Claiming a Large Slice of a Small Pie: Asymmetric Disconfirmation in Negotiation

Richard P. Larrick
Duke University

George Wu
University of Chicago

Three studies show that negotiators consistently underestimate the size of the bargaining zone in distributive negotiations (the small-pie bias) and, by implication, overestimate the share of the surplus they claim (the large-slice bias). The authors explain the results by asymmetric disconfirmation: Negotiators with initial estimates of their counterpart’s reservation price that are “inside” the bargaining zone tend to behave consistently with these estimates, which become self-fulfilling, whereas negotiators with initial “outside” estimates revise their perceptions in the face of strong disconfirming evidence. Asymmetric disconfirmation can produce a population-level bias, even when initial perceptions are accurate on average. The authors suggest that asymmetric disconfirmation has implications for confirmation bias and self-fulfilling-prophecy research in social perception.

Keywords: confirmation bias, learning from feedback, negotiation, self-fulfilling prophecy, triangle hypothesis

Consider a common negotiation scenario. Jill posts an ad for a used car. It is listed for $2,800, but she is willing to accept $2,300. After several rounds of posturing, arguing, and conceding, she and the buyer arrive at a price of $2,450. Jill is quite satisfied that she has cleared her $2,300 limit by $150. When a friend asks how much higher she could have pushed the buyer, Jill states confidently, “Given the fuss he was making, I don’t think he would have gone above $2,500.” In Jill’s mind, she has done very well for herself. According to her estimate, there was only a $200 range in which she and her counterpart could have reached agreement, and that she claimed 75% of this pie. But consider the following question: What is the buyer’s estimate of Jill’s limit? How much of the “pie” does he think he obtained?

In this article, we argue that most negotiators leave a distributive negotiation believing that they have pushed their opponents close to their limits. Such a belief has two consequences: Negotiators tend to underestimate the size of the pie or bargaining zone (the small-pie bias) and, by implication, believe that they have received a larger share of the surplus than they actually have (the large-slice bias). We consider two principal causes of the small-pie and large-slice biases: Flawed hypothesis testing and motivated reasoning. First, we suggest that there is an asymmetry in the disconfirmation of incorrect beliefs. Some classes of erroneous judgments are disconfirmed reliably, whereas others are self-fulfilling.

Specifically, negotiators with initial beliefs of their opponent’s true limit that are “inside” the bargaining zone are unlikely to have these incorrect beliefs disconfirmed, whereas those with initial “outside” estimates learn that their estimates are too extreme. Second, negotiators may be motivated to believe that they are effective negotiators and that they performed well in a given negotiation. Although the motivation to self-enhance almost certainly contributes to the small-pie bias in real-world negotiation, we argue that flawed hypothesis testing is a sufficient cause of the bias, and we therefore make it the focus of this article.

These results have implications for both the negotiation and social-perception literatures. For negotiation researchers, we suggest that these biases are systematic and robust and therefore have important practical consequences for everyday negotiations. These biases extend a large body of work on cognitive biases in negotiation, pioneered by Neale and Bazerman (1991), that has included demonstrations of anchoring (Galinsky & Mussweiler, 2001; Whyte & Sebenius, 1997), correspondence bias (Morris, Larrick, & Su, 1999), fixed-pie bias (Thompson & DeHarport, 1994; Thompson & Hastie, 1990), and stereotyping (Kray, Thompson, & Galinsky, 2001) in negotiation. For social-perception researchers, we propose that asymmetric disconfirmation is a general phenomenon that occurs in social interactions other than negotiation. These results highlight the role the feedback environment plays in producing accurate—and inaccurate—social inferences.

The degree to which social perceptions are inaccurate has been debated in the social-psychology literature. A major theme has been that erroneous social perceptions tend to be self-fulfilling (Jones, 1986; Merton, 1948; Miller & Turnbull, 1986; Rosenthal & Jacobson, 1968; Snyder & Swann, 1978). Decades of research have demonstrated that initially inaccurate expectations can be maintained through a variety of processes, including perceptual and behavioral confirmation (Jones, 1986), positive test strategies (Klayman & Ha, 1987), and biased sampling of evidence (Zuckerman, Knee, Hodgins, & Miyake, 1995). However, the ubiquity of
this pattern of error in perception has been questioned (Jussim, 1991; Miller & Turnbull, 1986). In a provocative challenge to this tradition, Jussim (1991) argued that the “strong constructivist perspective” in social psychology has neglected accuracy in social perception and emphasized error and bias. He analyzed the conditions under which confirmation of initial beliefs should be regarded as accurate or erroneous and concluded that the evidence for self-fulfilling prophecies in naturalistic settings is thin. Jussim’s critique suggests that there may not be a general tendency toward error, and thus, it is important to understand the conditions that foster or impede accuracy. We propose that the concept of asymmetric disconfirmation contributes to this debate by introducing an important moderator of accuracy (Jussim, 1991; Miller & Turnbull, 1986).

