4, the results did not significantly differ across stimuli sets for both source memory for opinions versus facts about the world ($F(1, 305) = 2.06$, $p = .152$) and for source memory for facts about the source vs. facts about the world ($F(1, 305) = 2.32$, $p = .129$). We also reanalyzed the data allowing for random effects for claim (Judd et al. 2017). The coefficients on claim type remained the same, given this less powerful test, $t = 1.77$, for facts about the self versus facts about the world and $t = 1.19$ for opinions versus facts about the world.

EXPERIMENT 5

In experiment 5, we use a between-subject design to manipulate how much information claims provide about their source, while holding constant the set of claims used. We then measure source memory and claim recognition memory. This use of a moderation design that holds constant the set of claims used between-subjects also serves to address any lingering concerns as to the role of stimulus sampling. If differences in source memory accuracy were due to the idiosyncratic memorability of a particular set of claims used, these differences would persist across a design that differentially disrupts the source-relevance of a claim. In conjunction with the recognition memory findings throughout, the design in experiment 5 allows us to rule out the concern that our main effect is driven by enhanced memory overall for opinions versus facts. Experiment 5 was preregistered on AsPredicted. Data were collected on AMT using CloudResearch's "approved participants" filter.

Method

Experiment 5 used the same protocol, sources, and claims as in experiment 2b, with a full set of 24 sources and 96 claims drawn from public book reviews on Goodreads. See Research Box for a complete list of stimuli and sources. Participants ($N = 1{,}213$; 121 excluded for low recognition memory scores) were presented with six sources, each of which was accompanied by four claims (two factual statements, two opinions). In a between-subject manipulation of claim authorship, participants were told that the sources accompanying each set of claims were either (a) the authors of the claims (author condition, a direct replication of experiment 2b) or (b) the re-tellers of claims authored by others and randomly pulled out of a hat (re-teller condition). The manipulation of claim authorship created two contexts, one in which claims provide information about the sources (when the sources are authors of the claims), and one in which claims provide limited to no information about the sources (when the sources are simply re-telling claims that they did not write).

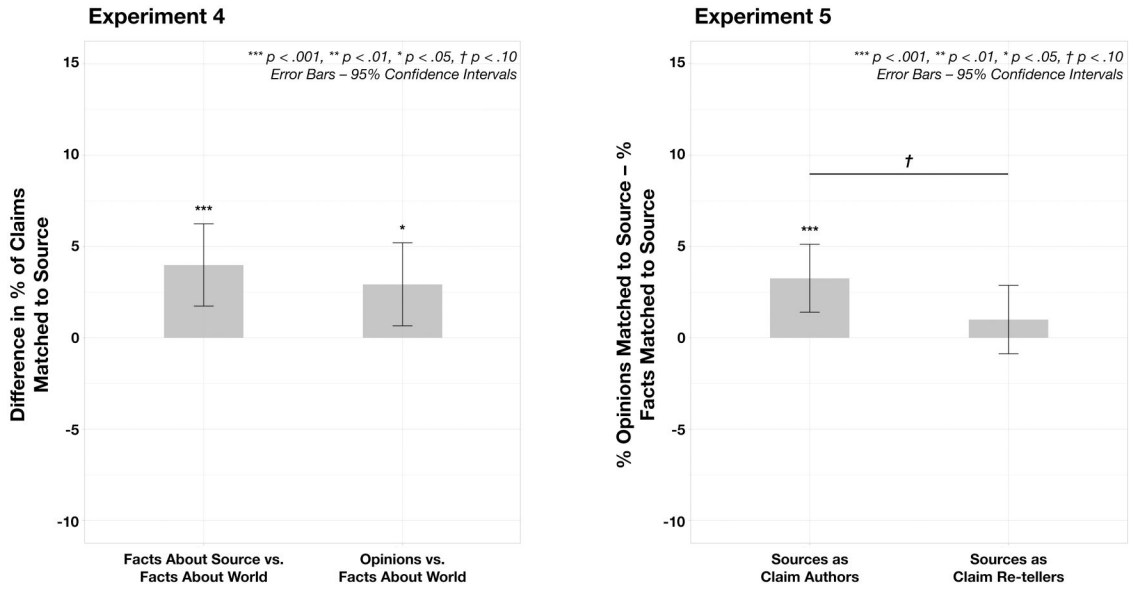
As in prior experiments, source memory was tested using a subset of half of the claims presented in the encoding stage (six factual statements and six opinions). Participants were asked to identify each claim's source from a panel of 12 sources (with names and photographs), including the six sources that were seen in the encoding stage and six (filler) sources not previously seen.

