Aristotle's Anxiety: Choosing Among Methods to Study Choice

*WILLIAM HEDGCOCK and AKSHAY R. RAO**

According to a thought experiment described by Aristotle, a person "who, though exceedingly hungry and thirsty, and both equally, yet being equidistant from food and drink, is therefore bound to stay where he is" might consequently waste away for want of food and drink (Stocks 1922). The problem of choosing between two equally desirable options is analogous to the trade-off problem a decision maker faces when confronted with two equally attractive options. Choosing from such a choice set is difficult because choosing one option may involve giving up another attractive option, and the trade-off difficulty the decision maker experiences may result in conflict in his or her mind, which can generate negative affect. The introduction of a dominated alternative (the "decoy") into such a choice set may mitigate the problem by allowing the decision maker to focus on the simpler choice set comprising only the dominating option (the "target") and the decoy. Therefore, decision making when confronted by choice sets enriched with a decoy may yield less negative affect than a two-item trade-off choice set. This was our thesis in Hedgcock and Rao (2009), and the empirical evidence from fMRI scans of participants as they engaged in decisions involving trade-off versus decoy-enriched choice sets was consistent with this argument.

The two commentaries by Huettel and Payne (2009) and Yoon, Gonzales, and Bettman (2009) offer several thoughtful, provocative, and constructive observations about our work, the particular theoretical issue we examine, and the use of neuroscientific techniques to study consumer behavior. In this rejoinder, we first provide a reprise of our conceptual argument. We then identify three issues raised in the commentaries that we deemed to be particularly noteworthy because they were issues with which we struggled while conceptualizing, designing, and executing our research. Our discussion of these issues allows for an elaboration of theoretical, methodological, and philosophical issues that should inform future studies. We conclude by returning to the metaphor of Aristotle's anxiety, which is a particularly apt metaphor to employ when choosing research methodologies to study consumer choice.

REPRISE

Huber, Payne, and Puto (1982) demonstrate that the choice shares of an option (the target) in a two-item choice set can increase following the introduction of a third, irrelevant option (the decoy) that is dominated by the target. This attraction effect is a robust finding in the consumer behavior and allied literature streams, but it appears to be multiply determined. Several explanations for the effect have been offered, including a change in the weight attached to the attribute on which the target and decoy perform well (Ariely and Wallsten 1995), the ability to justify choice (Simonson 1989), negative emotion associated with difficult choices (also referred to as "trade-off aversion"; see Luce 1998; Luce, Bettman, and Payne 2001), and so forth. In Hedgcock and Rao (2009), we focused on an examination of the negative emotion explanation for the attraction effect. This explanation was relatively new (having been directly examined in only one study; see Luce 1998), was intuitively appealing, and seemed to be particularly amenable to examination using the cognitive neuroscientific approach that we wanted to employ.

In our study, our core focus was on whether the choice between two equally (un)attractive options might yield cognitive conflict, which in turn might generate negative emotion that would manifest as heightened amygdala activation, compared with a choice problem comprising the same choice set enriched with a third, dominated option. Our empirical setting comprised a complex amalgam of stimuli, and our analyses incorporated both behavioral (i.e., choice share) and cerebral activation data.

In their commentary, Huettel and Payne conclude (p. 16) that we "show not only that the amygdala response is reduced when a decoy is present but also that participants who are more influenced by the presence of the decoy show less amygdala activation. This result provides compelling evidence that the observed neural differences are indeed related to the attraction effect and not to some other aspect of the experimental stimuli or task." Our principal prediction—that choice sets comprising trade-offs are accompanied by greater negative emotion than choice sets enriched by a decoy—appears to have been supported.

AREAS OF DEBATE

In their commentaries, Huettel and Payne and Yoon, Gonzales, and Bettman raise several observations, three of which we believe are of particular significance. They are (1) the possibility of a rival explanation for our results (Yoon, Gonzales, and Bettman), (2) employing reverse inference to formulate hypotheses (Huettel and Payne), and (3) distinguishing between correlation and causation (Yoon, Gonzales, and Bettman, see also Huettel and Payne).[1]

Rival Explanation

Yoon, Gonzales, and Bettman are less sanguine about our conclusions than Huettel and Payne, observing that our

*William Hedgcock is Assistant Professor of Marketing, Henry B. Tippie College of Business, University of Iowa (e-mail: William-hedgcock@uiowa.edu). Akshay R. Rao is General Mills Chair in Marketing and Director of the Institute for Research in Marketing, Department of Marketing & Logistics Management, Carlson School of Management, University of Minnesota (e-mail: arao@umn.edu). The second author gratefully acknowledges the hospitality of the Hong Kong University of Science & Technology's Marketing Department for hosting him while he was on sabbatical, during which time this rejoinder was written.

