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When Effortful Thinking Influences Judgmental Anchoring: Differential Effects of Forewarning and Incentives on Self-generated and Externally Provided Anchors

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ABSTRACT

Two experiments examined the impact of financial incentives and forewarnings on judgmental anchoring effects, or the tendency for judgments of uncertain qualities to be biased in the direction of salient anchor values. Previous research has found no effect of either manipulation on the magnitude of anchoring effects. We argue, however, that anchoring effects are produced by multiple mechanisms—one involving an effortful process of adjustment from ''self-generated'' anchors, and another involving the biased recruitment of anchor-consistent information from ''externally provided'' anchors—and that only the former should be influenced by incentives and forewarning. Two studies confirmed these predictions, showing that responses to ''self-generated'' anchors are influenced by both incentives and forewarnings whereas responses to ''externally provided'' anchors are not. Discussion focuses on the implications of these effects for debiasing efforts. Copyright © 2005 John Wiley & Sons, Ltd.

KEY WORDS anchoring; bias; incentives; effortful thought

INTRODUCTION

The fatal tendency of mankind to leave off thinking about a thing when it is no longer doubtful is the cause of half their errors.

(J. S. Mill, 1859/1975, *On liberty*, p. 105)

Although one may argue with Mill's figure, it is hard to argue with his conclusion. Everyday life confronts us with a wide range of complicated problems, and at least some of the errors in thinking about these

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problems result from people simply thinking too little. People are overconfident in the accuracy of their judgment because they think too little about the ways in which they might be wrong (Koriat, Lichtenstein, & Fischoff, 1980). People are overly egocentric in their social judgments because they think too little about the ways in which others might perceive the world differently (Nickerson, 1999). And people are overly inclined to explain others' behavior with dispositional causes because they think too little about mitigating situational constraints (Gilbert & Malone, 1995). In each of these cases, errors in judgment are reduced when people are willing or able to pause for a moment and think a bit harder (Dunning, Griffin, Milojkovic, & Ross, 1990; Epley, Keysar, Van Boven, & Gilovich, 2004; Gilbert, 2002; Koriat et al., 1980; Lerner & Tetlock, 1999).

But as Mills noted, not all errors or biases in judgment are the product of insufficient effortful thought. Indeed, many judgments are not influenced by manipulations designed to increase effortful thinking, such as incentives for accuracy or explicit warnings to avoid making errors. This is generally taken as evidence that the prevailing process of judgment is automatic—unconscious, unintentional, effortless, and therefore uncontrollable. Whether specific errors or biases in judgment will be influenced by more effortful thought therefore depends on the exact psychological processes that produce them. Those produced by deliberate and effortful thinking are more likely to be influenced by increased effortful thought than those produced by more automatic and unconscious thought. The present research applies these insights to one of the most pervasive—and pervasively studied—biases in human judgment, namely judgmental anchoring. The goal of this research is to understand when increased effortful thought will influence the impact of anchors on intuitive judgment and when it will not.

Judgmental anchoring and effortful thinking

Across an ever-expanding number of domains, research has shown that people's judgments of uncertain quantities are biased in the direction of a salient comparison value or ''anchor.'' People give a higher estimate of the length of the Mississippi River, for instance, after they have first considered whether it is longer or shorter than 5000 miles than when they have considered whether it is longer or shorter than 200 miles (Jacowitz & Kahneman, 1995). Final agreements in many negotiations are biased in the direction of the opening offer (Chertkoff & Conley, 1967; Galinsky & Mussweiler, 2001). And grocery shoppers in one study purchased more *Snickers* bars when the accompanying advertisement recommended buying ''18 for your freezer'' than when it recommended buying ''some for your freezer'' (Wansink, Kent, & Hoch, 1998).

Anchoring effects are remarkably robust and easy to demonstrate experimentally. In the most common experimental paradigm, participants are first asked to make a comparative judgment about whether a target value is more or less than a given anchor value, and then asked to make an absolute estimate about the actual value of the target (Tversky & Kahneman, 1974). The typical result in this two-stage paradigm is that the absolute estimate is biased in the direction of the initial anchor, even if care is taken to explain that the anchor value was generated randomly and is therefore not a useful clue to the absolute estimate. In one study, for instance, people asked to estimate the height of Mount Everest provided a median estimate of 8000 feet after first considering whether Everest was taller or shorter than 2000 feet, but provided a median estimate of 42,500 after considering whether it was taller or shorter than 45,500 feet (Jacowitz & Kahneman, 1995).

These results and others like them were originally interpreted as the product of insufficient adjustment from the initial anchor—resulting from the use of what Tversky & Kahneman (1974) called the anchoring and adjustment heuristic. According to this account, people start by rejecting the anchor value as a plausible estimate and then adjust in a deliberate fashion until they reach a satisfactory answer (''I don't need 18 *Snickers* bars, but 14 would be nice, and 12 would be just right''). Because adjustment requires mental effort that people may be either unwilling or unable to expend, adjustments tend to be insufficient and final estimates are biased in the direction of the initial anchor value.