In the next section, we describe how asymmetric disconfirmation in negotiation produces the small-pie and large-slice biases. In the following section, we describe how our research contributes to the larger debate about accuracy in social perception and the constructive role that moderators play in this debate. Following the presentation of three studies demonstrating the small-pie and large-slice biases, we present a formal model of asymmetric disconfirmation in the General Discussion. In the remainder of the General Discussion, we suggest other social phenomena that exhibit asymmetric disconfirmation and consider other implications of the small-pie and large-slice biases.

The Small-Pie Bias as Asymmetric Disconfirmation

In a distributive negotiation, the bargaining zone is defined by the highest price the buyer will pay and the lowest price the seller will accept (Fouraker & Siegel, 1963). These amounts are frequently termed reservation prices, bottom lines, or limits. Any settlement within the bargaining zone leaves both parties better off than walking away without a deal. The surplus is the difference between the buyer’s reservation price and the seller’s reservation price and is often colloquially called the pie. At the individual level, there is a small-pie bias if the seller underestimates the buyer’s true reservation price or the buyer overestimates the seller’s true reservation price. We refer to such estimates as being inside the bargaining zone. In contrast, we refer to estimates as outside the bargaining zone when sellers overestimate the buyer’s reservation price or buyers underestimate the seller’s reservation price. An inside estimate and an outside estimate are illustrated in the two panels of Figure 1.

Why might people leave a negotiation with the perception of a small pie? The quality of a postnegotiation estimate of an opponent’s reservation price depends on (a) the accuracy of a negotiator’s prenegotiation estimate, (b) the diagnosticity of information received during the negotiation, and (c) the process that a negotiator uses to revise the initial estimate on the basis of new information. Although we discuss the first step for completeness, our studies focus on the role of the remaining two steps in producing the small-pie bias. In particular, our studies suggest that biased initial beliefs are sufficient but not necessary for generating a small-pie bias.

Initial Beliefs

Savvy negotiators walk into a negotiation with some sense of their counterpart’s reservation price (Raiffa, 1982). What determines whether these initial estimates are inside or outside the true reservation price? Estimates may be based on sound research but may also be influenced by less relevant information (Neale & Bazerman, 1991; Whyte & Sebenius, 1997). For example, negotiators often use their own reservation price to estimate their opponent’s limit (Bottom & Paese, 1999; Diekmann, Tenbrunsel, & Galinsky, 2003). Thus, one’s own reservation price may serve as an anchor (Tversky & Kahneman, 1974), in which case estimates are more likely to be inside the zone in large bargaining zones (where adjustments from the anchor are likely to be insufficient) than in small bargaining zones.
Although anchoring may produce initial inside estimates in some situations, we are agnostic about whether negotiators tend to enter negotiations with inside or outside estimates of their opponents’ bottom lines. In fact, our studies manipulate the accuracy of initial judgments and the degree to which these judgments are inside or outside the bargaining zone. We do propose, however, that there is an asymmetry in how inside and outside estimates are revised during a negotiation: Inside estimates will tend to persist, whereas outside estimates will tend to be driven toward and perhaps inside the truth (see Figure 1). We illustrate this asymmetry in the next two sections.

Revising Initial Estimates That Are Outside the Zone

We hypothesize that inaccurate estimates outside the bargaining zone will tend to be disconfirmed, such that they end up close to or perhaps even inside the bargaining zone (Bottom & Paese, 1999). Ambitious estimates are likely to lead to ambitious opening offers (Galinsky & Mussweiler, 2001; Galinsky, Mussweiler, & Medvec, 2002) that are outside the opponent’s reservation price. These offers will be rejected, as they must be. This will tend to produce a more protracted negotiation process (Bottom & Paese, 1999), require more concession making, and create the impression that agreement was difficult to reach (Morris et al., 1999). Thus, the number of rejected offers and the process of haggling will tend to disconfirm the ambitious misestimate.

Consider the left panel of Figure 1. The buyer is willing to pay as much as $2,700, whereas the seller requires a minimum of $2,300. A seller who overestimates the buyer’s reservation price at $2,900 might start ambitiously, demanding $3,100. This ambitious offer is firmly rejected.\(^1\) The buyer responds with a counter-offer of $2,900, which is too high. On the basis of this evidence, her initial outside estimate at $2,900 is revised toward the true reservation price, and she walks out of the negotiation believing that the buyer’s reservation price is $2,750.