Results

In each of the claim authorship conditions (authors vs. re-tellers), a stimulus set of 96 claims and 24 sources was counterbalanced across four between-subject groups such

FIGURE 2

SOURCE MEMORY IN EXPERIMENTS 4 AND 5: PROCESS EVIDENCE



NOTE.—Source memory accuracy is affected by how much information claims provide about a source; source memory is more accurate when factual claims provide more information about a source (experiment 4) and source memory is not affected by claim objectivity when sources are re-tellers, rather than authors, of claims (experiment 5).

that each participant saw a subset of 24 claims and 6 sources. Of the 24 claims participants saw, half were used to test source memory and half were used to test recognition memory, counterbalanced between-subjects. This 2 × 4 × 2 counterbalancing resulted in 16 between-subject groups and 15 contrast-coded variables. The key difference score of interest was regressed on the complete set of 15 contrast-coded variables (−1, +1) representing the 16 between-subject groups. The coefficient on the contrast code representing the between-subject manipulation of claim authorship (authors vs. re-tellers) was the key test of interest, representing the interaction between claim authorship and claim objectivity on source memory. The remaining coefficients were intended to merely be nuisance variables to account for differences in baseline tendencies between sets and the interaction of those baseline tendencies with claim authorship. As such, the primary results of interest were: (i) the effect of claim objectivity on source memory for author sources, which was a direct replication of experiment 2b, (ii) the effect of claim objectivity on source memory for re-teller sources, and (iii) the interaction effect of claim authorship, representing the difference between (ii) and (i). One hundred and twenty-one participants were excluded from the analysis of experiment 5, as pre-registered, for scoring at or below chance on the recognition memory task, suggesting inattentiveness.

The main effect, represented by the intercept, replicated the results of experiments 1–4. Source memory was more accurate for opinions than for facts ($b = 2.13$, $t(1076) = 3.18$, $p = .002$).[10] The interaction effect of claim authorship, represented by the coefficient on the contrast code reflecting the between-subject manipulation of claim authorship (authors vs. re-tellers), indicated a marginally significant reduction in the main effect. The magnitude of the difference in source memory accuracy between opinions and facts was reduced for re-tellers compared with authors ($b = -2.26$, $t(1076) = -1.69$, $p = .092$).[11]

10 In experiment 5, the magnitude of the main effect varied across the eight sets of stimuli $F(7, 1076) = 7.70$, $p < .001$. The magnitude of the interaction effect of claim authorship did not vary significantly across the eight sets of stimuli $F(7, 1076) = 0.52$, $p = .824$.

11 This attenuation, though marginally significant, is a two-tailed test of a directional prediction, as specified in the pre-registration. We suspect that participant inattention may have contributed noise, reducing power. When using a stricter exclusion of participants who scored at or below 75% accuracy on claim recognition memory, the simple effect in the authors condition ($b = 4.51$, $t(571) = 3.39$, $p < .001$) is fully attenuated by the authorship condition manipulation ($b = 2.25$, $t(571) = 2.36$, $p = .018$), resulting in no simple effect in the re-tellers condition ($b = 0.01$, $t(571) = 0.01$, $p = .995$). We also reanalyzed the data allowing for random effects for fact–opinion claim pairs (Judd et al. 2017). The coefficient on the interaction between claim objectivity and source authorship remained the same, given this less powerful test: $t = 1.31$.

When sources were presented as authors of claims, our results replicated those of experiment 2b. Participants accurately identified the source for 36.8% of opinions and for 33.5% of facts. Source memory was more accurate for opinions than for facts ($b = 3.26$, $t(1076) = 3.45$, $p < .001$). When sources were presented as re-tellers of claims, participants accurately identified the source for 27.5% of opinions and for 26.5% of facts. This difference is not statistically significant; source memory was not more accurate for opinions than for facts when claims originated from re-teller sources ($b = 1.00$, $t(1076) = 1.05$, $p = .293$) (figure 2).

When comparing across conditions, source memory accuracy was reduced by 9.2%age points for opinions and by 6.9%age points for factual claims in the re-tellers condition compared with the authors condition. Participants choosing at random would have correctly matched the sources for 8.33% of claims (or, if they chose at random from previously seen sources, for 16.67% of claims). Participants perform substantially better than chance at the source memory task in both conditions.