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This account predicts that the magnitude of an observed anchoring effect ought to vary with the amount of effortful thinking that individuals devote to the task—a prediction that research has failed to support. For instance, manipulations that should thwart a person's ability to engage in effortful adjustment, such as time pressure and attentional load, do not influence absolute estimates in the standard two-step anchoring paradigm (Epley & Gilovich, 2004a; Mussweiler & Strack, 1999b). Likewise, manipulations that should increase a person's willingness to engage in effortful adjustment, such as incentives for accuracy or forewarnings about the nature of the anchoring bias also do not influence responses in the standard anchoring paradigm (Chapman & Johnson, 2002; Tversky & Kahneman, 1974; Wilson, Houston, Etling, & Brekke, 1996). The one published exception was a marginally significant reduction due to incentives ($p < 0.09$) reported by Wright and Anderson (1989). Overall, the balance of evidence strongly suggests that the anchoring effects observed in the usual two-step paradigm are not the product of insufficient effortful thought (for reviews, see Chapman & Johnson, 2002; Epley, 2004).

This empirical track record clearly implies that anchoring effects cannot be diminished by encouraging people to think harder before providing their estimates. However, this conclusion assumes that all anchoring effects are alike and are produced by a single psychological mechanism. Recent research calls this assumption into question, and suggests that anchoring is produced by at least two psychological processes. One of these processes should be systematically influenced by effortful thought; the other should not.

Anchoring as accessibility and anchoring as adjustment

The standard two-stage anchoring paradigm presents participants with a novel anchor value and asks them to directly compare it to an uncertain target value: ''Did Einstein first visit the US before or after 1905?,'' ''Did Gandhi live to be more or less than 79 years old?,'' ''Is the average speed of a house cat more or less than 35 mph?'' Having thought little about Einstein's travels or Gandhi's longevity—and even less about a cat's foot speed—one is likely to answer this question by first assessing whether the target value might be *equal to* the provided anchor. Because people evaluate hypotheses by trying to confirm them (Klayman & Ha, 1987), this comparative assessment is likely to activate information consistent with the target value. When participants are then asked to estimate the true value of the target (e.g., ''What is the actual speed of an average house cat?''), the evidence recruited during the comparative assessment is disproportionately accessible and yields an absolute estimate biased in the direction of the initial anchor value (Chapman & Johnson, 1994; Chapman & Johnson, 1999; Jacowitz & Kahneman, 1995; Mussweiler & Strack, 1999a, 1999b, 2000a; Strack & Mussweiler, 1997).

Several empirical findings support this account (see Chapman & Johnson, 2002, and Epley, 2004, for reviews). For example, people spend more time attending to shared features between the target and the anchor than to unique features (Chapman & Johnson, 1999), and anything that leads people to attend to unique features diminishes the magnitude of anchoring effects (Chapman & Johnson, 1999; Mussweiler, Strack, & Pfeiffer, 2000). In addition, people who have just answered questions in the standard anchoring paradigm are faster to identify words consistent with the implications of an anchor value (such as the words ''snow'' and ''ski'' after considering whether the annual mean temperature in Germany is more or less than five degrees Celsius) than to identify words inconsistent with an anchor value (such as the words ''beach'' and ''swim,'' Mussweiler & Strack, 2000b). Finally, altering the hypothesis considered in the comparative assessment alters participants' absolute assessments. Thus, people give larger absolute estimates after being asked whether a target value is *more* than the anchor value than after being asked whether a target value is *less* than the anchor value (Mussweiler & Strack, 1999).

Note that this account explains why effortful thought does not influence anchoring effects in the standard anchoring paradigm. Semantic priming and knowledge accessibility effects—the driving forces of this model—often arise from automatic psychological processes (Higgins, 1996) that tend to be unaffected by manipulations of the amount of effortful thought. What additional thinking *might* do, however, is induce

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participants to generate evidence that they might not have considered otherwise. But in order to influence the magnitude of anchoring effects, this additional evidence would have to be systematically different in both its content and implications than the information activated more automatically. We know of no evidence that people who think harder are systematically more likely to generate hypothesis-inconsistent information, which explains why additional effortful thought should not systematically influence responses in the standard anchoring paradigm.

Not all anchors, however, arise as they do in the standard anchoring paradigm—as novel values presented just before generating novel numeric estimates. Many anchors are generated by individuals themselves to simplify an otherwise complicated assessment by calling to mind a value known to be close to the right answer but in need of adjustment. One might not know, for instance, the cost of next year's Toyota Camry, but one can readily adjust up from the cost of this year's model to accommodate inflation. Or one might not know the height of K2 (the second tallest mountain in the world), but can easily adjust down from the height of the better-known Mount Everest (the tallest mountain in the world, at 29,035 feet tall). These ''self-generated'' anchors are thus part of a heuristic process as originally described by Tversky & Kahneman (1974), functioning as a short-cut to an otherwise complicated assessment by substituting a value one knows to be close to the right answer that is in need of only slight adjustment. These ''self-generated'' anchors differ from those in the standard anchoring paradigm because they are known from the beginning to be wrong and thus do not need to be considered as possible answers to the target question. They therefore do not activate the same selective accessibility mechanisms that novel ''experimenter-provided'' anchors do, but instead initiate a process of effortful serial adjustment that modifies the initial anchor in a direction that seems appropriate until a plausible estimate is reached.