This process of disconfirmation is reinforced by the skewed nature of the evidence acquired during a negotiation. In a distributive negotiation, skilled negotiators tend to follow a culturally shared script that will, in general, enhance their performance (Cohen, 1989). They know that they should not reveal their bottom line to their counterpart and that ambitious offers and small concessions can enhance their final share of the surplus (Thompson, 2001). Finally, skilled bargainers know that they need to give the impression of a limit that is more favorable than their true limit. Thus, in a negotiation with a skilled bargainer, the perceiver observes a series of cues all systematically biased to suggest that the opponent has a reservation price that is more favorable than it actually is. This biased sample serves to disconfirm ambitious estimates. Indeed, to the extent that bargainers trust such biased information, initial estimates that are outside the zone might be overly disconfirmed, such that estimates end up being inside the zone.

It is important to note that it is relatively costless for negotiators to give the impression of a reservation price more favorable than it actually is. Economists have described this kind of behavior as “cheap talk” and have argued that information of this sort has little or no diagnostic value (Farrell & Rabin, 1996). Thus, why would a negotiator not maintain his or her initial estimate in the face of such cheap talk? We suggest that negotiators fail to discount sufficiently for the strategic actions of the other party because of a primacy or anchoring process. Even though negotiators might understand that bluffing is “part of the game,” this misleading information can still influence their perceptions (Cain, Loewenstein, & Moore, 2005). Gilbert, Krull, and Malone (1990) have shown that it is difficult to discount false information, even when one is forewarned. The mind seems to start with the assumption that evidence is true before adjusting insufficiently for its unreliability. This tendency to be influenced by posturing in negotiation could be considered the competitive equivalent to the reactions that people have to acquiescence in cooperative interaction (see Zuckerman et al., 1995). In both cases, the samples of responses are biased but are not appropriately recognized as so by perceivers. Below, we discuss how motivated reasoning may also contribute to the acceptance of cheap talk.

Revising Initial Estimates That Are Inside the Zone

In the previous section, we outlined the process by which initial estimates outside the zone are likely to be revised. Now consider a seller who begins a negotiation believing that the buyer’s reservation price is lower than it actually is, at $2,500, in the right panel of Figure 1. An inside estimate such as this is maintained in part through behavioral-confirmation processes (Jones, 1986). Most skilled negotiators open with offers better than what they think they can actually obtain to give themselves room to bargain. However, an offer that is more extreme than an initial inside estimate (perhaps $2,700 in this case) might still be near or inside the opponent’s reservation price, thus providing little opportunity for disconfirmation. As negotiators make concessions from their offer, they are likely to find that reaching agreement is easy (Bottom & Paese, 1999) and that they end up at a final price near their initial inside estimate. Inside estimates, therefore, can set off a cycle of behavior that maintains the erroneous estimate. An exception to this self-fulfilling cycle occurs when the opponent also has an inside estimate and also makes an unambitious first offer. This can disconfirm the negotiator’s inside estimate. However, even in the rare instances when negotiators learn that their inside estimate is wrong, they will virtually never receive information that would lead them to infer the true reservation price.

In sum, we hypothesize that two different fates await initial beliefs that are inside or outside the zone (see Figure 2). Outside beliefs tend to be disconfirmed, as bargainers encounter rejections of their offers. Initial estimates that are outside the bargaining zone may even be driven inside the bargaining zone if cheap talk is taken as diagnostic. In contrast, inside estimates encounter a “supportive” environment. They tend to be self-fulfilling, maintained in part through behavioral confirmation. Inside estimates lead to unambiguous offers that thus provide little opportunity for discon-\(^1\) For simplicity, we refer to first offers by both buyers and sellers as offers, even though first offers made by sellers are often referred to as demands (because the seller is demanding that the buyer pay that amount), whereas first offers made by buyers are just referred to as offers (because the buyer is offering the seller that amount).
confirmation. Inside estimates will also be “confirmed” by the biased sample of evidence they encounter in the form of the opponent’s cheap talk.

Motivated Reasoning

Why might negotiators take bluffs about limits, extreme offers, and other cheap talk to be diagnostic of a small bargaining zone when an alternative attribution is that they are bargaining in a large zone with a cagey bargainer? We suggest that there may be motivational reasons in addition to the cognitive reasons described above. First, bargainers are motivated to see themselves as cleverer than their opponent (Galinsky & Mussweiler, 2001; Kramer, Newton, & Pommerenke, 1993). Second, it is simply more pleasant to believe that one has conceded little value, rather than much value, to the opponent. A large literature exists showing that people tend to hold favorable views of themselves, their abilities, and their outcomes in life (Taylor & Brown, 1988). In part, these favorable impressions are driven by motivated reasoning, or the tendency to recruit information consistent with desired outcomes (Kunda, 1990).