EXPERIMENTS 6A AND 6B

In experiments 1–3, participants were presented with all the key information during the exposure stage (i.e., novel claims and their novel sources). But in daily interactions, consumers often go on to receive new information about the things they have seen previously. Consumers encode the new information and rely on memories for previously encoded information to update their beliefs accordingly. For instance, a colleague might mention their favorite restaurant to us, and only later do we learn that the restaurant is located in Helsinki. We integrate this new information (the location of the restaurant) with the old information (the recommendation of the restaurant), relying on source memory (which colleague gave the recommendation), to update our beliefs about the source (e.g., that our colleague has been to Finland). With updated beliefs, we form a better understanding of the other people around us, helping us keep track of whom to ask about their kids, with whom to avoid discussing politics, and whom to turn to for advice on taking a trip to Finland.

In experiments 6a and 6b, we continue the investigation of how claim objectivity affects source memory, with a focus on the downstream implications that this effect has for inference formation and advice-seeking intentions. In experiment 6a, participants are first presented with sources and claims (e.g., "Viletta is a horror film set in a medieval castle"). Then, following a filler task, participants are presented with new information (e.g., "Viletta is currently streaming only in Italian cinemas"). Participants are then asked to make inferences about the previously seen sources (e.g., "Who do you know who is in Italy?"). Experiment 6b uses the same set of stimuli but extends the implications of experiment 6a to advice-seeking intentions. Whereas experiment 6a tests the effect of differential source memory on inference formation, experiment 6b asks participants for their advice-seeking intentions based on those inferences (e.g., "Who would you seek advice from about traveling to Italy?"). In experiments 6a and 6b, we consider downstream consequences of differential source memory for facts versus opinions. This provides initial insight into effects beyond accuracy, addressing both cognitive (inferences) and social (advice-seeking) implications.

Method

Using a variation on the same three-stage design as in prior experiments, experiments 6a and 6b provided participants with sources and claims during an encoding stage. The total stimulus set used in both experiments consisted of 12 sources and 48 claims (24 factual statements and 24 opinions). Every participant was sequentially presented with six sources where each source was accompanied by four claims (2 factual statements, 2 opinions). The claims were presented to participants as snippets of overheard conversation, taken out of context (e.g., "...variable-venturi carburetors weigh less than fixed-venturi carburetors..."). The particular subset of claims presented was randomized across participants, as was the subset of sources accompanying the claims. During the encoding stage, participants were asked to rate how interesting a conversation with each of the six presented sources would be on a scale from (1) Not at all interesting to (5) Very interesting.

Following a filler stage, participants were presented with new information, framed as information that was meant to provide additional context to the snippets they had been shown previously (e.g., "On a daily basis, car mechanics work with and compare the two different types of carburetors found in cars (variable-venturi vs. fixed-venturi)"). On the same page, in experiment 6a ($N = 640$), participants were then asked to make inferences about the previously seen sources (e.g., "To the best of your ability, please identify the person who you think is a car mechanic") from a multiple-choice list of 12 sources (6 previously seen sources, 6 filler sources not previously seen). In experiment 6b ($N = 639$), participants were asked to identify the sources from whom they would seek advice about specific topics (e.g., "To the best of your ability, please identify the person who you would most likely seek advice from about fixing your car").

To ensure that participants' conclusions about the sources did not differ between conditions, stimuli were pretested, presenting all the information simultaneously (claims, sources, and the "context") and testing participants' inferences without any memory-based retrieval. In other words, we wanted to ensure that observed differences in participants' responses (inferences about sources or advice-seeking) were attributable to differences in source memory rather than to differences in the stimuli. Pretest participants made the expected inferences at a high rate

across claim type and did not systematically vary across facts versus opinions. See Research Box for a complete list of stimuli and sources as well as pretest data.

It is worth noting that for some participants and for some claims, the "context" may be more necessary to make the appropriate inferences than for others. On one hand, for claims about carburetors it is likely that some participants may not need the context to recognize the claim's relevance to car repair. On the other hand, for claims about a horror film, most participants will likely need the context to know that it is only being streamed in Italian cinemas. While the importance of context presented at a later stage may have varied across topics and participants, it was equivalent across conditions and, since it was only presented following a delay, context did not affect the strength of source–claim links formed during the initial encoding of information. Thus, even in situations where context was less necessary, a conservative interpretation of these results for inference-making and advice-seeking intentions requires a process rooted in source memory.