Several findings support our contention that self-generated anchors instigate different psychological processes than experimenter-provided anchors (Epley, 2004). For instance, participants in one study were asked either to nod their heads up and down or shake their heads from side to side while answering a series of anchoring questions. Previous research has shown that people use these nonverbal cues as information in determining the validity of their own thoughts, with people being more likely to believe that their thoughts are valid when they come to mind while nodding their heads (consistent with nonverbal acceptance) than while shaking them (consistent with nonverbal rejection, Brinol & Petty, 2003; Tom, Pettersen, Lau, Burton, & Cook, 1991). Consistent with our adjustment account, participants provided responses closer to a self-generated anchor when they were nodding their heads up and down than when shaking their heads from side to side (Epley & Gilovich, 2001; see also Epley et al., 2004). Analogous results have been observed with conceptually similar proprioceptive movements (Epley & Gilovich, 2004b). However, these various proprioceptive movements such as pulling up versus pushing down on a table had no influence on responses to experimenter-provided anchors in the standard anchoring paradigm, providing evidence of multiple mechanisms underlying judgmental anchoring.

In addition, because the adjustment from self-generated anchors is conscious and deliberate, participants are able to consciously report utilizing a process of adjustment when responding to self-generated anchors, but report no such adjustment process when responding to experimenter-provided anchors in the standard anchoring paradigm (Epley & Gilovich, 2001).

Finally, and most relevant to the current research, diminishing people's ability or motivation to engage in effortful thought reduces adjustment from self-generated anchors, but does not influence responses to experimenter-provided anchors (Epley & Gilovich, 2004a). In one study, participants provided responses closer to a self-generated anchor value when they were simultaneously distracted by having to memorize an eight-digit letter string than when they were not. In a second study, participants who had consumed alcohol at a campus-wide party provided estimates closer to a self-generated anchor than those who had abstained. In a third study, those low in a dispositional tendency to engage in effortful thought—that is, those low in Need for Cognition (Caccioppo & Petty, 1982)—provided estimates closer to a self-generated anchor than those high in the tendency to engage in effortful thought. Again, neither busyness, drunkenness, nor

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cognitive laziness influenced responses to experimenter-provided anchors in the standard anchoring paradigm.

The research reported here was designed to examine further the role of effortful thinking in judgmental anchoring by investigating the impact of financial incentives and explicit forewarnings of bias on responses to self-generated and experimenter-provided anchors. Consistent with past research, we predicted that increasing the motivation or tendency to engage in effortful thought would have no influence on responses to experimenter-provided anchors. However, we expected that both would increase the amount of adjustment from self-generated anchors, and thus diminish the anchoring bias. These results would not only shed light on the role of effortful thought in one of the most widely studied biases in human judgment, but they would also provide further support for the multiple mechanisms involved in judgmental anchoring.

STUDY 1

As we have noted, previous attempts to ameliorate anchoring effects through financial incentives have met with little success (Chapman & Johnson, 2002; Tversky & Kahneman, 1974; Wright & Anderson, 1989). But those attempts have targeted anchoring effects in the standard anchoring paradigm, which research indicates are robust against variations in the amount of effortful thought. Previous studies have not examined the impact of incentives in contexts in which effortful adjustment actually occurs—namely, on responses to self-generated anchors that are known to be close to the right answer but in need of slight adjustment. Because of the effortful nature of serial adjustment, and the more automatic nature of selective accessibility and semantic priming, we predicted that financial incentives for accuracy would influence responses to self-generated anchors but not to experimenter-provided anchors.

To investigate this hypothesis, approximately half of the participants were given a financial incentive to answer a series of anchoring items correctly, whereas the others were not. Participants in one condition were then asked to answer a series of four questions designed to activate ''self-generated'' anchors known to be close to the right answer, but off the mark. All four questions have been shown in previous research to activate a process of adjustment (Epley & Gilovich, 2001, 2004a, 2004b). Participants in the other condition were asked four anchoring questions of the type used in the standard anchoring paradigm.[1]

Method

Participants ($N = 107$) were confronted by an experimenter on the Harvard University campus and asked if they would be interested in participating in a psychology experiment in exchange for some candy. Interested participants were then randomly assigned to receive a questionnaire containing either four self-generated anchoring questions ($n = 56$), or four experimenter-provided anchoring questions ($n = 51$). The four self-generated anchoring questions were, ''In what year was George Washington elected President of the United States?,'' ''In what year did the second European explorer land in the West Indies?,'' ''What is the freezing point of vodka?,'' and ''What is the boiling point of water on the top of Mount Everest?'' These questions were intended to activate anchor values of 1776, 1492, 32°F, and 212°F, respectively. The four experimenter-provided anchoring items followed the standard two-stage anchoring paradigm. The four questions, taken from Jacowitz and Kahneman (1995) (and with the anchor introduced in the comparative assessment in