[1]Several other issues were raised in the commentaries, but in the interest of brevity, we do not address them here. For example. Yoon, Gonzales, and Bettman request response latencies (response time for two-item choice sets was shorter than for three-item choice sets [8167 milliseconds < 10121 milliseconds, $p < .001$]). The data and accompanying discussion were removed from Hedgcock and Rao (2009) at the behest of the review team. We concur with that decision because, unlike Yoon, Gonzales, and Bettman, we are not persuaded that more difficult decisions always take more time or that quick but difficult decisions will not generate negative affect. Similarly, our decision not to impose an "objective function" that would specify a correct answer was consistent with the tradition in attraction effect research. Interested readers may contact the authors for further details.

premise that "the presence of a (specially defined) decoy in a trade-off choice set reduces experienced trade-off difficulty" (p. 17) was not directly tested, because we did not compare a three-item choice set that included a dominated decoy with a three-item choice set that included a nondominated decoy. They cite (p. 19) Drevets and Raichle (1998), who "review several studies to examine the interaction between emotion and cognition and report that more cognitively demanding tasks are associated with deactivations in the amygdala…. From [Hedgcock and Rao's] study, it seems difficult to rule out Drevets and Raichle's explanation."

Although Yoon, Gonzales, and Bettman's assertion that we did not compare three-item choice sets that incorporated or did not incorporate a decoy is correct, this omission does not invalidate our conclusion regarding the implication of amygdalar activation, for two reasons.[2] First, as Huettel and Payne note, we compared participants who examined identically structured choice sets but displayed the attraction effect to a greater or lesser degree, and we observed the predicted differences in amygdala activation. In the interest of parsimony, any alternative explanation should explain both sets of findings in our study—that amygdala activation is (1) higher under the trade-off condition and (2) higher for participants who display the attraction effect. Second, a careful reading of Drevets and Raichle (1998) indicates that their conclusions are not inconsistent with our thesis. They note (p. 370) that a reduction in regional cerebral blood flow in the amygdala when engaged in other tasks (e.g., processing a third option, as in our study) "may thus relate to an attentional mechanism in which the neural-processing resources become allocated across systems as attentional demands rise.… [D]eactivation of emotion-related areas may reflect a relative reduction in the processing resources devoted to emotional evaluation." To draw a parallel, "in the course of bereavement, grief can be temporarily interrupted by occupation with the attentionally demanding cognitive activities required to solve work-related tasks" (Drevets and Raichle 1998, p. 370). Therefore, our findings of reduced amygdala activation accompanied by reciprocal activation in other brain regions when a person is engaged in additional processing simply indicate that when the person is distracted by the need to engage in additional cognitive processing, decreased negative emotional processing occurs. However, our core claim that choices based on trade-offs are relatively aversive is not in jeopardy.

Substantively, the negative emotion–driven amygdala activation observed in the two-item choice set is suppressed in the three-item choice set, perhaps because of the employment of a different choice process (e.g., the employment of a heuristic) or perhaps because resources are drawn away from the amygdala and diverted to other brain regions because of the need to engage in additional cognitive operations. The implication of this reasoning is that though we have evidence that trade-offs generate negative emotion, it is less clear whether the reduction in negative emotion due to the introduction of a decoy is driven by the invocation of an alternative choice process, the redirection of resources, or some other process. This implication is one fruitful consequence of Yoon, Gonzales, and Bettman's critique, which suggests that the emotional and cognitive systems could share a common set of resources. That is, when higher-order cognitive tasks are engaged in, emotional activation may be suppressed. As Drevets and Raichle (1998, p. 356) observe, "[t]he deactivation of particular (brain) regions may be consistent with a 'limited capacity' model of cognitive processing, in which the excessive amounts of information available to the brain necessitate a variety of attentional mechanisms that select among competing mental processes." This speculation would indicate that the depletion of resources (through the performance of a cognitively demanding task) should diminish amygdala activation. However, it is feasible that resource depletion due to heightened emotional activation might also increase the likelihood that "decisions are made less prudently" (Drevets and Raichle 1998, p. 376). To the extent that the attraction effect is a "bias" reflecting insufficient attention to all options, attraction effect–based choices may be imprudent (i.e., subject to irregularity), and therefore the impact of resource depletion on the role of emotions in decision making is an issue worthy of empirical scrutiny. Pocheptsova and colleagues (2009) have recently suggested that the depletion of cognitive resources magnifies the attraction effect, underscoring the need to examine the process underlying the attraction effect. A comparison of the magnitude of the effect under cognitive load versus cognitive depletion might yield an understanding of the role of overlapping though distinct processes.