We believe that motivated reasoning certainly contributes to the small-pie and large-slice biases in many everyday settings. In that sense, the small-pie and large-slice biases are overdetermined. However, we believe that asymmetric disconfirmation is sufficient for producing these patterns. To address this concern, we designed our studies to minimize self-enhancement by giving participants immediate feedback (Studies 1–3) and incentives for accuracy (Study 3). In each of these ways, we tried to reduce the role of motivated reasoning in the small-pie and large-slice biases and emphasize the role of asymmetric disconfirmation.

Asymmetric Disconfirmation as a General Moderator of Accuracy

We have proposed a pattern of systematic biases that arise in negotiation because erroneous beliefs are asymmetrically disconfirmed—some errors are corrected by feedback, but others are self-fulfilling. We believe that this pattern of asymmetric disconfirmation in negotiation has two important implications for the debate about accuracy in social perception. First, negotiation is an ideal setting for studying issues of accuracy. Negotiation provides strong incentives to form accurate impressions about a counterpart’s bargaining situation (De Dreu, Koole, & Steinel, 2000; Thompson, 2001). Negotiation’s mixed-motive nature prompts negotiators to be suspicious of their counterparts’ ulterior motives and therefore to process situational information more carefully (Fein, 1996; Schul, Mayo, & Burnstein, 2004). Unlike many social perceivers, negotiators are motivated to look beyond behavior—in

Figure 2. A hypothetical bargaining zone. The left panel shows a hypothesized distribution of prenegotiation estimates and postnegotiation estimates made by buyers (triangles) and by sellers (circles). Even though prenegotiation estimates are accurate on average, the postnegotiation estimates are inaccurate and “inside” on average. The right panel shows the sellers’ postnegotiation estimates plotted as a function of the sellers’ prenegotiation estimates. RP = reservation price.
Second, asymmetric disconfirmation speaks to the accuracy debate by emphasizing feedback as a moderator of accuracy. Social-perception researchers have shown that the goals of perceivers (E. R. Smith, 1998) and targets (Hilton & Darley, 1985; D. M. Smith, Neuberg, Judice, & Biesanz, 1997) in social interaction moderate the accuracy of perceptions. However, a class of moderators that has received less attention is the feedback environment in which hypotheses are tested (Einhorn & Hogarth, 1978; Klaiman & Ha, 1987). Hogarth (2001) proposed that there are “kind” and “wicked” environments in which to learn. Kind environments provide immediate, concrete, and unbiased evidence about one’s initial beliefs, whereas wicked environments provide delayed, ambiguous, or biased evidence (Hogarth, McKenzie, Gibbs, & Marquis, 1991). The feedback environment we have described in distributive negotiation is what might be termed selectively wicked: Outside estimates encounter clear disconfirming evidence, often yielding more accurate perceptions, whereas inside estimates encounter supportive evidence, preserving initial inaccuracy.

An interesting implication of asymmetric disconfirmation is that it can yield final perceptions that are systematically biased at the population level, even when the distribution of initial individual beliefs is accurate on average. This can be seen in the right panel of Figure 2. In the figure, we have assumed that sellers’ prenegotiation estimates of buyers’ limits are distributed around and centered on the truth—that is, they are imperfect but accurate on average. However, the distribution of postnegotiation estimates is skewed and has an average value smaller than the true reservation price. Thus, this feedback environment can take accurate but noisy judgments (i.e., judgments with random error around the true reservation price) and convert them to biased judgments (i.e., judgments that systematically underestimate the true reservation price). In the model depicted in Figure 2, the magnitude of the final population-level bias increases with the proportion of initial individual estimates that are inside the zone.

We believe that this pattern has interesting consequences for the debate on accuracy in social perception. First, not all erroneous beliefs are self-fulfilling (Jussim, 1991): Outside estimates are disconfirmed. Second, the direction of error determines the likelihood of disconfirmation in these environments: Inside estimates tend to be self-fulfilling. Thus, feedback environments with this structure do moderate when individual errors are corrected or self-fulfilling. However, these structures nonetheless can yield population-level biases from initial distributions of individual beliefs that are accurate on average.

The notion of asymmetric disconfirmation is useful for the debate about accuracy in social perception. It shifts the debate from general claims about accuracy or inaccuracy to an emphasis on diagnosing feedback environments. By identifying asymmetric environments, researchers can predict circumstances in which biased perceptions at the population level are systematic and robust.