[1]Readers might wonder why we could not use the same questions in the self-generated and experimenter-provided anchoring conditions. The reason is that our theory predicts that adjustment processes will be activated when participants naturally generate an anchor value known to be close to the right answer but wrong, and not when novel anchor values are provided by an external source. A test of this prediction therefore requires the use of different anchoring questions—some that naturally activate anchors known to be close to the right answer but wrong, and some in the standard anchoring paradigm that do not.

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parentheses), were: ''What is the population of Chicago? (anchor = 200,000),'' What is the height of the tallest redwood tree? (anchor = 65 feet),'' What is the length of the Mississippi River? (anchor = 2000 miles),'' and ''What is the height of Mount Everest? (anchor = 45,500).'' The first two of these questions were preceded by low anchor values, and the last two by high anchor values.

Before answering, all participants were told that they would be asked a series of difficult questions and that they were to provide estimates to the best of their ability. Participants in the incentive condition were then informed that the two most accurate participants would receive a $40 gift certificate to one of three popular Cambridge (MA) restaurants. These participants indicated the restaurant at which they would like to dine if they were the winner, wrote down contact information for receiving the prize, and provided their signature to indicate their consent to participate and their understanding of the accuracy incentive.

After answering all anchoring questions, participants who answered the self-generated anchoring items completed a follow-up questionnaire that assessed whether they knew the intended self-generated anchor values (e.g., the year the United States declared its independence) and whether they thought of that value when generating their estimate. Note that participants in this and the following experiment were *not* asked to report on the process that led to their judgments. Rather, they were merely asked whether they knew a particular anchor value, and whether it occurred to them while answering the question—mental *contents* that can be reported more accurately than mental *processes* (Nisbett & Wilson, 1977).

Overview of analyses

To provide a valid assessment of the amount of adjustment from self-generated anchor values in this and the following study, participants had to: (a) know the intended anchor value for a given item; and (b) report having thought of it when making their estimate. Participants who did not meet both criteria were excluded on an item-by-item basis, but all participants provided at least one valid response to the self-generated anchoring items. The number of participants who provided valid responses to the self-generated anchoring items are listed in Tables 1 and 2 (from Studies 1 and 2, respectively).

Some participants confused Fahrenheit with Celsius, reporting 100 degrees as the boiling point of water or 0 for its freezing point. The responses of these participants were therefore converted to degrees Fahrenheit.

Results and discussion

We predicted that financial incentives would influence responses to self-generated anchoring items—increasing adjustment with incentives provided—but would have no effect on experimenter-provided anchors in the standard anchoring paradigm. To test this hypothesis, we first standardized participants' responses to each of the anchoring items by converting them to z-scores. Because some of the self-generated anchoring items required upward adjustment to a larger value (such as the date when Washington was elected President of the United States) whereas others required downward adjustment to a smaller value (such as the freezing point of vodka), we then reverse-scored the self-generated anchoring items that involved downward adjustment (i.e., the freezing point of vodka and boiling point of water on Everest). After this transformation, then, negative z-scores always reflect responses closer to the self-generated anchor. Similarly, we reverse-scored the experimenter-provided anchors that used high anchor values (i.e., the length of the Mississippi River and the height of Mount Everest), such that negative z-scores reflect more anchor-consistent responses. For both types of anchoring questions, negative z-scores therefore indicate responses closer to the anchor value, or stronger anchoring effects. Finally, we averaged these standardized responses into a single composite measure for each participant.

Analysis of these composite scores confirmed our predictions. As can be seen in Figure 1, those provided with an incentive for accuracy gave estimates further from a self-generated anchor value (i.e., they adjusted more, $M = 0.29$) than participants not provided an incentive ($M = -0.23$), $t(54) = 2.71$, $p < 0.01$. Responses

