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When viewing advertisements, consumers must decide what to believe and what is meant to deceive. Accordingly, much behavioral research has explored strategies and outcomes of how consumers process persuasive messages that vary in perceived sincerity. New neuroimaging methods enable researchers to augment this knowledge by exploring the cognitive mechanisms underlying such processing. The current study collects neuroimaging data while participants are exposed to advertisements with differing levels of perceived message deceptiveness (believable, moderately deceptive, and highly deceptive). The functional magnetic resonance imaging data, combined with an additional behavioral study, offer evidence of two noteworthy results. First, confirming multistage frameworks of persuasion, the authors observe two distinct stages of brain activity: (1) precuneus activation at earlier stages and (2) superior temporal sulcus and temporal-parietal junction activation at later stages. Second, the authors observe disproportionately greater brain activity associated with claims that are moderately deceptive than those that are either believable or highly deceptive. These results provoke new thinking about what types of claims garner consumer attention and which consumers may be particularly vulnerable to deceptive advertising.

Keywords: deceptive advertising, decision neuroscience, functional magnetic resonance imaging, theory of mind, metacognition, persuasion knowledge

Suspicious Minds: Exploring Neural Processes During Exposure to Deceptive Advertising

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> Any seeming deception is costly. Not only in the expense of the advertising, but in the detrimental effect upon the customer who believes she has been misled.
>
> —John Wanamaker, quoted in Mayer (1991)

> Truth is beautiful, without doubt, but so are lies.
>
> —Ralph Waldo Emerson (1835)

Questionable claims are endemic to the marketplace. A television advertisement touts that a cereal can lower cholesterol. A poster in the doctor's office offers reassurance that a certain pharmaceutical product is effective and safe. A salesperson states that his or her product is less expensive than that of competitors. How do consumers tell which claims are true and which are false?

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Marketing researchers have devoted significant effort to explain how consumers evaluate and respond to persuasion attempts. To consolidate often disparate insights into mechanisms that may mediate persuasion, an integrative model of advertising persuasion has been developed (Meyers-Levy and Malaviya 1999), positing that availability of cognitive processing resources determines how different strategies for processing persuasion are employed. Grounded in previous findings (e.g., Martin, Seta, and Crelia 1990), the integrative framework posits a later correction stage as part of a multistage processing of persuasion. An important limitation of extant research, however, is the methodological challenge of traditional behavioral experiments in capturing the real-time processes and cognitive mechanisms that underlie observed behaviors.

Neuroscientific research offers a new approach to the question of how consumers tell truthful messages from deceptive ones by examining the brain's response to potentially false information. Recently, a rapidly growing body of functional magnetic resonance imaging (fMRI) research has begun to investigate "deception detection" (e.g., Kozel, Padgett, and George 2004); however, the focus has been on identifying the brain regions used in *telling* lies. However, far less research has considered the opposite perspective—namely, the brain regions that are involved in determining when one is *being told* lies. For marketers, this is the more consequential perspective. Marketplace deception is no small fear, being prevalent (Blumberg 1989) and painful to consumers (Shimp and Preston 1981) and firms (Biegelman and Bartow 2006).

Existing neuroscience research has focused on human-to-human interactions related to trust or betrayal, examining what information people seek in determining whether others are violating a social contract (using hypothesis-testing tasks such as Wason tasks; e.g., Cosmides, Tooby, and Barkow 1992) or how people respond to those who cheat, either in terms of physiological reactions (e.g., Delgado, Frank, and Phelps 2005) or increased attention to and memory for cheaters' faces (e.g., Chiappe et al. 2004). However, new research has recently discovered that detection processes activate areas of the brain associated with theory-of-mind (ToM) reasoning (Chang and Sanfey 2009). This highly influential cognitive metatheory describes the human ability to attribute mental states to the self and to others and, most critically here, to recognize that another's intentions or desires may differ from one's own.

Theory-of-mind reasoning affects both buyers and sellers as they seek to understand their own and the others' intentions and desires to carry out successful transactions; however, few marketing studies have addressed it (Dietvorst et al. 2009; Wright 2002). Consumer response to deceptive marketing claims is a perennially important topic for practitioners and policy makers (Darke and Ritchie 2007), and a neuroscientific approach to deceptive marketing is especially timely as advances in brain imaging have prompted calls for increased research in "the neurology of belief" (Harris, Sheth, and Cohen 2008; Sacks and Hirsch 2008). Although marketplace metacognition (i.e., social intelligence about marketplace behavior; Wright 2002) has been a prominent research domain (Alba and Hutchinson 2000; Friestad and Wright 1994), little is understood about the neural processes responsible for applying marketplace knowledge because such research efforts are hampered by a reliance on consumers' ability to think about their own cognition or the interruption of the process itself (Gilbert 1991).

Thus, we attempt to contribute to neuroscience and marketing research by identifying patterns of brain activation when consumers are exposed to product claims that differ in perceived deceptiveness. The fMRI data offer unique insights beyond consumers' self-reports or other proxy measures of processing, and from these data, we are able to identify two different patterns of brain activity at earlier and later stages of processing. One danger with fMRI is the temptation to interpret findings on the basis of intriguing but necessarily ambiguous data; inferring psychological processes merely from the location of activation may lead to erroneous conclusions because neural function is widely distributed through the cortex. To mitigate this, we first conduct a behavioral study to inform the observable behavioral responses to the stimuli. Considered together, the results offer new insights into a multistage perspective of persuasion processing and the unique impact of ad claims perceived as being "just a little deceptive," suggesting important ramifications for theory, practice, and consumer welfare. These exploratory results provoke new questions about the biological bases of persuasion and human processes in detecting false claims.

TOWARD A NEUROLOGY OF DISBELIEF IN THE MARKETPLACE

Marketplace Metacognition: How Consumers Perceive Truth and Lies in Advertising

What are consumers' expectations about truth in advertising? Despite norms and beliefs about firms' truthful signaling (Miller, Visser, and Staub 2005; Riley 1975) or trust in legislative standards (Hansen and Law 2008), people are quick to doubt others' truthfulness. Encouraging participants to question the honesty of others decreases persuasion efficacy and decreases the perception of others' honesty (Miller Visser, and Staub 2005). Marketplace norms pertaining to persuasion are different from social norms because of the financial incentive to deceive (Kramer 1999). Buyers know that "misleading" can vary in severity, ranging from puffery (e.g., "My product is unrivaled") to objectively false claims.