Results

As in prior experiments, in experiments 6a and 6b the particular subset of 24 claims presented to each participant (6 sources, 4 claims from each source) was randomized across participants. Which sources accompanied which subset of claims was also randomized across participants,[12] as was the particular subset of claims used to test recognition memory.[13] As in prior experiments, this randomization across participants aimed to control for effects that could be driven by individual subsets of stimuli. The resulting counterbalanced design had eight between-subject groups ($2 \times 2 \times 2$). For each experiment, the key measure of interest, defined below, was regressed on the complete set of seven contrast-coded variables (-1, $+1$) representing the eight between-subject groups. In each experiment, the intercept was the key test of interest. As pre-registered, 42 participants were excluded from the analysis of experiment 6a and 42 participants were excluded from the analysis of experiment 6b for scoring at or below chance on the recognition memory task, suggesting inattentiveness.

In experiment 6a, participants were asked to infer which source had certain attributes (e.g., "is in Italy," "is a car mechanic"), where the relevance of an attribute was informed by new information about previously shared claims. The key measure of interest was the difference between the percentage of claim-based inferences made about relevant sources who shared opinions and the percentage of claim-based inferences made about relevant sources who shared facts. This measure, and therefore the estimated intercept, reflects the effect of claim objectivity on subsequent claim-based inferences made about the sources. Participants were more likely to make claim-based inferences about relevant sources who had previously shared opinions than about relevant sources who had previously shared facts ($b = 4.07$, $t(590) = 4.00$, $p < .001$). Participants made inferences about 40.6% of relevant sources based on opinions and 36.6% of relevant sources based on factual statements.

In experiment 6b, participants were asked to select sources from whom they would seek relevant advice (e.g., "about traveling to Italy," "about fixing your car"), where source relevance was informed by new information about previously shared claims. The key measure of interest was the difference in the percentage of claim-based advice-seeking intentions from relevant sources who had shared opinions versus facts. This measure, and therefore the estimated intercept, reflects the effect of claim objectivity on advice-seeking intentions from topically relevant sources. Participants were more likely to intend to seek advice from topically relevant sources when the sources had initially shared opinions rather than facts ($b = 2.78$, $t(589) = 2.61$, $p = .009$). Participants intended to seek advice from topically relevant sources for 41.0% of sources who shared opinions and for 38.2% of sources who shared facts.

In both experiments, we find that when sources share opinions rather than facts, participants are more likely to make relevant inferences about the sources and intend to seek advice from relevant sources following a delay[14] (figure 3). For context, selecting sources purely at random during experiments 6a and 6b would have attributed inferences or advice-seeking intentions at a rate of 8.33% (or, if chose at random only from previously seen sources, 16.67%).

Experiments 6a and 6b extend our investigation of claim objectivity's impact on source memory beyond accuracy itself, providing initial evidence of consequences for belief formation and social decision making. In these experiments, we find that when sources initially shared opinions rather than facts, and participants later learned relevant context, they were more likely to form claim-based inferences about the sources (experiment 6a) and identify those sources from whom they could seek topically relevant advice (experiment 6b). These findings highlight the potential role of claim objectivity for source memory in shaping consumer beliefs and intentions, paving the way for future research to further explore additional implications.

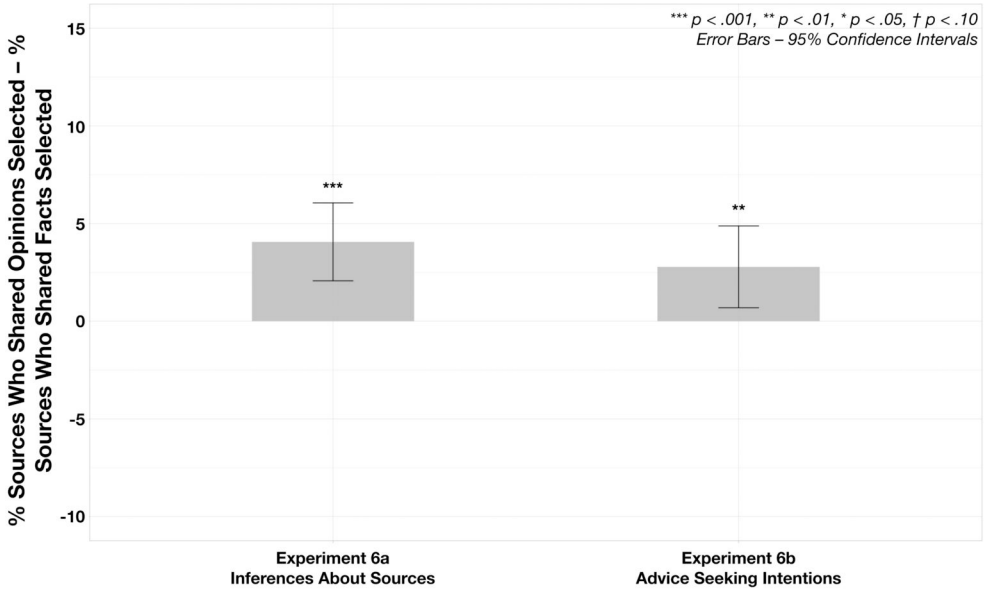
12 In experiments 6a and 6b, we de-coupled sources from claims (i.e., different participants would see the same set of sources but with a different set of claims) randomized across participants.