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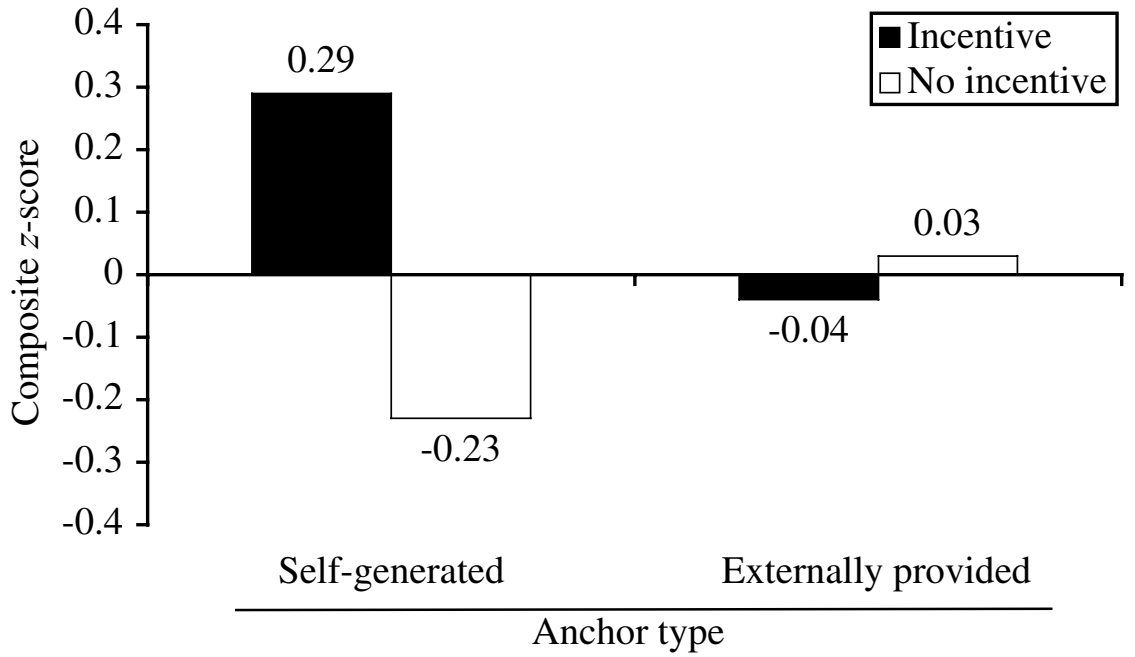

Figure 1. Average responses (in *z*-scores) to self-generated and experimenter-provided anchoring questions among those participants provided with a financial incentive for accuracy and those not provided an incentive (Study 1). *Note*. Positive *z*-scores indicate responses less consistent with the anchor value.

to experimenter-provided anchors, in contrast, did not differ between those provided with an incentive for accuracy ($M = -0.04$) and those not provided an incentive ($M = 0.03$), $t < 1$, *ns*. A 2 (incentive vs. no incentive) $\times$ 2 (self-generated vs. experimenter-provided anchoring questions) ANOVA yielded only the predicted interaction, $F(1, 103) = 5.67$, $p < 0.05$. Mean responses to the self-generated anchoring questions are listed in Table 1.

These results support our contention that different kinds of anchor values activate different psychological processes. Questions that evoke self-generated anchors known to be close to the right answer but off the mark instigate effortful adjustment from the anchor value until a satisfactory response is reached. Increasing the amount of effortful thought devoted to such questions should therefore increase the amount of adjustment from these self-generated anchor values, just as we found. Anchor values presented by an experimenter or

Table 1. Mean responses to self-generated anchoring questions among those provided with a financial incentive for accuracy and those not provided an incentive (Study 1)

		Incentive for Accuracy?		
Question	*n*	No	Yes	Actual answer
Washington elected President	42	1777.19	1786.35	1788
Second explorer after Columbus	42	1497.30	1500.84	1501
Boiling point on Mount Everest	45	154.00	156.52	167°F
Freezing point of vodka	51	9.24	−2.19	−20°F

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some other external source, in contrast, activate mechanisms of selective accessibility that are unaffected by increased effortful thinking. Indeed, responses to these items were not influenced by financial incentives. This latter finding is consistent with previous research, and with the contention that the anchoring effects observed in the standard anchoring paradigm are not the product of insufficient adjustment, but of the increased accessibility of anchor-consistent information (Mussweiler & Strack, 1999b, 2000a, 2000b; Strack & Mussweiler, 1997). The accessibility effects evoked by the standard anchoring paradigm are largely automatic processes that are not influenced by incentives or motivation, whereas the adjustment processes evoked by self-generated anchoring questions are effortful processes that are subject to the influence of incentives. Past efforts to ameliorate anchoring effects through financial incentives have therefore been unsuccessful because they have examined their impact on the wrong type of judgmental anchor.

Although we believe this is the most plausible interpretation of the differences that we observed between self-generated and experimenter-provided anchors, there is one alternative that deserves attention. Perhaps the experimenter-provided anchoring items were more difficult than the self-generated anchoring items, and so the incentives may not have influenced responses to experimenter-provided anchoring items because participants lacked the necessary knowledge or competence for their judgments to be influenced by increased effortful thinking. To test this possibility, we recruited a separate sample of 80 Harvard undergraduates who answered either the four self-generated or four externally provided anchoring items used in Study 1. After doing so, these participants rated the difficulty of each item on an 11-point scale ranging from 0 (not at all difficult) to 11 (extremely difficult). When finished with all four items, they also indicated the difficulty of their set of items overall. At odds with this alternative interpretation, there was no significant difference between the average difficulty of the individual self-generated ($M = 6.45$) and externally provided ($M = 6.30$) anchoring items, $t(78) = 0.39$, $p = 0.70$, nor in the perceived overall difficulty of the self-generated ($M = 6.95$) and externally-provided ($M = 6.86$) anchoring items, $t(78) = 0.17$, $p = 0.86$. Differences in the difficulty of self-generated and experimenter-provided anchoring items therefore cannot account for the effects observed in Study 1.