In the General Discussion, we offer a general model of asymmetric disconfirmation that includes a population of targets that vary in their reservation prices, rather than assuming a single value. We show that the general model produces a triangular pattern of learning that is conceptually similar to Kelley and Stahelski’s (1970) triangle hypothesis.
uate School of Business who were enrolled in several MBA classes in negotiation.

Procedure. Negotiators were randomly assigned to one of two conditions: A small-zone condition (n = 118) and a large-zone condition (n = 154). Participants negotiated the sale of a bunch of headlamps between a manufacturer (the “seller”) and an end user (the “buyer”). Participants were randomly assigned to the role of either the buyer or seller, and each individual was given a case that provided some background material for the negotiation. The case provided participants with their respective reservation prices, as well as some information that helped them to estimate the other party’s reservation price (such as information on comparable costs and prices). In the large-zone condition, the seller’s reservation price was $10 per headlamp, and the buyer’s reservation price was $35 per headlamp. Thus, the large bargaining zone was (10, 35). In the small-zone condition, the bargaining zone was (17, 23).

Participants prepared for the negotiation prior to class and were asked to fill out a brief prenegotiation questionnaire. The questionnaire asked them to provide an assessment of the other party’s reservation price. Specifically, the seller was asked “What is your assessment of the buyer’s maximum willingness to pay (per unit)? In other words, what is your best guess as to the buyer’s reservation price (your reservation price is $10 [17])?” The parenthetical remark about their own reservation price was intended to eliminate confusion about the meaning of “maximum willingness to pay” and to ensure that the seller assessed the buyer’s reservation price (White & Neale, 1991). The wording for the buyer was similar, except that buyers were asked to estimate “the seller’s minimum willingness to accept.” We also asked participants to indicate how confident they were in their assessment of their opponent’s reservation price on a scale of 1 (extremely confident) to 7 (extremely unsure). (In reporting this scale, we reverse it for ease of interpretation.)

Participants were then given 45 min to negotiate. Once the negotiation was finished, buyers and sellers each completed a postnegotiation questionnaire, in which they indicated whether they reached an agreement and, if so, for what price. Participants were asked to estimate their opponents’ reservation prices, using the same wording described above, and to indicate their confidence level in their estimates, using the scale from the prenegotiation questionnaire. Participants also recorded the seller’s first offer and the buyer’s first offer. For 90% of dyads in this study, there was perfect agreement on each side’s first offer; when dyad members disagreed, we used the seller’s report, a practice followed in Studies 2 and 3. (If included, these dyads would increase the size of the small-pie and large-slice biases.) We also omitted one dyad in the large-zone condition, because the seller’s estimate of the buyer’s reservation price was an extreme outlier (more than 10 standard deviations from the overall mean). We were left with 60 dyads in the large-zone condition and 48 dyads in the small-zone condition.

Reservation-price estimates. The top panel of Figure 3 plots the pre- and postnegotiation reservation-price estimates for the large-zone condition. In the large-zone condition, the postestimates were almost identical to the preestimates. The preestimates for both roles were significantly inside the zone, as were the postestimates (all comparisons by t tests, ts > 7, ps < .0001). In contrast, preestimates were outside the zone on average in the small-zone condition (see the bottom panel of Figure 3), whereas postestimates were inside the zone. (Final estimates were significantly inside the zone for the sellers but not for the buyers.) Because these data are dyadic, and the postestimates may not be independent, we present fuller statistical tests in the dyadic analysis sections (a practice followed in Studies 2 and 3, as well).

 Dyadic analysis of reservation prices. It is instructive to look at how the estimates changed during the negotiation. To measure the extent to which estimates were inside or outside the true reservation price, we calculated a difference between the true value and the estimate. Seller’s estimates of the buyer’s reservation prices were calculated as estimated reservation price minus actual reservation price; buyer’s estimates of the seller’s reservation prices were calculated as actual reservation price minus estimated reservation price. Thus, for both roles, a positive sign indicated an outside estimate and a negative sign an inside estimate.

Figure 4 plots the shift in estimates for each dyad for both the large- and small-zone conditions. The left panel plots, for each dyad, the buyer’s and seller’s perceptions of their opponents’ reservation prices before the negotiation. The right panel plots these perceptions following the negotiation. (For this graph, we divided the differences by the actual zone size to express the magnitude and direction of error as percentages. We perform statistical tests on the unscaled differences and report those means in the text.) However, graphing the measure as a percentage facilitates comparisons between conditions and across studies.)