A second useful implication of Yoon, Gonzales, and Bettman's critique is the implicit question of the nature of the baseline or control condition. That is, they liken the three-item choice set with a decoy to an experimental condition and a three-item choice set without a decoy to a control condition. This is an important methodological and philosophical concern that is particularly relevant to neuroscience research. Unlike paper-and-pencil-based research, in which a control condition is frequently identifiable, in brain scanning, such a baseline or control condition may not be easy to establish. For example, in mood research, it is often the case that a "neutral mood" is generated by asking participants to write or read a story that is expected not to generate a positive or negative mood. Then, responses on the positive and negative affect schedule (PANAS) scale in positive- or negative-mood conditions are compared with the neutral-mood condition to assess the strength of the mood manipulation relative to the baseline. In neuroscientific research, such neutral conditions are elusive. For example, a plausible control condition is the focusing on or anticipation of a fixation point (Hedgcock and Rao 2009). However, such a task may not be neutral from a cerebral activation standpoint. It might produce anxiety. The appearance of the fixation point might startle the participants when it is first encountered, or as Drevets and Raichle (1998, p. 370) note, "while performing a control task that is not very attentionally demanding,… subjects may be actively monitoring their environment," a problem the authors associate with many PET (positron emission tomography) studies. Thus, it is important to recognize that

[2]In addition, our purpose in Hedgcock and Rao (2009) was to identify whether negative emotion might explain the attraction effect. Over the past three decades, the standard approach to studying the phenomenon has been to compare two- with three-item choice sets (e.g., Ariely and Wallsten 1995; Huber et al. 1982).

in neuroscientific work, a baseline condition may not be the equivalent of a control condition as conceived of in standard experimental design. The living brain is never completely at rest.

Reverse Inference

Huettel and Payne point out (p. 14) that "most neuroeconomic research has taken a relatively brain-centric form. Researchers have used techniques from behavioral economics and the decision sciences to improve the understanding of brain function.... [Yet] Hedgcock and Rao take the opposite approach. They use the techniques of neuroscience to improve the understanding of decision phenomena." That is, rather than taking known phenomenon, such as the fear of snakes, and identifying where in the brain such fear is manifested (an exercise in cranial cartography), we engage in the considerably more risky task of "reverse inference," which assesses whether a known brain function manifests in accordance with a prior behavioral theory. We concur with Huettel and Payne, who observe that we are on relatively safe ground when reaching our core conclusion regarding amygdala activation; our secondary conclusions regarding the use of rule-based selection processes due to activation in the DLPFC and implication of "response conflict" due to activation in the ACC are more speculative in light of current knowledge about the multitude of processes that might occur in these cranial areas.

The issue of forward versus reverse inference (i.e., brain mapping versus theory testing) is a critical one in cognitive neuroscientific research that has far-reaching implications for the study of human behavior. Rather than conceive of these two modes of inquiry as "opposites," we believe that they are complementary modes of inquiry. On the basis of our own work, we recognize that it would have been infeasible to test our prediction implicating negative emotion in the attraction effect had there not been considerable prior forward inferential research correlating activity in the amygdala with aversive stimuli. Similarly, in prior research, it would have been difficult to identify the cerebral area associated with negative emotion in the absence of some theory about what constitutes negative emotion, such as sadness (Schneider et al. 1995) or aversive olfactory stimulation (Zald and Pardo 1996).