STUDY 2

Incentives for accuracy increase the amount of effortful thought devoted to a judgment task, but they do not systematically focus that effortful thought on any particular aspect of the judgment. Study 2 sought to use a somewhat different test of the role of effortful thought on judgmental anchoring by using an experimental manipulation that focuses participants' effortful thought directly on the judgment itself—namely, by forewarning participants of an anchoring bias in judgment. If self-generated anchor values influence judgment, as we have suggested, through an effortful and deliberate process of adjustment, then warning participants about the potential for error in that adjustment process should lead people to adjust further. In contrast, if experimenter-provided anchor values influence judgment through the relatively automatic recruitment of anchor-consistent information, then no amount of forewarning will influence responses to experimenter-provided anchor values, as the process that produces the bias is unavailable to conscious inspection and deliberate intervention. Study 2 tested both of these hypotheses.

Method

Participants ($N = 48$) were confronted by an experimenter in a large Boston-area train station and asked if they would be interested in participating in a psychology experiment in exchange for some candy. All interested participants were then asked to complete a questionnaire containing six self-generated and six experimenter-provided anchoring questions. Four of the self-generated anchoring questions were the same as those used in Study 1, and two were new items that had been used in previous research (Epley & Gilovich, 2001,

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2004b)—''How long does it take Mars to orbit the sun?,'' and ''How many states made up or comprised the United States in 1880?'' These two items were intended to activate anchor values of 365 and 50, respectively. The six experimenter-provided anchors were those that yielded the largest anchoring effects in Jacowitz & Kahneman (1995), and included the four used in Study 1 plus ''In what year was the telephone invented? (anchor = 1920),'' and ''What is the average number of babies born per day in the United States? (anchor = 100).'' The first of these involved a high anchor value and the last a low anchor value.

The experimenter then told participants in the *forewarned* condition ($n = 24$) that ''previous research has demonstrated that people's judgments are often biased by the first pieces of information that come to mind.'' The experimenter described an example of a real estate agent whose housing assessment was biased in the direction of the last house visited, and explained that this bias occurs because people start with the first information that comes to mind and then insufficiently adjust from that value. Participants were told that the following questions would either provide them with information or ask them to generate it themselves, and that they should try not to adjust insufficiently. The experimenter told participants in the control condition ($n = 24$), in contrast, only that they would be asked a series of questions that they should answer to the best of their ability.

After answering all twelve anchoring questions, participants answered the same follow-up questions used in Study 1 to determine whether they knew each intended anchor value for the self-generated anchoring questions and whether they thought of that value when generating their estimate.

Results and discussion

The order in which participants answered the self-generated and experimenter-provided anchoring items was counterbalanced, but did not influence any of the following results and is not discussed further.

Responses were transformed and excluded as in Study 1. All participants provided a valid response to at least three of the six self-generated anchoring items.

Consistent with previous findings (Epley & Gilovich, 2001), not all participants adjusted in the same direction from the intended anchor value on one of the self-generated anchoring questions—the time required for Mars to orbit the sun. That is, some participants mistakenly believed that Mars orbits the sun in fewer than 365 days. Because we are interested in the amount of adjustment from these anchor values, the absolute difference between the stated anchor and final answer was used on this item. A higher number on this ''adjustment score'' indicates a larger discrepancy between the anchor value and final answer, or greater adjustment.

As can be seen in Figure 2, participants forewarned about insufficient adjustment provided estimates that were further away from the self-generated anchor values than participants who were not forewarned, $t(46) = 4.28$, $p < 0.001$. Responses to experimenter-provided anchoring items, however, did not differ between the forewarned and control conditions, $t < 1$. A 2 (condition: forewarning vs. control) × 2 (anchor: self-generated vs. experimenter-provided) ANOVA with repeated measures on the second factor yielded only the predicted interaction, $F(1, 46) = 9.181$, $p < 0.05$. Responses to the self-generated anchoring items are presented in Table 2.

These results validate the effectiveness of one strategy, forewarning, for diminishing anchoring effects—or at least one type of anchoring effect. Forewarnings are only effective, it is now clear, if one is aware of and can control the underlying process one is urged to avoid. Serial adjustment is effortful, deliberate, and therefore consciously available (Epley & Gilovich, 2001), whereas the semantic priming mechanisms that produce anchoring effects in the standard anchoring paradigm are effortless, unconscious, and unintentional. The difference between the two underlying processes helps to explain why forewarning has an effect on the deliberate process of serial adjustment from self-generated anchors, but not on the automatic assimilation of judgments to an experimenter-provided anchor. Knowledge may be power, but only if one knows when and how to use it.