Buyers' and sellers' recognition of this system is captured in the persuasion knowledge model (PKM; Friestad and Wright 1994). According to the PKM, knowledge of the persuasive motivation of sellers encourages buyers to activate coping mechanisms that guide attention, provide inferences, generate predictions, choose response tactics, evaluate exchange outcomes, and learn for future exchanges. Thus, the buyer monitors the exchange to detect false or misleading claims. These behaviors, paired with an ever-vigilant and automatic ToM monitoring system, should facilitate more effective marketplace transactions. People are alert to potential deception in market claims (Darke and Ritchie 2007), and over time, consumers may adopt a "sinister attribution" posture characterized by vigilance for the hostile intentions of marketers (Main, Darke, and Dahl 2007). Taken together, the literature suggests that consumers are motivated to look for deceptive information while largely expecting to observe truthful claims. This forms a basis for a metacognitive approach to persuasion.

Marketplace metacognition is an emerging perspective in marketing that emphasizes the importance of consumers' thinking about market-related events. Predominant metacognitive theories within the marketing domain are largely focused on the calibration and application of domain-specific knowledge (Alba and Hutchison 2000; Wright 2002). Yet the mechanisms involved in marketplace metacognition are underinvestigated at best. Wright (2002) calls for an expanded examination of metacognitive theory to include not only the application of knowledge but other processes such as attention, recognition, and memory as well. Much metacognitive work for the individual person is socially oriented, especially in the marketplace. Consumers must take the perspective of others such as family, friends, other consumers, salespeople, and marketers (and what they know of those players) to understand the benefits and risks associated with decisions. Thus, recent work in social cognitive neuroscience has provided an illuminating set of theories and paradigms to begin examining metacognitive processes of persuasion.

Neuroscientific Approaches: Cheater Detection and ToM

Research in cheater detection focuses on circumstances in which a person must consider the intentions of another to make a subsequent decision or transaction (Sanfey 2007). While the concept of a "cheater" is conceptualized broadly in this literature, many investigations take a social cognitive perspective and explore circumstances that capture issues of trust in a joint outcome situation (Camerer 2003). In this paradigm, cheaters are not necessarily just those who cheat in an interaction but are people who violate social economic norms, such as deception, inequity, or noncooperation. There are two common protocols for investigation. One is the "ultimatum game," which is often used to examine emotional processes underlying irrational responses to inequity (Camerer 2003; Crockett et al. 2008; Koenigs and Tranel 2007). A second paradigm explores increased attention to and memory for people who cheat. "Attention" is not mere stimulus perception but rather an expanded concept of examination brought on by social expectation violation (Chiappe et al. 2004; Cosmides, Tooby, and Barkow 1992; Oda 1997).

A recent finding is of particular importance here. Chang and Sanfey (2009), examining whether people remember partners who make unfair offers to them in the ultimatum game, find enhanced memory for partners whose offers violate expectations. There are two vital aspects of their findings. First, their fMRI data show that the neural correlates of this type of cheater detection are associated with several brain regions believed to be involved in ToM reasoning. Second, memory for cheaters is less a function of the objective amount of untrustworthiness than it is a function of the subjective perception of untrustworthiness (i.e., violations of expectations). We explore ToM in greater detail next.

How ToM Contributes to Marketplace Metacognition

Does ToM matter to marketers? Because ToM describes the ability to attribute mental states (e.g., beliefs, intentions, desires) to oneself and to others, it is considered a vital inference system for social cognition and therefore has been a topic of intense interest, stemming from seminal articles such as Premack and Woodruff (1978). Theory of mind matters to the marketplace because it is this form of "social mind reading" that facilitates successful market transactions (Wright 2002). Importantly for marketers and consumers, ToM differs from traditional motivated reasoning and knowledge-based metacognition (i.e., persuasion knowledge; Friestad and Wright 1994) in that persuasion knowledge refers to beliefs consumers hold about intentional social influence (Wright 2002). Theory of mind involves processes that allow a consumer to develop persuasion knowledge and attempt to understand the intention of a persuader, which may include accessing explicit schemer schemas. To successfully navigate the marketplace, buyers and sellers must understand that their own beliefs, intentions, and desires are not necessarily the same as those of others.

Chang and Sanfey (2009) find that when participants viewed the faces of cheater partners (who made inequitable offers), brain areas associated with ToM reasoning were activated, including the bilateral temporal-parietal junction (TPJ), right superior temporal sulcus (STS), and precuneus. The TPJ is associated with ToM for its roles in thinking about others' mental states (Saxe and Kanwisher 2003), processing expectation violations (Downar et al. 2000), and orienting attention (Corbetta et al. 2000). The right STS has also been implicated in ToM as a region that detects and evaluates the intentions of others (e.g., Frith and Frith 1999). Both the STS and TPJ are involved when people make predictions about the value of a social partner's advice and again when they update predictions after feedback (Behrens et al. 2008). The precuneus is associated with attention orientation and social memory (Cavanna and Trimble 2006), mentalizing perceived intentionality (Den Ouden et al. 2005), and reasoning about another's beliefs (Saxe and Kanwisher 2003). Decety and Lamm (2007) also suggest that the right inferior parietal lobe (rIPL) plays a crucial role in ToM and expectation violation. Sommer et al. (2007, p. 1383) propose that the rIPL is involved with "computing mental states that create a perspective difference, such as a person's false belief that contrasts with the state of reality."

Importantly, for marketers, Dietvorst et al. (2009) describe how ToM reasoning is critical to the successful completion of marketplace transactions by showing that sales professionals with strong ToM abilities are better able to both recognize customer intentions and interpret interpersonal cues. Sales professionals who score more positively on their salesperson ToM scale demonstrate increased activation in regions of the brain associated with ToM, specifically the right medial prefrontal cortex and the right and left TPJ.

Thus, both the neuroscience and marketing literatures have much to offer in understanding persuasion and how consumers respond to potentially deceptive ad claims. We now turn to a discussion of how these literature streams can be integrated to offer hypotheses about neural response to claims that vary in the degree of perceived deceptiveness at different stages of processing.