On this topic, a caveat is in order. Although more precise theories that rely on precisely defined constructs are desirable, it does not follow that such precision will always yield the identification of small regions of the brain (through forward inferencing) that can subsequently be implicated in a test of behavioral theories. That is, "emotion" is a precise term that plays a role in several theories that vary in their degree of precision. It is also fortuitous that the cerebral area for negative emotion has been reliably identified. However, other precise constructs, such as loss aversion (Tom et al. 2007), generate activations in several brain regions, including the striatum and the ventromedial prefrontal cortex. It is possible that the simultaneous employment of both forward and reverse inference modes of inquiry will be more productive than a sequential process, according to which reverse inference can occur only after forward inference has precisely and reliably identified a brain area that is implicated in a particular process. In other words, systematic theoretically justifiable reverse inference–based investigations that implicate "rule-based processes" in the DLPFC might eventually confirm or refute the role of that part of the brain in heuristic-based decision making.

Correlation Versus Causation

Yoon, Gonzales, and Bettman observe (p. 18) that "neural activity can accompany a phenomenon without any causal connection" and caution against inferring causation from correlational data. However, Huettel and Payne note (p. 15) that "[Hedgcock and Rao (2009)] do not attempt simply to identify the 'neural correlates' of the attraction effect; those kinds of exploratory studies may (rightfully) be viewed as being of interest only to neuroscientists. Instead, they construct specific and well-formed hypotheses about brain function based on prior behavioral theories. In effect, neuroscience data become an operational proxy for the cognitive processes postulated in prior studies.... In summary, the value of the authors' approach is that they use neuroscience data to test predictions derived from behavior. This is a major strength of the article." Huettel and Payne then observe that our cautions against overinterpreting fMRI data may be overstated because increasing sophistication in design and analysis has begun to allow for less "conservatism" in the conclusions that can be drawn from imaging work. The difference in positions between the two sets of commentators is informative because it reflects philosophical differences that often typify a nascent science. While Huettel and Payne do not explicitly argue against the claim that statements about neural activity are essentially correlational, Yoon, Gonzales, and Bettman seem to recommend a more conservative rhetorical style.

Our position on this issue is squarely in the middle. Although it is technically correct that fMRI-based data are correlational, it is also philosophically defensible to attribute causation (1) if the underlying theory would support that claim and (2) until the underlying theory's causal claim is refuted.[3] In other words, whether trade-offs cause negative emotion or are accompanied by negative emotion is as much a matter of theoretical sufficiency as it is a matter of conceptual or methodological clarity. To address the issue of causation, future studies could employ other techniques, including neuroscientific methods that examine patients suffering from damage to particular cerebral areas that have been implicated in emotional activation, and behavioral studies that manipulate factors that are theoretically implicated in the generation of emotion.

QUO VADIS?

There are three broad topics that merit further discussion: (1) the development of a better understanding of the processes underlying the attraction effect, (2) the employment of cognitive neuroscientific methods in consumer research, and (3) the role of neuroscientific methods in the broader domain of research on human behavior. We discuss each in turn.

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[3]We are cognizant of the philosophical problems associated with empirical refutations of theories (i.e., the discredited philosophy of science referred to as "falsificationism"). A discussion of that topic is beyond the scope of this rejoinder. We refer the interested reader to Anderson (1986).

The Attraction Effect

We are in complete agreement with Huettel and Payne when they say (p. 16), "However, we suspect that Hedgcock and Rao share with us the view that changes in emotional response may be but one of several contributors to the attraction effect." We are also intrigued by Yoon, Gonzales, and Bettman's suggestion that the underlying process may be cognition → decision and emotion rather than cognition and emotion → decision (it is also feasible that cognition and emotion → decision and more emotion). Furthermore, consistent with Huettel and Payne, we believe that context matters. Whether compromise, justification, weight shifting, negative emotion activation, or some other process occurs to generate the attraction effect likely depends on a host of contextual factors, including whether the choice is publicly observable, the hedonic properties of the product, and the emotional and/or long-term significance of the decision. In addition, according to our data, some people are likely to display the attraction effect (and associated amygdala activation) more so than others, which suggests the need for an examination of individual differences. Finally, as we alluded to previously, resource depletion seemingly matters in the manifestation of the attraction effect (Pocheptsova et al. 2009). In light of our findings regarding the role of emotion, neuroscientific examinations of the effect of resource depletion on the magnitude of the attraction effect will be informative.