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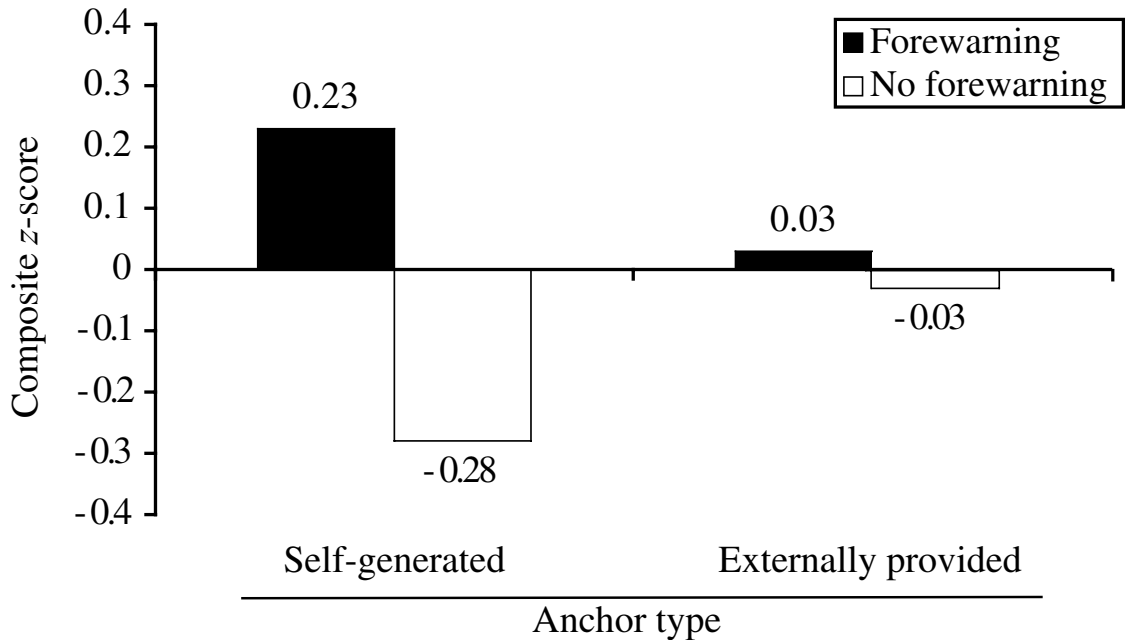

Figure 2. Average responses (in *z*-scores) to self-generated and experimenter-provided anchoring questions among those participants forewarned about the anchoring bias and those not forewarned (Study 2).
Note. Positive *z*-scores indicate responses less consistent with the anchor value.

Table 2. Mean responses to self-generated anchoring questions among those forewarned about insufficient adjustment and those not forewarned (Study 2)

		Forewarning?		
Question	*n*	No	Yes	Actual answer
Washington elected President	37	1781.29	1784.50	1788
Second explorer after Columbus	39	1498.47	1504.82	1501
Boiling point on Mount Everest	36	182.04	161.37	167°F
Number of states in US in 1880	37	39.86	35.11	38
Freezing point of vodka	43	10.09	1.72	−20°F
Orbit of Mars around sun	44	230.35	340.71	(See note*)

Note. *Participants adjusted in both directions from the 365-day anchor value when estimating the duration of Mars' orbit (i.e., some thought it was longer than 365 and some shorter). The means presented in this table for this question are therefore absolute differences between the anchor value and participants' final estimates.

GENERAL DISCUSSION

Observers of the human condition from at least the time of David Hume have noted that everyday judgment can be distilled into two basic processes. One is quick, intuitive, efficient, and automatic whereas the other is relatively slow, analytical, effortful, and deliberate. Although these twin processes of judgment have been given many names—automatic vs. controlled, heuristic vs. systematic, passion vs. reason, System 1 vs. System 2, associative versus analytical, among others—the resulting terminological diversity should not obscure the simple fact that mental operations largely come in one of two flavors. To determine the flavor

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of any particular judgment, psychologists typically observe how the judgment responds to manipulations designed to influence the ability or inclination to engage in effortful or deliberate thought. Those that are systematically influenced by such thought appear to be of the effortful and deliberate variety, whereas those that are not are more effortless and intuitive.

The two experiments reported in this paper indicate that both of these processes are involved in judgmental anchoring, albeit in responses to different kinds of anchors. Some anchors are generated by participants themselves, and serve as starting points that are effortfully and deliberately adjusted until a satisfactory value is reached. These ''self-generated'' anchors simplify judgment by substituting a value known to be close to the right answer but incorrect—a value that is then adjusted until it seems right—in place of a more elaborate assessment that might involve a trip to the library or a Google search. For instance, one might estimate the closing value of tomorrow's Dow Jones average by adjusting up from today's closing value, or estimate the number of lives lost in a looming military campaign by adjusting from the casualties sustained in a similar past campaign. In this sense, the generation and use of these ''self-generated'' anchors function as a judgmental heuristic in the manner originally described by Tversky and Kahneman (1974). This heuristic involves both the automatic recruitment of a relevant anchor followed by an effortful process of serial adjustment. Consistent with this account, responses to self-generated anchors were influenced by two different manipulations designed to increase effortful adjustment—incentives and explicit forewarning of bias. In both cases, participants adjusted more when they engaged in more effortful thought.