Hypotheses for Early Stage Processing of Potential Deception

Consumers are exposed to many persuasive messages each day. Thus, monitoring for deception is necessarily dynamic (Richards 1990); interpersonal deception theory (Burgoon and Buller 1996) posits that the detection of deception places increasing demands on cognitive resources as people are exposed to, note discrepancies in, and finally test the veracity of a suspicion-provoking claim (Berger 2005). Richards's (1990) three-stage deceptive advertising model posits an initial stage in which consumers exposed to an advertisement will first recognize incongruent claims or attributes. This can be viewed as similar to attention orientation to violated expectations observed in cheater detection. Thus, in considering the neural correlates of consumers' initial responses to potentially deceptive advertising claims, we might first expect to observe brain activity in areas associated with attention orientation, such as precuneus activation (Cavanna and Trimble 2006; Chang and Sanfey 2009) and, possibly, the amygdala.

The benefit of studying three levels of deceptiveness is that we can see that deceptiveness and uncertainty are not linearly correlated. While highly believable claims provoke higher levels of certainty (i.e., a claim is most probably true), so too may a highly deceptive claim provoke a high level of certainty (i.e., a claim is most probably false). In contrast, a claim perceived as moderately deceptive (i.e., may be true or false) may be more likely to provoke lower certainty. Using these three levels of deception enables us to observe how consumers respond differently to claims that make the consumer more certain as well as claims that make the consumer less certain. Thus, we should not simply look for precuneus or amygdala activation at Stage 1; rather, we should determine whether levels of activation differ by perceived level of deceptiveness. We hypothesize a linear effect, with the greatest activation for highly deceptive claims because they create larger violations of normative expectations and the lowest activation for believable ad claims that do not violate expectations of trustworthiness.

Hypotheses for Late-Stage Processing of Potential Deception

The second stage of Richards's (1990) advertising model is verification, in which consumers attempt to validate the veracity of claims they think may be true, which leads potentially to the third stage of purchase decision. Similar to verification processes in interpersonal deception contexts (Berger 2005), consumers must engage factual domain knowledge as well as knowledge of the intentions and motivations of the person or entity making the claim (Friestad and Wright 1994). As we discussed, it might be posited that this stage of processing relies on ToM reasoning, as consumers assess claims in light of marketers' motivation to persuade (Wright 2002). Thus, in subsequent stages of processing in which information must be reconsidered (Gilbert 1991; Meyers-Levy and Malaviya 1999), we hypothesize activation in the STS and TPJ (Behrens et al. 2008; Chang and Sanfey 2009; Dietvorst et al. 2009) as well as in the rIPL (e.g., Decety and Lamm 2007). Here, because we posit that the first stage acts as a screening process to identify clearly deceptive claims, it would be reasonable to expect greater activation for more believable advertisements during the second stage because such advertisements are the least likely to be initially dismissed. However, we posit the greatest activation for moderately deceptive claims because they are the most uncertain, being neither strongly perceived as true nor strongly perceived as false. In this way, moderately deceptive claims may generate more neural activation than believable advertisements across both stages.

STUDY 1: BEHAVIORAL RESPONSE TO VARIANCE IN PERCEIVED DECEPTIVENESS

To examine these issues using fMRI methodology, we use a research protocol in which consumers are exposed to claims perceived as believable (i.e., low perceived deceptiveness), moderately deceptive, or highly deceptive. However, we first conduct a behavioral study with a threefold purpose: (1) to develop and test our stimuli, (2) to demonstrate that exposure to advertisements with differing levels of message deceptiveness leads to different behavioral outcomes, and (3) to offer evidence of a multistage process that involves a correction stage, as Meyers-Levy and Malaviya (1999) propose in their integrative model of advertising persuasion, that may help guide neuroimaging analysis and interpretation. In particular, the authors suggest that the level of cognitive resources devoted to processing may affect the observed stages of behavior. Thus, in our behavioral study, we use a cognitive load protocol to assess explicit evaluations of advertising claims under conditions with greater/lesser processing resources. In line with Meyers-Levy and Malaviya, we should observe that as cognitive load varies, the presence of a secondary stage leads to more optimal decision making.

Stimuli Development

We first identified target products whose claims could serve as our experimental manipulation. We chose products that were moderately familiar to our study population; this made it likely that, while participants did not have previous experience with the specific products they were exposed to during the fMRI study, they possessed sufficient referent information regarding similar products to assess their perception of the truthfulness of the claims. Products (and their descriptions) were sampled from an online retailer advertising novelty gadgets; because we used real products, we did not base conditions on actual deception but rather on the perception that the advertisements were potentially deceptive. Two independent coders, blind to the hypotheses, assigned advertisements to believable, moderately deceptive, and highly deceptive categories. Both coders selected 33 product advertisements (11 in each category) as clearly belonging to one of the three categories; we then pretested these products.

Pretest of Stimuli

The purpose of the pretest was to select 15 final products (from the initial set of 33) for use in the behavioral and fMRI studies. Our goal was twofold. First, we wanted products for which participants' reported classification of the product advertisements (as believable, moderately deceptive, or highly deceptive) confirmed the independent judges' classification. Second, we wanted products that were of similar interest level to the participants (i.e., that did not differ in terms of how interesting/good the product was perceived to be). Pretest participants were recruited from a similar population to be used in the behavioral and fMRI studies. Undergraduate students (n = 180, 51% female, mean age = 20.5 years) participated in a computer-based pretest in which they saw the 33 advertisements, all similar to one another in quality and layout (see Figure 1, Panels A–C) with a color photo in the upper-left corner and a short description of approximately the same length (73–110 words). Participants answered three questions about the innovativeness, perceived benefit, and believability of each product using seven-point scales (1 = "not at all," and 7 = "very").

First, to check the categorization, we performed an exploratory factor analysis (EFA) on the believability evaluation with a Varimax rotation and three forced factors. Because believability judgments of product advertisements with varying deceptiveness contents were assessed within subject, EFA enabled us to extract and group products on the basis of correlations of believability judgments within and between subjects. Loadings for 23 of the 33 products ($\lambda >$ .5) corresponded with the coders' classification of believable, moderately deceptive, or highly deceptive and advanced to the next round of screening tests.