13 When testing for recognition memory, we included a set of 12 filler claims (6 facts, 6 opinions). As in experiments 1 and 4, the same filler claims were used for all participants.

14 The magnitude of the main effect differed across stimuli sets in experiment 6a ($F(7, 590) = 3.48$, $p = .001$) and in experiment 6b ($F(7, 589) = 4.64$, $p < .001$). We also reanalyzed the data allowing for random effects for fact–opinion claim pairs (Judd et al. 2017). The coefficients on objectivity remained the same, given these less-powerful tests: experiment 6a $t = 2.25$, experiment 6b $t = 1.43$.

FIGURE 3

EXPERIMENTS 6A AND 6B: IMPLICATIONS FOR BELIEF UPDATING, INFERENCE FORMATION AND ADVICE SEEKING



NOTE.—Claim objectivity affects downstream inferences and advice-seeking intentions following a delay. Participants were more likely to make claim-based inferences about sources (experiment 6a) and identify sources with relevant expertise from whom to seek topical advice (experiment 6b) when sources had previously shared opinions than when sources had previously shared factual statements.

GENERAL DISCUSSION

Throughout this research, we propose and find that consumers are better able to accurately identify the source of a claim when the claim is an opinion than when it is a fact. Put differently, consumers are more likely to make inaccurate source misattributions for facts than they are for opinions. This effect holds across a variety of consumer contexts and claims, ranges in magnitude from a 2.6% difference to a 12.5% difference,[15] and persists for expert sources in a medical context.

To investigate whether this effect could more simply be attributed to participants having better memory for opinions than for facts, we also measured claim recognition memory. Sometimes average claim recognition memory was better for opinions than for facts (e.g., experiments 1, 6a, 6b)[16]; other times it was better for facts than for opinions (e.g., experiment 2a), and in most experiments there was no difference (e.g., experiments 2b, 2c, 2d, 4, and 5). See figure 4 and table 1 for summary statistics and the web appendix for analyses. Analyzing data across experiments using a linear mixed model with experiment level random effects finds no significant difference in claim recognition memory for opinions versus facts ($b = 0.11$, $t = 0.18$). This is further reinforced by the finding in experiment 5, in which a manipulation that kept the claims the same but reduced the relevance of a source's link to its claims attenuated the difference in source memory accuracy but had no discernable effect on recognition memory accuracy. Taken together, these results suggest that the consistent effect of claim objectivity on source memory is unique to the processes underlying source memory (e.g., the strength of the source–claim links formed during encoding) and does not simply reflect more accurate memory for one type of claim over another.

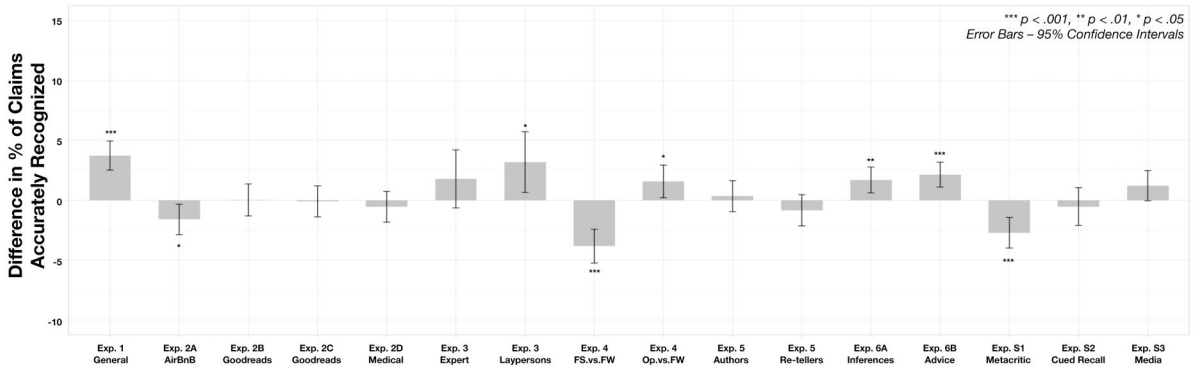
Instead, experiments 4 and 5 support the proposed process where, as opinions are generally more informative about sources than are facts, consumers form stronger associations between sources and opinions than between sources and facts, with the resulting consequences for source memory. When facts are made to be more informative about their sources, source memory is more accurate for those facts, on par with opinions (experiment 4). Conversely, when opinions are less informative about their