We analyzed this difference measure in a Zone Size (large vs. small) × Time (pre vs. post) × Role (buyer vs. seller) multivariate analysis of variance (MANOVA), where the last two measures were analyzed within-dyad. We used dyad as the level of analysis, because we did not have specific predictions about the effect of role and wanted to collapse across role. However, either pooling

Results

Outcomes. All but 1 of the 77 dyads in the large-zone condition reached agreement, with an average settlement of $21.12 (SD = 5.63). The one impasse was omitted.3 In the small-zone condition, 56 of the 59 dyads settled, with an average price of $20.02 (SD = 1.61). Four dyads in the small-zone condition settled outside the bargaining zone and were omitted along with the three impasses.

Some negotiators gave reservation-price estimates for their partners that fell between their own reservation price and the final negotiated price. (This occurred in the large-zone condition for 10 of the 77 sellers and 8 of the 77 buyers and in the small-zone condition for 3 of the 59 buyers and 4 of the 59 sellers.) These participants either did not understand the reservation-price question or believed that their opponents accepted a deal outside the zone. We chose to be conservative and omitted these dyads. (If included, these dyads would increase the size of the small-pie and large-slice biases.) We also omitted one dyad in the large-zone condition, because the seller’s estimate of the buyer’s reservation price was an extreme outlier (more than 10 standard deviations from the overall mean). We were left with 60 dyads in the large-zone condition and 48 dyads in the small-zone condition.

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3 It is possible to calculate an estimated-size-of-zone statistic for the impasses. If included, impasses would increase the size of the small-pie bias, because participants tended to perceive a negative zone in such cases. However, because there is no settlement price, we cannot calculate an imputed-share statistic. To make the analysis comparable and conservative, we omitted these dyads.
the roles or analyzing the roles separately would risk overstating degrees of freedom if the judgments of the dyad members were not independent. Using dyad as the level of analysis reduces the degrees of freedom for the error term by half, creating a conservative test of our hypotheses. This analysis tests for what we will call a weak small-pie bias, which occurs when the average estimate

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of the two parties is inside the bargaining zone. For example, if the seller’s estimate is inside the zone by 4 and the buyer’s estimate is outside the zone by \((-4 + 2)/2 = -1\). (All dyads that fall to the bottom left of the dashed lines in Figure 4 show a weak small-pie bias.)

There was an unexpected main effect of role, such that sellers \((M = -5.01)\) gave estimates that were more inside than did buyers \((M = -2.75)\), \(F(1, 111) = 8.64, p = .001, \eta^2 = .07\). There was also an anticipated main effect of zone size, such that bargainers’ estimates were more inside in the large zone \((M = -8.53)\) than in the small zone \((M = -0.76)\), \(F(1, 111) = 274.89, p = .001, \eta^2 = .71\). There was no main effect of time, \(F(1, 111) = 2.16, p = .14\).

The main effect of zone size was qualified by the expected interaction with time, \(F(1, 111) = 14.65, p = .001, \eta^2 = .12\), which illustrates the asymmetric disconfirmation process: In the large zone, initial estimates fell well inside the zone and changed very little during the negotiation, becoming slightly less “inside” \((M_{\text{pre}} = -9.14 \text{ vs. } M_{\text{post}} = -7.92)\). Thus, there was a large and sustained small-pie bias in the large-zone condition. In the small-zone condition, initial estimates fell outside the zone and moved inside over time \((M_{\text{pre}} = 2.14 \text{ vs. } M_{\text{post}} = -0.62)\), generating a modest small-pie bias. All means were significantly different from 0 by a simple-effects test, \(p < .05\).

We define a dyad as exhibiting a strong small-pie bias if both the buyer and seller have inside (negative) estimates. (All dyads that fall in the bottom left quadrant in Figure 4 exhibit a strong small-pie bias.) In the large-zone condition, 92% of dyads (55 of 60) exhibited a strong small-pie bias prior to negotiating, with the same proportion showing a strong small-pie bias after the negotiation (Wilcoxon \(z = 0, p = 1.00\)). In the small-zone condition, only 10% of dyads (5 of 48) exhibited a strong small-pie bias entering the negotiation, but 50% (24 of 48) finished the negotiation with a strong small-pie bias, which is a significant change (Wilcoxon \(z = 3.86, p < .001\)).

**Dyadic analysis of imputed share.** We next test the large-slice bias by calculating a measure we call imputed share. Consider a dyad in the large-zone condition that reached agreement at $20, in which the seller’s postestimate of the buyer’s reservation price is $25, and the buyer’s postestimate of the seller’s reservation price is $15. These estimates imply that the buyer believes that the bargaining zone is $15 \((25 - 10)\), her surplus is $10 \((20 - 10)\), and that her share of the pie is $10 of the $15 pie, or 67%. Similarly, the buyer’s imputed share is 75%: \((35 - 20)/(35 - 15)\).