Second, it was important that the selected categories of advertisements did not differ in terms of how new or how interesting/good the products seemed to participants. We screened the set for any product advertisements that differed significantly from the average in participants' perception of their innovativeness or relative benefit. To reduce the set of 23 products to the final 15, we eliminated the 8 products that differed the most from the average. For the remaining 15 products, we ran two two-factor analyses of variance with the deceptiveness category (i.e., believable, moderately deceptive, and highly deceptive) and replicates (five ad replicates) as within-subject factors and either product innovativeness or product benefit as a dependent variable. Planned contrasts confirmed that the deceptiveness categories did not differ in mean product innovativeness or benefit ($p > .10$). As a final check, we performed a second EFA on believability ratings for the 15 advertisements. The resultant factor structure explained 49.40% of variance and again was consistent with the coders' classification (for factor loadings, see Web Appendix WA.1 at www.marketingpower.com/jmr_webappendix).

Method

The experiment employed a 2 (cognitive load: low, high) × 3 (perceived deceptiveness: believable, moderately deceptive, highly deceptive) × 5 (advertisement replicates) mixed design in which cognitive load and perceived deceptiveness are between-subjects factors and the replicates are nested within subject. One hundred ninety-seven undergraduate students (48% males; 20 people per session) participated in exchange for course credit. Participants were seated in carrels with personal computers and informed that the hour-long session would comprise several unrelated experiments. The introductory computer screen told participants that the purpose of the first experiment was to understand how well consumers' memory works during writing and decision-making tasks. Next, we manipulated cognitive load using a common procedure (Shiv and Fedorikhin 1999) in which

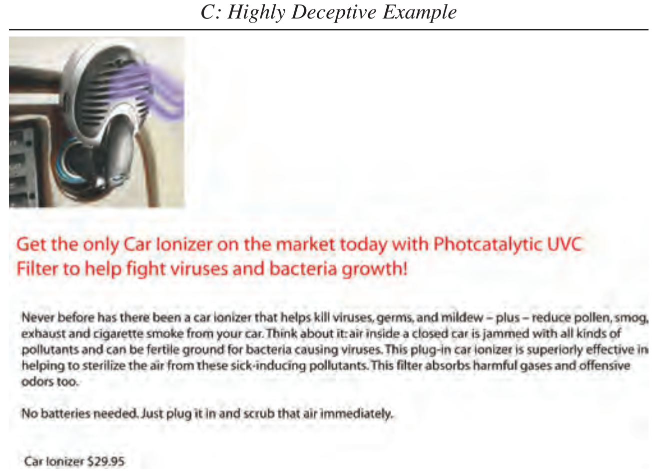
Figure 1

EXAMPLES OF DECEPTIVE ADVERTISEMENTS USED IN STUDIES 1 AND 2

A: Believable Example

B: Moderately Deceptive Example

C: Highly Deceptive Example



participants memorized either a two-digit number (low cognitive load) or a seven-digit number (high cognitive load). They were instructed not to write the number down and were told that they would be asked to recall the number later in the session. Participants then moved on to begin a seemingly unrelated "advertising study" in which they evaluated five product advertisements. They were randomly assigned to one of three conditions in which they evaluated five believable, five moderately deceptive, or five highly deceptive advertisements. Participants read each advertisement at their own pace and reported two well-established evaluative measures (Zeithaml, Berry, and Parasuraman 1996): their likelihood of recommending the product to a friend and their likelihood of purchase (1 = "not at all likely, " and 9 = "very likely"). Later in the session, they recalled the memorized number.

Results

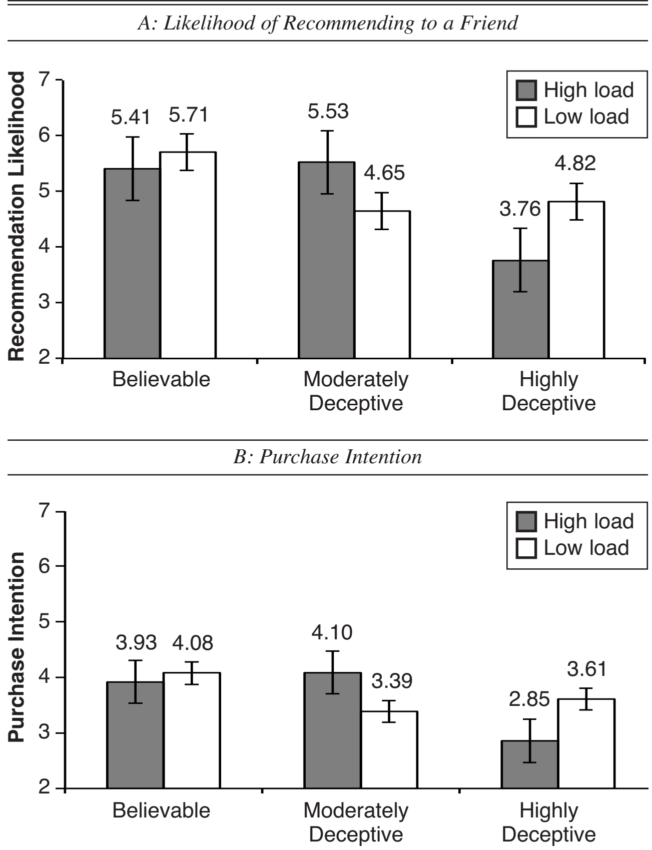
Manipulation check. In line with previous research, we assume that the cognitive load manipulation is successful when participants are able to correctly recall their number. One hundred seventy-three participants (47% males) correctly recalled their number. We excluded responses of the 24 participants who failed this check from further analysis.

Product evaluation and purchase likelihood. To investigate whether and when the later judgment correction stage of processing leads to higher or lower evaluation of the "maybe" claims, we used mixed analyses of variance to assess differences in ratings of recommendation and purchase. First, for recommendation, we find a significant main effect of ad deceptiveness ($F(2, 167) = 9.02$, $p < .0001$) and a two-way load × deceptiveness level interaction ($F(2, 167) = 5.37$, $p = .006$). To better understand this interaction, we conducted a series of pairwise comparisons among means using Fisher's least significant difference procedure. Participants rated moderately deceptive claims more positively in the high-load condition ($M_{\text{moderately deceptivene\_low load}} = 4.65$, $M_{\text{moderately deceptivene\_high load}} = 5.53$; $t(58) = 2.11$, $p = .03$). Importantly, when we consider these evaluations in comparison to ratings of believable and highly deceptive claims, high-load, moderately deceptive advertisements are rated as similar to believable advertisements ($M_{\text{believable\_high load}} = 5.41$, no significant difference) and different from highly deceptive advertisements ($M_{\text{highly deceptive\_high load}} = 3.76$; $t(48) = 3.92$, $p < .001$; see Figure 2, Panel A).