15 In experiment 1, while source gender was balanced across participants, participants were tested on source memory using either exclusively male or female sources, which may help explain why the magnitude of the observed effect is less pronounced in subsequent experiments where source gender was heterogenous for all participants during source memory recall tasks.

16 Additional exploratory analyses in experiments 6a and 6b find that the difference in claim memory was unique to the set of filler claims seen by all participants and not attributable to claims shown to participants during encoding.

FIGURE 4

EXPERIMENTS 1–6 AND S1–S3: CLAIM RECOGNITION MEMORY.



sources, source memory is reduced, on par with facts (experiment 5). Whereas this evidence points to the role of informativeness about the source, arguably the question of why opinions provide more information about a source than facts do remains. Some research has pointed to linguistic structure (i.e., the structural position of an adjective in a sentence) as a factor affecting the perceived objectivity of a claim (Kaiser and Wang 2020, 2021), but whether this could also affect how *informative* a claim is perceived to be is unclear. Future research on the underpinnings of claim objectivity and its implications may help to illuminate the precise pathways through which claim objectivity affects the associative links formed between sources and claims during encoding, allowing for a more granular identification of the elements influencing this effect and its extensions (e.g., for brands, using familiar versus novel sources, and in other contexts).

Supplementary Experiments

We conducted three additional similar experiments throughout the course of data collection, which found null results. These pre-registered experiments included substantial changes to the experimental design, which resulted in attenuations of the main effect. They are presented in detail in the web appendix and are summarized here briefly.

Experiment S1 used a substantially larger and more complex stimulus set (i.e., each participant was shown 12 paragraph-long film reviews from Metacritic with embedded facts and opinions). Notably, one third of participants were excluded for poor recognition memory and remaining participants had a higher average rate of misattributing claims to filler sources than in any other experiment we conducted. Source memory for both factual statements and opinions was poor and did not substantively differ based on claim type. We suspect that this result may be attributable to the increased cognitive load associated with a considerably larger and more complex stimulus set.

Experiment S2 followed the same design and stimulus set as experiment 2b but tested source memory using a cued recall task (i.e., book titles) rather than a full recall task (i.e., full reviews). There was no effect of claim objectivity on participants' source memory when previously seen claims were cued. It is possible that cued recall may be insufficient in the absence of any substantive information about the content of a previously seen claim.

Experiment S3 deviated from human sources to consider media outlets as sources. Participants were presented with claims in the form of headlines from artificially generated media outlets. Source memory did not vary between opinion and news headlines. As the extent to which a claim provides information about its source (and a familiar source provides information about its claim) is key for stronger associative links to form during encoding, it is possible that the use of artificially generated media outlets (rather than e.g., individual journalists or familiar media outlets) limited our ability to detect a main effect.

Experiments S1–S3 are presented as supplements rather than as boundary conditions because the null effects were unexpected. Whereas we anticipated extensions of the main effect, these experiments instead present either a set of potential *post hoc* boundary conditions or possibly type II errors. Additional testing would be required to confidently establish each as a boundary condition.

Source Credibility and Source Memory Failures

In designing campaigns, marketing managers frequently rely on carefully selected sources (e.g., experts, influencers) to share relevant information with consumers (Berger 2014). Consumers find claims made by credible sources to be more persuasive than claims made by less credible sources (Hutchinson and Moore 1984). But for

consumers, the ability to put such information to use depends on whether or not they can recall the source of a claim (Bell et al. 2021; Fragale and Heath 2004; Hutchinson and Moore 1984).