Other anchor values, however, are presented by situational circumstances as novel values that need to be considered as potential answers to the target question. A friend might ask whether her house is worth more or less than the $300,000 for which an adjacent house sold, or an employer might wonder whether you would be willing to work for $50,000 per year. Of course, both the friend and employer are looking for an absolute estimate of value. To generate such an estimate, such ''externally provided'' anchor values must—even if only for a moment— be entertained as possible answers to the sought-after value itself. This leads individuals to activate information that is biased in the direction of the anchor value, thereby skewing the absolute estimate. Such knowledge activation processes tend to be largely automatic and efficient, and are therefore unlikely to be affected by additional effortful or deliberate thought. More effortful thought, then, is unlikely to influence the absolute estimates provided in the aftermath of entertaining an externally provided anchor value. Indeed, neither financial incentives nor forewarnings influenced responses to experimenter-provided anchors in the paradigm most commonly used to demonstrate anchoring effects in human judgment.

Although anchoring effects have been largely seen as a single psychological phenomenon, the present results add to a growing literature suggesting that judgmental anchoring is actually a family of phenomena (Epley, 2004). ''Self-generated'' anchors like those we have studied here are influenced by proprioceptive movements designed to influence the likelihood of accepting a value early in the adjustment process, and are influenced by manipulations that limit the ability or motivation to engage in effortful thought (Epley & Gilovich, 2001, 2004b; Epley et al., 2004). Externally-provided anchors in the standard experimental paradigm are not. This resolves some of the empirical puzzles of past research. The reason that researchers have found little support for an adjustment-based account of judgmental anchoring is because they have been searching for such evidence in the wrong place—in the standard anchoring paradigm where effortful adjustment does not occur.

This dual nature of anchoring processes also has important implications for attempts to debias everyday thought. Responses to both self-generated and experimenter-provided anchors are biased in the direction of the original anchor value (Chapman & Johnson, 2002; Epley & Gilovich, 2004b), but for different reasons. Efforts to remedy these biases must therefore take different forms. Deliberate mental processes, such as effortful adjustment, can be altered by increased attention and intensified thought. Anchoring effects that result from insufficient adjustment should therefore be reduced by leading people to think harder using any number of variations on the methods that we have presented here.

More automatic and intuitive mental processes, in contrast, influence judgment by contamination (Wilson, Brekke, & Centerbar, 2002). Simply being exposed to the circumstances that set an automatic process in

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motion is sufficient to influence judgment, and attempts to undo contamination from externally provided anchors should therefore adopt one of two approaches. One is to avoid the contaminating stimulus altogether. Externally provided anchors influence judgment by leading people to compare the anchor value to the target estimate, setting in motion the selective recruitment of anchor-consistent information. Anchoring effects are dramatically reduced, if not eliminated, when participants are simply exposed to an anchor value without being explicitly led to compare it to the target entity (Brewer & Chapman, 2002).

But exposure to externally provided anchors is difficult to control, and a more practical method for reducing bias might be a second approach that provides an antidote once exposure occurs. With externally provided anchors, the antidote is akin to the ''consider-the-opposite'' strategy commonly employed in debiasing research—in this case, considering the ways in which the anchor value might be *wrong* (Chapman & Johnson, 1999). For instance, in one clever study (Mussweiler, Strack, & Pfeiffer, 2000), auto mechanics and auto dealers were asked whether a high or low selling price seemed appropriate for the experimenter's used car, or whether the price seemed inappropriate (i.e., the price was too low in the low-anchor condition, or too high in the high-anchor condition). Results showed that estimates of the car's true value were less influenced by the suggested selling price in the latter condition than in the former. A healthy skepticism about the validity of externally provided anchor values encountered in everyday life might, therefore, be the most practical way to avoid their unwanted influence.

Some caution, however, may be in order. Warding off the influence of arbitrary, externally-provided anchor values is one thing; reigning in any excessive influence of self-generated anchors is another. To eliminate the contaminating effects of arbitrary anchors, it may be wise to employ debiasing strategies designed to turn off or completely counteract the psychological processes that give rise to them. After all, if the anchor values are completely arbitrary, their influence is by definition untoward and excessive. But self-generated anchor values are anything but arbitrary and so eliminating their influence on judgment is likely to be counterproductive. With respect to self-generated anchors, the relevant debiasing efforts are perhaps best geared toward fine-tuning the governing psychological processes, not counteracting them completely. At the present time, unfortunately, sufficient research on anchoring effects in ecologically-valid contexts is lacking. And so using blunt, unguided efforts to undo the influence of anchor values in everyday life may end up doing as much harm as good. Before taking an antidote, after all, one needs to know the toxicity of the poison.

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