Employing Neuroscientific Techniques in Consumer Behavior Research

Much has been written about the promise and problems of employing fMRI, MEG (magnetoencephalagraphy), and other neuroscientific techniques in examining human and animal behavior (e.g., Rubinstein 2009). Some researchers view these techniques as a fad, while others are of the opinion that these techniques represent an important step forward in identifying the processes underlying human behavior (Camerer, Loewenstein, and Prelec 2005). Consistent with Huettel and Payne and Yoon, Gonzales, and Bettman, we are simultaneously excited by the promise of the existing and emerging technologies but cautious about raising expectations.

Within the consumer behavior domain, in addition to understanding the underpinnings of choice processes and the role of emotions in economic decisions, there are many derivative questions that are amenable to neuroscientific examination. In particular, as the availability of fMRI technology expands globally, knotty questions of cross-cultural differences in perception, cognition, emotion, decision making, and behavior can be addressed. In that vein, the role of language (ideographic versus phonetic scripts), family structure, religion, and other subtle dimensions of culture, as well as their role on the social psychological drivers of consumer behavior, would benefit from careful scrutiny.

Perhaps the most important prescription that emerges from our own experience and those of others who are schooled in the technique is that imaging methods and traditional approaches should not be viewed as alternative methods but rather as complementary methods. That is, paper-and-pencil approaches, observations of behavior, verbal protocols, and other traditional methods have many advantages, including their nonintrusive nature and cost, while imaging procedures have the advantage of real-time observations of process. We are in agreement with Yoon, Gonzales, and Bettman, who observe (p. 19) that "fMRI should not be used as a stand-alone methodology. Rather, researchers should seek convergent validity by linking fMRI data to other behavioral measures." In particular, because human participants are an extremely precious resource in neuroscientific studies, it is useful if a neuroscientific study is informed by a theory that has strong behavioral support. This is precisely the reason we chose to examine the attraction effect, a phenomenon that has been examined exhaustively and has yielded a rich set of contextual factors that allow for nonobvious predictions about the underlying cerebral process.

Employing Neuroscientific Techniques in General

We are particularly cognizant of and troubled by the potential misuse of fMRI and associated methods. For example, in a *New York Times* op-ed, Iacoboni and colleagues (2007) present brain scan evidence regarding presidential candidates and proceed to make claims that are inconsistent with their own prior work. In a stern rebuke, 17 prominent neuroscientists castigated Iacoboni and colleagues for, among other things, "flawed reasoning to draw unfounded conclusions" (Aron et al. 2007). In marketing research, in political science, and in other areas in which practitioners are interested in "holy grail" kinds of answers to human behavior, the potential to misrepresent neuroscientific findings is substantial. Important ethical issues must be considered in the employment of these seemingly powerful techniques.

CONCLUSION

In closing, we would be remiss if we did not acknowledge the many thoughtful and insightful observations offered by Huettel and Payne and Yoon, Gonzales, and Bettman. We are grateful to them for their gracious and generous comments. Like them, we believe that neuroscientific techniques, such as fMRI and MEG, have the potential to revolutionize the conduct of research in human behavior. Yet there are prohibitive costs to conducting such research, as well as setup costs of learning the requisite technical skills. Therefore, as in any hyperspecialty, the number of consumer researchers employing these techniques is likely to remain small, and their need to collaborate with those who employ the technique on a daily basis (e.g., medical scientists, psychologists, physicists) will remain high. In light of this observation, it seems fair to assume that these techniques will not (and should not) replace existing techniques, such as surveys and self-reports on questionnaires. Yet the notable and unique insights that emerge from neuroscientific examinations of consumer behavior phenomena suggest that such research should receive serious publication consideration in marketing journals. In other words, from the standpoint of the consumer behavior discipline, the field is presented with the trade-off between a sophisticated but costly and difficult option and a relatively crude, less expensive, yet highly reliable alternative. Unlike Aristotle's mythical person, we will doubtless eschew intellectual starvation and make the best of both techniques.

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