As associative memory tends to weaken over time, this presents a problem to marketing managers and policymakers alike. For instance, consumers may misattribute a layperson's claims about a medical condition to a medical expert who never made such claims, as in experiment 3. Labels intended to safeguard consumers from suspected misinformation or promotional content are often forgotten by the time the information itself is recalled, and as a result are not as effective as when the information was initially presented (Skurnik et al. 2005; Bell et al. 2021). Efforts to combat memory decline in highly saturated information environments may benefit from strategies aimed at improving source memory at the time of encoding, strengthening the associative links formed between sources and claims when the information is first presented to consumers (Bell et al. 2021; Fragale and Heath 2004).

The present research suggests that using claims that provide more information about a source (such as opinions) strengthens the associative links formed between sources and claims, resulting in more accurate source memory. For marketing managers working with influencers, while ensuring a coherent, logical brand-influencer alignment is important, it may also be valuable to consider how much consumers learn about an influencer through their claims, as this can enhance the encoding of associative links between the influencer and the promoted message. For instance, influencers could share personal anecdotes or subjective preferences that provide followers with new, relevant insights about the influencer (e.g., "You may not know this about me, but I love to cook. . .") before advertising a related product (e.g., ". . .and when preparing food, I prefer to use Le Creuset cookware") to strengthen subsequent source memory. Developing strategies to enhance source memory based on claim objectivity may offer a valuable and low-cost tool for advertisers and policymakers alike.

In experiments 6a and 6b, we extend the implications of differential source memory (in)accuracy, finding that it affects what inferences consumers draw about sources (experiment 6a) and from whom they intend to seek advice (experiment 6b). Future research will benefit from expanding on these initial findings, investigating such consequences in other environments. For example, in designing campaigns that rely on influencer endorsements to target a particular group, marketing managers may consider using claims that are inherently tied to the source (i.e., opinions) rather than factual claims to increase the likelihood that consumers will recall the particular endorser during a purchase decision. Similarly, guidance on policy and public health often relies on the importance of an identifiable expert source (e.g., announcements from the Surgeon General or bulletins the Director of the Centers for Disease Control and Prevention). It is possible that claims that inform the intended audience of the source's personal beliefs, in addition to providing the necessary factual guidance, could be more successfully linked to their source. Such potential consequences warrant further research.

Source memory is also affected by particularly salient claims and sources (Doerksen and Shimamura 2001). Regardless of a claim's objectivity, claims of a particularly outstanding nature (e.g., highly unusual claims or claims that elicit an emotional response) may provide greater information about their sources regardless of their objectivity. As such, the main effect of a claim's objectivity on source memory may be attenuated in the case of extraordinary claims or high-attention sources. Similarly, we expect that claim credibility can provide additional information about a source. For instance, if someone claims that "the moon is made of cheese," that claim presumably provides more information about the source than it does about the state of the world. Even though the noncredible claim is objective, it may be linked to a source more strongly during encoding than a more credible, less outlandish objective claim would be. Such effects of claim salience and credibility provide additional avenues for future research.

Potential Implications and Future Directions for Competitive Advertising

Advertising efficacy relies in part on consumers making decisions at a later point in time, based on accurate recall of information that was presented to them earlier (Bettman 1979; Biehal and Chakravarti 1986; Keller 1987; Lynch, Marmorstein, and Weigold 1988). Research on competitive advertisement interference builds on the same associative network model underlying source memory (Anderson 1983; Hutchinson and Moore 1984). Consumers are constantly exposed to many different claims from competing companies, weakening the associative links formed between any one company and its advertised claims, and subsequently reducing memory for and evaluations of the target brand (Baumgardner et al. 1983; Burke and Srull 1988; Keller 1987; Kent and Allen 1994; Kent and Kellaris 2001; Lee and Lee 2007). Promotional messages, which marketing managers can control, can strengthen associations between brands and advertisements and decrease vulnerability to competitive interference (Krishnan and Chakravarti 2003; Kent and Kellaris 2001).

The present results suggest that providing consumers with novel information about the brand (e.g., by using opinion claims) may strengthen source memory during encoding. This strategy could be particularly effective when delivered through anthropomorphized entities, such as mascots (e.g., GEICO, Planters), spokespersons (e.g., State Farm Insurance), or visible senior executives (e.g., Amazon, Meta). Compared with direct brand communication, these sources may foster stronger associative links between the brand and the opinions

they express. Future research could explore how the effectiveness of such strategies depends on the fit between the source (e.g., mascot or public figure) and the brand, whether the effect extends to brands themselves as communicators (vs. their mascots or spokespersons), and the consequences for downstream consumer decisions (product choice, confidence, and brand loyalty).