What occurs in conditions of low cognitive load when processing is not constrained? Here, we observe the opposite effect for moderately deceptive claims. With low cognitive load, moderately deceptive claims are evaluated as similar to highly deceptive claims ($M_{\text{highly deceptive\_low load}} = 4.82$, no significant difference) and different from believable claims ($M_{\text{believable\_low load}} = 5.71$; $t(59) = 2.57$, $p = .01$; see Figure 2, Panel A). When processing is not constrained, "maybe claims" appear more likely to be considered *not* believable. This pattern of results is mirrored in the purchase likelihood ratings, though with somewhat weaker effects, as might be expected from a dependent variable that depends both on evaluation and other variable constraints (e.g., individual preferences, budget). There is a significant interaction of load × deceptiveness level ($F(2, 167) = 3.46$, $p < .05$), and moderately deceptive claims are marginally more likely to generate higher purchase likelihood intentions in the high-load condition ($M_{\text{moderately deceptivene\_high load}} = 4.10$) versus the low-load condition ($M_{\text{moderately deceptivene\_low load}} = 3.39$; $t(58) = 1.84$, $p = .06$). Again, with high load, moderately deceptive advertisements generate purchase intentions similar to believable advertisements ($M_{\text{believable–high load}} = 3.93$, $p > .1$) and different from highly deceptive advertisements ($M_{\text{highly deceptivene\_high load}} = 2.85$; $t(48) = 2.94$, $p = .004$). With low load, moderately deceptive claims generate purchase intentions similar to highly deceptive claims ($M_{\text{highly deceptive\_low load}} = 3.61$, $p > .1$) and marginally different from believable claims ($M_{\text{believable\_low load}} = 4.08$; $t(59) = 1.79$, $p = .07$; see Figure 2, Panel B).

Figure 2

STUDY 1 RESULTS



Notes: The results depict participants' ratings of their likelihood to recommend and purchase intention for believable, moderately deceptive, and highly deceptive advertisements after reading them under conditions of low or high cognitive load. Under high cognitive load, moderately deceptive advertisements are evaluated on par with believable advertisements. Under low cognitive load, moderately deceptive advertisements are evaluated on par with highly deceptive advertisements. The error bars indicate +/–1 standard error of the mean.

The behavioral study offers a successful test of the ad stimuli and demonstrates observable differences in response to differing levels of perceived ad deceptiveness. We observe a two-stage process in which the latter stage seems to be congruent with belief reasoning processes. There is also some evidence of preferential processing for moderately deceptive claims.

STUDY 2: NEURAL RESPONSE TO VARIANCE IN PERCEIVED DECEPTIVENESS

To assess the neural activity of participants as they were exposed to advertising claims that varied in perceived believability, we used fMRI to assess blood oxygenation levels (called the blood oxygen level dependent, or BOLD, signal). The BOLD signal is a measure of hemodynamic response (change in blood flow) that occurs with neural activity in the brain. We present a detailed description of our procedure subsequently. Technical details (including fMRI parameters) appear in Web Appendixes WA.2–WA.4 (www.marketingpower.com/jmr_webappendix).

fMRI Participants

Twenty-six undergraduate students participated for course credit and a copy of their structural scan, conforming to sample size recommendations for fMRI studies (see Yoon, Gonzales, and Bettman 2009). Certified research personnel conducted each session with one participant at a time. These sessions lasted approximately one-and-a-quarter hour, including 30 minutes of scanning time that comprised structural scans and the experimental protocol. Participants arrived at a hospital facility and were fully briefed about the fMRI procedure and the experience while in the scanner. All participants provided written informed consent in accordance with the university's Institutional Review Board guidelines. Participants were led through a health and demographic questionnaire by a research technician to assess the potential for contraindications. All participants had normal to corrected-to-normal visual acuity and no (self-reported) neurological problems. Those who passed the screening measures were taken to the scanner for the imaging protocol.

fMRI Procedure

Imaging was conducted using a Siemens 3.0 Tesla Trio full-body scanner (Munich, Germany) with a 12-element head coil (for details, see Web Appendix WA.2 at www.marketingpower.com/jmr_webappendix). Before entering the magnet, participants were given a detailed explanation of the passive viewing task and were told that they would be reading actual product advertisements. Next, participants were placed in a prone position in the magnet with their head positioned in a standard head coil. Scanning began with structural acquisition of a standard T1 image for anatomic normalization and alignment purposes; this process took approximately eight minutes. During the functional session, participants were able to see the experimental stimuli on a screen located at the end of the scanner bore, by way of a back-projection mirror mounted on the head coil. The stimuli were presented using E-Prime software (Psychology Software Tools Inc.). Participants were informed that they would be exposed to several product advertisements that they should read. Participants then viewed the 15 target advertisements that were, in some cases, separated by blank screens (blank screens served as a necessary baseline of activation and were entered as a covariate in the general linear model). In this event-related design (see Web Appendix WA.3 at www.marketingpower.com/jmr_webappendix), advertisements were presented using a semi–Latin square design with the three deceptiveness levels and a control (i.e., blank screen) as four treatments. Thus, any repetition of a single condition did not covary with the presentation of another condition. This design minimized order effects between the deceptiveness blocks and provided a basis for comparison of activation to the baseline level (i.e., control). Each advertisement/blank screen remained on the screen for 50 seconds so that all participants could read and consider the full advertisement, as determined by pilot testing (participants [n = 173] completed reading and considering in under 50 seconds 99% of the time). Each trial consisted of a single ad presentation. Participants did not make any explicit response to each advertisement. The strength of the passive nature of the task was that it was deemed to be more similar to naturalistic ad viewing, and by not having participants rate the believability of each claim while in the scanner, we did not draw attention to possible deception as our focus. A downside to the passive task was that we could not later assess a correlation of brain activity to point-by-point deceptiveness ratings; however, the positives of the passive task, in this case, outweighed the negatives. Finally, participants were debriefed.