We calculated the imputed share for both the buyer and the seller and show them by dyad in the top panel of Figure 5. We analyzed the imputed share in a Zone Size (large vs. small) \(\times\) Role (buyer vs. seller) MANOVA, where role was a within-dyad measure. The overall average estimate of 65% was significantly greater than 50%, \(F(1, 106) = 179.44, p < .001, \eta^2 = .63\) (we subtracted 50% from all imputed shares before performing the MANOVA and tested the constant term against 0). There was an unexpected main effect of role \((M_{\text{buyer}} = 62% \text{ vs. } M_{\text{seller}} = 69\%)\), \(F(1, 106) = 5.71, p < .02, \eta^2 = .05\); an expected main effect of zone size \((M_{\text{large}} = 73\% \text{ vs. } M_{\text{small}} = 58\%)\), \(F(1, 106) = 42.55, p < .001, \eta^2 = .29\); and no significant interaction. In the large-zone condition, the imputed share for buyers \((M = 71\%)\) and sellers \((M = 74\%)\) were both significantly larger than 50%, buyer \(t(59) = 9.99, p < .0001\), seller \(t(59) = 11.21, p < .0001\). In the small-zone condition, the imputed share for sellers \((M = 63\%)\) was significantly higher than 50%, \(t(47) = 3.86, p < .001\), but not for buyers \((M = 53\%)\), \(t(47) = 1.23, p = 22\). The sum of these quantities

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4 It is important to note that although the small-pie bias and the large-slice bias are closely related, one does not by necessity imply the other. It is possible to have a large-slice bias without a small-pie bias or a small-pie bias without a large-slice bias. Consider the following example of such a divergence: A bargaining zone ranges from 10 to 20, the buyer’s estimate of the seller’s reservation price is 15, the seller’s estimate of the buyer’s reservation price is 30, and the settlement price is 16. In this case, there will be a large-slice bias (the sum of imputed shares is 83 + .3 = 1.13) but no small-pie bias. Thus, we analyze the measures separately in our studies, despite their close relationship.
exceeded 100% for 59 of the 60 dyads in the large zone and for 32 of 48 dyads in the small zone.

**Dyadic analysis of confidence.** Confidence was analyzed in a Zone Size (large vs. small) × Role (buyer vs. seller) × Time (pre vs. post) MANOVA, with the last two measures tested within-dyad. The only significant effect was a main effect for time, $F(1, 102) = 137.81$, $p < .001$, $\eta^2 = .57$. Average confidence increased significantly during the negotiation from 3.25 to 4.42 (after reverse scoring so that 7 corresponded to extremely confident). The effects were equally strong for buyers and for sellers (both $t > 7, p < .0001$).

**Figure 5.** Imputed share of the bargaining zone for buyer and seller by dyad for Study 1 (top panel), Study 2 (middle panel), and Study 3 (bottom panel). The diagonal line indicates deals in which the dyad’s imputed share sums to 100%. Data points above the line indicate overestimation at the dyadic level; data points below the line indicate underestimation.
**First offers.** First offers represent an important mechanism by which preestimates that are inside the zone become self-fulfilling. This mechanism is driven by the fact that initial estimates and first offers tend to be highly correlated (Galinsky & Mussweiler, 2001). In the large-zone condition, the correlation between the sellers’ preestimate and their first offer was .42 ($p < .001$), whereas the correlation between the buyers’ preestimate and their first offer was .11 ($p = .19$). (This difference in degree of correlation reflects a classic asymmetry in distributive negotiation. When the seller’s reservation price is close to zero, buyers are constrained by a floor in both their estimates of the seller’s reservation price and their opening offer, leading to a restricted range for both measures. Sellers never face this constraint. Study 2 avoided this floor.)

In the large-zone condition, only 16 of the 60 sellers and 2 of the 60 buyers made first offers that were outside the bargaining zone. Thus, it is not surprising then that only 4 sellers and 1 buyer gave outside estimates following the negotiation. By contrast, in the small-zone condition, 45 of the 48 sellers and 41 of the 48 buyers made first offers that were outside the bargaining zone. Thus, many more bargainers—17 sellers and 12 buyers—gave final estimates that were outside the zone.

**Discussion**

Study 1 demonstrated both the small-pie and large-slice biases. We found a strong tendency in this negotiation to underestimate the size of the bargaining zone (small-pie bias) and therefore to overestimate the share of the bargaining zone claimed (the large-slice bias). In this study, we tested two extreme conditions: one in which the bargaining zone was much larger than negotiators initially believed and one in which the zone was considerably smaller than initially believed. In both cases, we found reliable small-pie and large-slice biases, although the biases were, in absolute terms, considerably smaller in the small zone than in the large zone.