CONCLUSION

In the current work, we investigate the effect of claim objectivity on source memory, the ability to accurately identify the source of a claim. Our findings indicate that opinions are more likely to be correctly attributed to their sources than are factual statements. Investigations of process evidence indicate that this effect is driven by differences in how much information a claim provides about its source, where opinions generally provide more information about sources than facts do. The formation of stronger associative links between sources and opinion (vs. facts) during encoding results in more accurate source memory for opinions (vs. facts) during recall. The finding is robust across a variety of consumer contexts, is not attenuated by source expertise, and has notable implications for consumer beliefs. When information is shared with consumers, the objectivity of the communicated claims can affect consumers' ability to accurately remember where it came from.

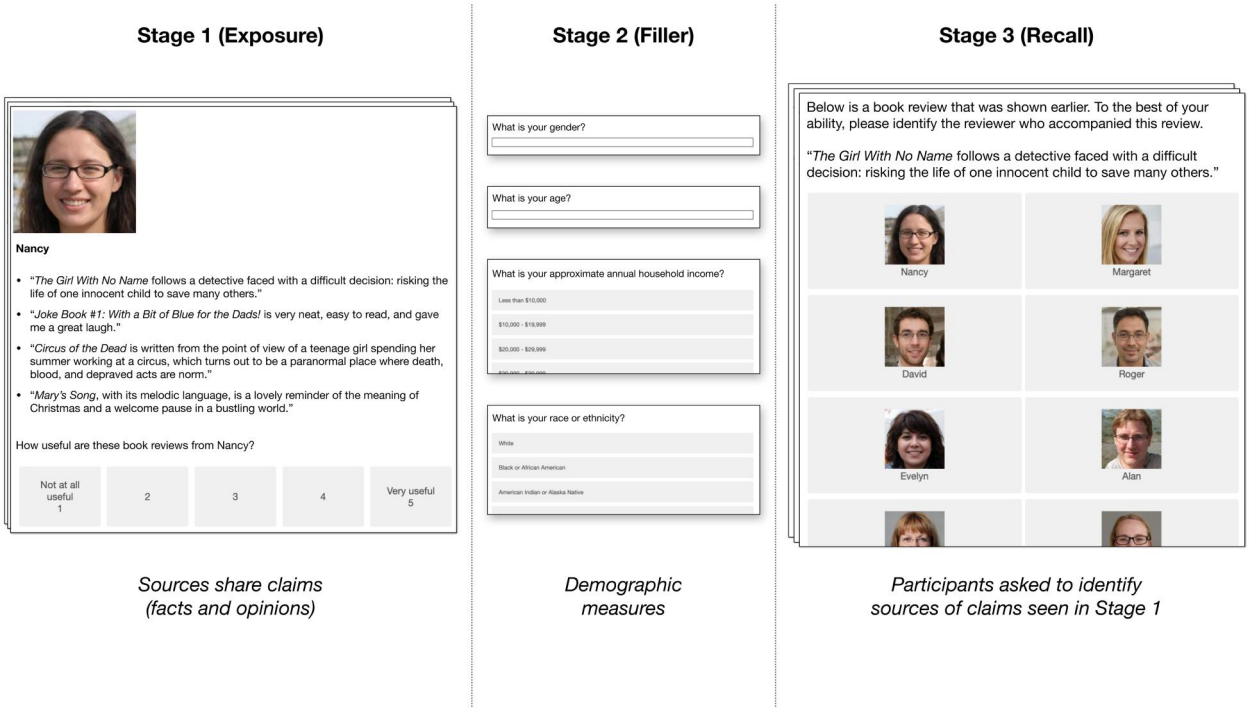
DATA COLLECTION STATEMENT

The first and second authors jointly managed the collection of data using MTurk, as described in the 'Method Across Experiments' section. All of the data were collected on MTurk between June 2020 and April 2024. Data were analyzed by the first author and are currently stored on ResearchBox. All data, materials, and code are available at https://researchbox.org/501.

APPENDIX

FIGURE A1

GENERAL FRAMEWORK FOR EXPERIMENTAL DESIGN



NOTE.—This figure shows a general framework for the experimental approach, illustrated with examples of stimuli from experiment 2b. While the experiments differed in specific design details (e.g., stimuli, engagement questions, recall tasks), each followed the same three-stage paradigm. For more information, see the web appendix.

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