fMRI Data Analysis

We carried out individual and group analyses of the fMRI data using FSL (FMRIB's Software Library). For higher-level (group) analyses, we used a Bayesian mixed-effects analysis (FLAME 1 and 2: FMRIB's Local Analysis of Mixed Effects). To test our research questions, comparisons, called "contrasts," were performed to reveal which brain areas were activated in each condition above and beyond what was activated in other conditions (e.g., believable > highly deceptive contrast). The general linear model consisted of the regressors for the blank, believable, moderately deceptive, and highly deceptive categories (one for each 15-second period) as well as six additional motion parameters. For illustration, statistical maps were overlaid onto a standard MNI brain template using MRIcron (Rorden, Karnath, and Bonilha 2007). Details about the fMRI data analysis appear in Web Appendix WA.4 (www.marketingpower.com/jmr_webappendix).

fMRI RESULTS

Recall that our analysis is of changes in blood oxygenation, as indicated by increases in the intensity of the BOLD signal. In this type of analysis, contrasts in BOLD signals between different conditions (in this case, the level of perceived deceptiveness of the advertisement) are tested for significance. We measured BOLD effects using rapid volumetric acquisition of images with contrast weighted by T1. Such volumetric pixel (voxel) images can be acquired with decent spatial and temporal resolution; images are usually taken approximately every 2 seconds, and the voxels in the resulting image typically represent cubes of tissue 3 millimeters on each side in humans. Responses to stimuli presented as close together as 1 or 2 seconds can be distinguished from one another using event-related fMRI, and the full-time course of a BOLD response to a briefly presented stimulus lasts approximately 15 seconds for the robust positive response.

We analyzed the exposure to advertisements by separating each trial into three nonoverlapping 15-second stages; in doing so, we sought to examine the effects of the potentially multistage nature of deception processing. Although signals at longer intervals are significantly reduced to account for signal drift and therefore can make it more difficult to observe effects, the nature of these effects are such that they should be large enough to reach significance. While the time periods are somewhat arbitrary, pilot testing suggested that, on average, 14.24 seconds were required to read the advertisement (not including rumination); thus, a 15-second span was considered reasonable.

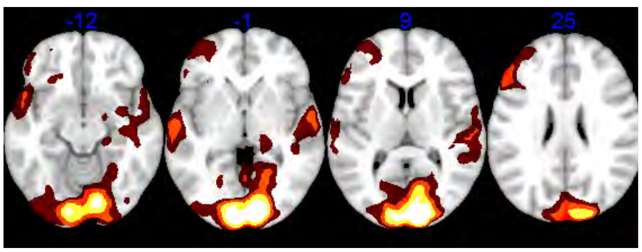
First-Stage Analysis

In examining our prediction regarding evidence of processes akin to expectation violation in early stage processing, we contrasted the levels of perceived deceptiveness during the first 15-second of the trial. First, we looked for differential activation in areas of the brain associated with attention orientation. As hypothesized, we observed greater activation in the precuneus for the highly deceptive claims compared with the believable claims (highly deceptive > believable contrast: x = –5, y = –68, z = 53; see Figure 3, Panel A). We also observed greater precuneus activity in the moderately deceptive versus believable claims (moderately deceptive > believable contrast: x = –9, y = –70, z = 35; see Figure 3, Panel B). Contrasting highly deceptive versus moderately deceptive claims revealed greater occipital lobe activation in the highly deceptive claims similar to the patterns comparing highly deceptive > believable claims (Figure 3, Panel C). Finally, we observed increased activity in the right amygdala in the highly deceptive claims versus the believable claims (highly deceptive > believable contrast: x = 24, y = 0, z = –21), suggesting a monotonically increasing relationship between level of deceptiveness and amygdala activation. All other contrasts were nonsignificant. Overall, this may reflect a linear pattern in processing akin to attention orienting toward expectation violation in early stage processing; advertisements that are higher in their potential for deception activate areas such as the precuneus and, in some cases, the amygdala, which is associated with various types of emotional processing (e.g., stimulus relevance; Sander, Grafman, and Zalla 2003). A complete list of activation for each significant contrast (local maxima coordinates) for the first stage appears in Web Appendix WA.5 (www.marketingpower.com/jmr_webappendix).

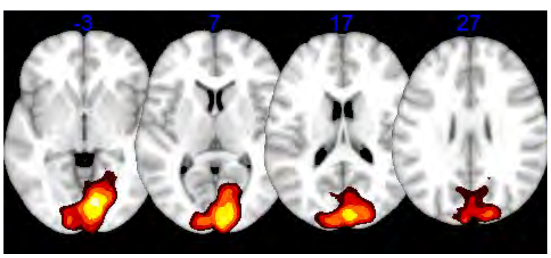
Figure 3

FIRST-STAGE ACTIVATION MAPS

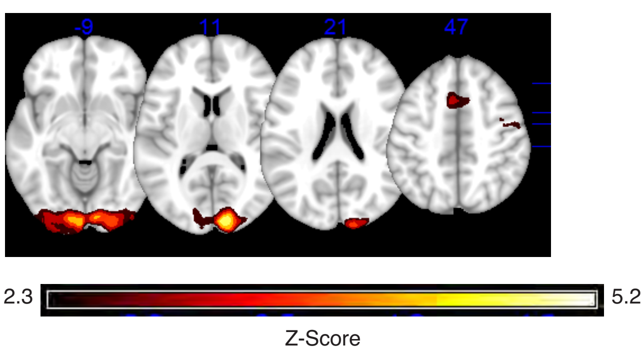
A: Highly Deceptive > Believable Contrast



B: Moderately Deceptive > Believable Contrast



C: Highly Deceptive > Moderately Deceptive Contrast



Notes: Panel A depicts a highly deceptive > believable contrast, which shows greater activation in the precuneus region for advertisements perceived as highly deceptive versus those perceived as believable. Activation is also observed in the amygdala. Panel B depicts a moderately deceptive > believable contrast, which shows greater activation in the precuneus region for advertisements perceived as moderately deceptive versus those perceived as believable. Panel C depicts a highly deceptive > moderately deceptive contrast, which shows greater activation in the occipital lobe for advertisements perceived as highly deceptive versus those perceived as moderately deceptive. Activation maps reached a threshold at Z > 2.3, $p < .05$ (corrected for multiple comparisons).

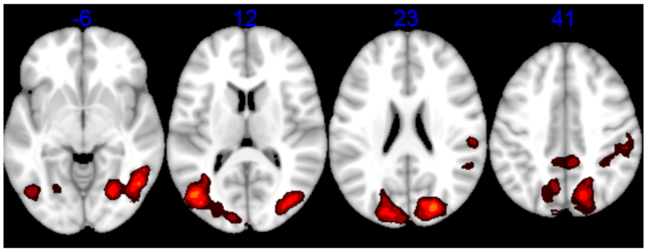
Second-Stage Analysis

Next, we examined differences in processing during the second 15-second period, conducting analyses to assess changes in brain activation in areas associated with ToM processing. Recall that we expected that in later stages (in which participants had time to consider the advertisement more fully), highly deceptive claims would be screened out, and more believable claims would show increased activation. Contrasting believable and highly deceptive claims (believable > highly deceptive), we observe greater activation in the right IPL (x = 58, y = –29, z = 20) and throughout the supramarginal gyrus (Figure 4, Panel A). Similarly, in contrasting moderately deceptive claims versus the highly deceptive claims (moderately deceptive > highly deceptive contrast), BOLD signal revealed increased right IPL activation (x = 58, y = –27, z = 23; see Figure 4, Panel B) and extending toward the TPJ. We also posited that increased processing would be associated with greater message uncertainty and, thus, with moderately deceptive claims. Specifically, we examined whether the moderately deceptive advertisements would result in more activation than both highly deceptive *and* believable advertisements in regions associated with ToM processing (e.g., the STS and TPJ) in the verification of claims. Consistent with this "inverted U" effect, the contrast of moderately deceptive and believable revealed greater STS activation (moderately deceptive > believable; x = 70, y = –23, z = 3; voxels = 8; Z > 3.1, $p < .005$, uncorrected; see Figure 4, Panel C). A complete list of activation for each significant contrast (local maxima coordinates) for the second stage appears in the Web Appendix WA.6 (www.marketingpower.com/jmr_webappendix).

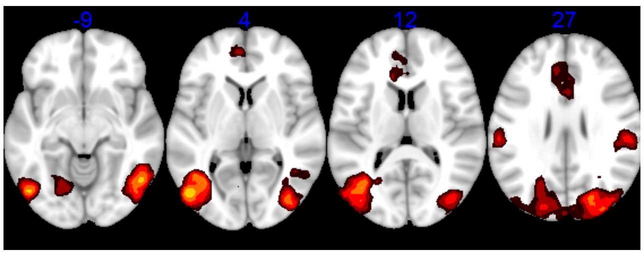
Finally, we did not find any significant results in the third 15-second period. While it is difficult to interpret null results, it appears that the majority of consumer consideration of these particular advertisements occurred in the first 30 seconds of assessment. The first two 15-second periods appear to correspond with hypothesized stages of processing, which may include expectancy violation and verifica-

Figure 4
SECOND-STAGE ACTIVATION MAPS

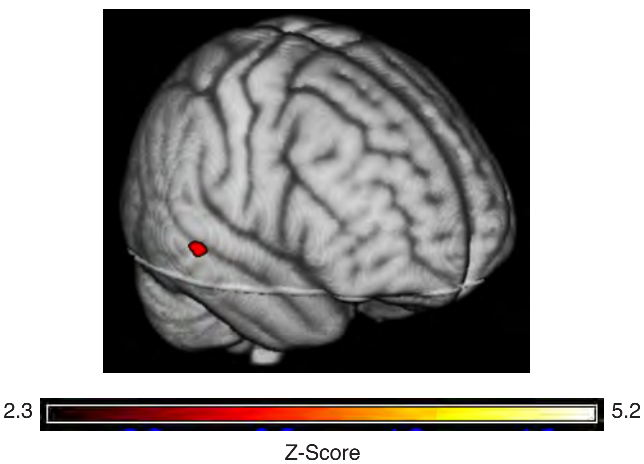
A: Believable > Highly Deceptive Contrast



B: Moderately Deceptive > Highly Deceptive Contrast



C: Rendered Image of the Moderately Deceptive > Believable Contrast



Notes: Panel A depicts a believable > highly deceptive contrast, which shows greater activation in the rIPL and supramarginal gyrus for advertisements perceived as believable versus those perceived as highly deceptive. Panel B depicts a moderately deceptive > highly deceptive contrast, which shows greater activation in the right IPL for advertisements perceived as moderately deceptive versus those perceived as highly deceptive. Activation maps reached a threshold at $Z > 2.3$, $p < .05$ (corrected for multiple comparisons). Left = right in Panels A and B. Panel C depicts a rendered image of the moderately deceptive > believable contrast, which shows greater activation in the superior temporal sulcus for advertisements perceived as moderately deceptive versus those perceived as believable. Activation maps reached a threshold at $Z > 3.1$ (uncorrected).

tion processes, thus presenting evidence of at least two stages; the rapidity of this process may be interesting to note in itself.

fMRI Discussion and Interpretation

In line with the hypothesized effects and building on the behavioral study findings, the fMRI data reflect a two-stage process through which potentially deceptive advertising is perceived and, importantly, engages activity in areas of the brain that support ToM processing. In the initial response (the first 15 seconds), activity patterns observed in the amygdala and precuneus were similar to patterns of expectation violation observed in person-to-person cheater detection (Chang and Sanfey 2009). Activation patterns in the superior temporal and inferior parietal areas (including the STS and TPJ) during later-stage processing is congruent with a perspective of verification and assessment of the claims. These patterns suggest that ToM plays a role in perceiving deception, in both early stage expectation violation and later-stage assessment.

While, from a neuroscience perspective, the results here shed new light on neural processing involved with deceptive advertising, the interpretation of these effects, especially with regard to outcomes for consumers, requires careful consideration. We now turn to a final discussion of the data and their implications for marketers, consumers, and future research initiatives.

GENERAL DISCUSSION

Evidence from this research suggests that consumer perception of potentially deceptive advertising claims is associated with two stages of neural processing. When initially exposed to a message, activation increases in the precuneus for moderately and highly deceptive advertisements. We also observe an increase in amygdala activation for advertisements perceived as more deceptive. In subsequent processing, however, areas identified in ToM research (the STS and TPJ) are more active for believable and moderately deceptive claims even as our paradigm allowed for continued opportunity for rumination of highly believable claims. Processes reflecting attention allocation may first be preferentially directed toward highly deceptive material, but they may shift as processing of highly deceptive material is truncated. Increasing levels of attention and belief reasoning may then be directed toward believable and moderately deceptive material. At the second stage, we also observe greater activation for claims perceived as moderately deceptive (vs. believable).

What do these data suggest about how consumers can potentially be harmed by deceptive claims? Given only the neuroimaging data, they might be interpreted as highlighting the cognitive dangers of moderately deceptive material; "little lies" may seem to lead to preferential processing, in that such claims generate both more initial attention (similar to highly deceptive "threats") and more expanded second-stage processing (similar to that garnered by believable claims). However, when considered in light of Study 1, this interpretation does not hold, and we observe a beneficial effect of second-stage processing. By imposing cognitive load, we reduced participants' ability to engage in expanded processing. The data show that when under high cognitive load, the moderately deceptive claims are evaluated similarly to believable claims. Conversely, when load is low (and resources are available for second-stage processing), evaluations of moderately deceptive advertisements are lower and more similar to highly deceptive claims, suggesting that processing at this stage (associated with ToM reasoning) helps consumers be more discriminating. Thus, while firms might be tempted by these findings to make their ad claims have an "edge" by being a bit debatable or difficult to believe, the overall conclusion is that this is not likely to be a promising practice when consumers have time to fully process claims.

Theoretically, these findings contribute to the neuroscience and marketing literature on deception by describing the brain's multistage processing of potentially deceptive information and by examining this physiological process within the domain of marketplace deception in which "cheaters" often are not deceptive people, but deceptive advertisements. We find neural evidence of ToM influence (Chang and Sanfey 2009) that supports the underlying processes of persuasion knowledge in the marketplace (Friestad and Wright 1994; Wright 2002). Mentalization about the validity of ad claims is observed to be an automatic process in which brain activity may be first identifying potential "threats" in deceptive information and then reasoning about the underlying intent of the claim. Notably, this pattern is observed within a paradigm of passive ad exposure and thus may be an automatic response by consumers to advertisements whether those advertisements are of focal interest (i.e., the consumer is actively considering the product for purchase) or not, though we must acknowledge that because our paradigm allows sufficient reading time, we do not directly address mentalization during rapid exposure. Most mentalization (ToM) research focuses on human-to-human interaction, and so these findings (like work by Castelli et al. [2002] that demonstrates mentalizing for animated triangles on a computer) are interesting as a rare demonstration of intention-oriented reasoning directed toward a nonhuman entity.

As a biological examination of a business phenomenon, this research is necessarily focused on a very narrow slice of the overall issue of deceptive advertising. However, the results provide evidence that is not easily verified through other physiological research paradigms. Both eye-tracking and response-time studies can provide revealing process evidence in many circumstances, but they only provide evidence of a summation of processes rather than an ability to isolate and describe a process occurring simultaneously with many others. The combination of fMRI and experimental methods can provoke many new questions about deception in the marketplace with strong future research potential.

One especially promising area for future work involves the neurology underlying trust in consumer decision making. For example, we found that marketplace claims containing moderately deceptive claims activate the rIPL, which has been associated with processing expectation violation. The rIPL, however, has also been implicated in perspective taking (Decety and Lamm 2007). Thus, when people encounter marketplace claims, it remains unclear if self-referential product usage expectations and subsequent imagined violations engage defensive processing more so than other referential violations. These issues may be especially important in interpersonal marketplace deception, such as in consumer–salesperson or manager–employee dyads. This is an issue with material consequences, as recent research has shown that managers hold strong beliefs about how to detect lying and false claims but are largely incorrect about those cues (Hart et al. 2006). Our results highlight the importance of this point and suggest that further research should endeavor to tease apart certainty or confidence from processing of potentially deceptive advertisements. Manipulating both deceptiveness and uncertainty in the scanner with simple, single-statement stimuli (e.g., Vendemia et al. 2005) may address the question. Obvious deception (even if incorrectly cued) may engender confident disbelief.

Another important question raised is whether the repeated perception of belief or disbelief affects threat vigilance and quick "defensive" attention. Experienced distrust can generalize to other people or situations (e.g., Main, Dahl, and Darke 2007), and this may mean that threat surveillance attends all marketplace transactions. However, a person who has a history of trust with a given person or firm may respond over time with a decrease in defensive vigilance. In this way, there may be a neurological "brain-based" benefit for firm reputation or other trust-oriented marketing variables through reduced neural activation of ToM areas.

This work offers an initial integration of ToM and the PKM and suggests that further research in this area is highly promising. Although the two offer confluent perspectives on attribution of intentions (whether person-to-person or brand-to-person), it is unclear how prior persuasion-related knowledge interacts with the ability to mentalize or assess others' intent. Does prior persuasion knowledge improve mentalization, or does mentalization facilitate accumulation of persuasion knowledge? Considering these results with those of Dietvorst et al. (2009), who show interpersonal "trait" ToM differences in salespeople, it seems highly likely that consumers' inherent cognitive differences in ToM abilities would be correlated with susceptibility to deceptive advertising. Assessing susceptibility, or "error" rates, to deception between differing ToM trait levels while incorporating reaction time measures may lead to important insights. This remains an important empirical question for further research and may help clarify a disarray of results in populations with less persuasion knowledge (e.g., children; Wright, Friestad, and Boush 2005).

Finally, while neuroimaging provides novel physiological data and appealing visual results, we echo the cautions of Huettel and Payne (2009) and Yoon, Gonzalez, and Bettman (2009) regarding fMRI data. It would be tempting to infer more precise attentional processing from the pattern of data; however, the paradigm is not optimized for this task. Instead, we emphasize the activation pattern relative to the experimental condition. The long presentation duration, coupled with the visual complexity of the stimuli, demand caution in interpretation of the precise psychological mechanism. We have used labels such as attention and belief reasoning, but it is improper to make strong claims about exact processes from one fMRI study alone without directly manipulating these processes. This danger of "reverse inference" (Poldrack 2006) will become more critical as related fields begin to use neuroscientific tools. This, the careful combination of imaging and traditional behavioral tools becomes more important. Studies such as this one or Hedgecock and Rao's (2009) illustrate the advantages of combining methodologies. Ultimately, though, it is exciting to see how interdisciplinary perspectives offer new possibilities for understanding decision processes through advances in biological research.

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