These data support an asymmetric disconfirmation process. The large-zone condition showed that initial beliefs inside the zone are sufficient to generate the effect, as initial beliefs inside the zone tended to lead to first offers inside the zone. Indeed, it was almost impossible for negotiators who made a first offer inside the zone to have their inaccurate estimate fully disconfirmed. By contrast, the majority of negotiators in the small-zone condition began with estimates and first offers outside the zone. Nevertheless, it appears that their counterparts’ behavior led them to revise their judgments toward and often inside the bargaining zone. Together, the two conditions demonstrate that those who began with estimates outside the zone tended to be driven inside the zone, whereas those with estimates inside the zone changed their estimates very little.

Study 1 also suggests two boundary conditions on our asymmetric-disconfirmation proposal. First, in the large-zone condition, the preestimates that were furthest inside did move toward the actual reservation price, though they remained very much inside the zone. Thus, estimates that are sufficiently far inside the zone may be revised in the direction of the correct reservation price (as discussed in the introduction) but, critically, not nearly enough to undo the small-pie bias. Second, although we found small-pie and large-slice biases in the small-zone condition, they were relatively small in absolute terms.

We believe that self-enhancement played a relatively minor part in our findings. First, there was an accuracy motivation prior to and during the negotiation to correctly estimate the other party’s reservation price. In other words, most negotiators knew that a critical part of being successful in distributive negotiation is having an accurate picture of their counterparts’ bottom lines (Raiffa, 1982). Second, our negotiators were told that they would learn their opponents’ actual reservation prices immediately after completing the postnegotiation questionnaire, which should have increased accuracy motivation. Nevertheless, it is hard to determine exactly how much self-enhancement contributes to these biases. In Study 2, we used additional measures to demonstrate that asymmetric disconfirmation, and not motivation, is the more parsimonious explanation for these results.

**Study 2: Manipulation of Initial Expectations**

In Study 1, we manipulated whether participants tended to begin the negotiation with estimates inside or outside the bargaining zone by manipulating the zone size. In Study 2, we used an alternative method of creating inside and outside estimates: manipulating initial perceptions. We provided participants with estimates of their opponents’ reservation prices that were accurate, inside the zone, or outside the zone. Although conceptually similar, this method has the advantage that the bargaining zone is held constant in size across all conditions. We also manipulated expectations for sellers and buyers factorially. In Study 1, members of a dyad shared expectations—both tended to have inside estimates in the small zone, and both tended to have outside estimates in the large zone. In Study 2, we created some dyads in which one partner had inside estimates and the other had outside estimates.

We hypothesized a pattern of final reservation-price estimates similar to that found in Study 1. Initial estimates inside the zone should generate the small-pie bias, as these estimates will be maintained through behavioral confirmation. In contrast, initial estimates outside the zone should be disconfirmed in the negotiation process, and these estimates will move toward the true reservation price and perhaps even inside the bargaining zone.

Finally, we asked sellers and buyers to estimate the settlement rate and average settlement price among all dyads. These additional measures helped us to separate the role of biased information from motivated reasoning in producing the small-pie bias. If negotiators are primarily self-enhancing, they should report that other dyads frequently failed to settle and that other negotiators in the same role as themselves settled for a less favorable price. Both of these would be evidence for a better-than-average effect. If negotiators are primarily updating their beliefs on the basis of biased information garnered during a negotiation, then only the settlement rate should be biased downward, but price should not be distorted. Thus, to the extent to which biased information leads to perceptions of a small zone, we expect participants to predict that other dyads agreed to prices similar to their own—that is, there is a “sweet spot” to hit in a small zone, and any pair that reaches agreement will find it.

**Method**

**Participants.** Participants were 266 MBA students at the University of Chicago’s Graduate School of Business who were enrolled in several executive MBA sections of a managerial decision-making and negotiation course.
Procedure. Participants completed a negotiation with the same cover story used in Study 1. The buyer’s reservation price was $46, and the seller’s reservation price was $34. Thus, the bargaining zone was (34, 46). The case provided participants with their respective reservation prices, as well as some information that helped them to estimate the other party’s reservation price. In addition, both the seller and buyer were given explicit expectations about their opponent’s reservation price. These expectations were described as being a “best guess” by an analyst within their firm who did “not have much information to base a guess upon.” Guesses were therefore expressed as a range of values. Buyers were supplied with a “best guess” of the minimum the seller would be willing to accept (i.e., the seller’s reservation price). Sellers were supplied with a “best guess” of the buyer’s maximum. We manipulated expectations of the bargaining zone size such that buyers and sellers were given correct expectations, expectations that were outside the zone, or expectations that were inside the zone. Participants were randomly assigned to one of nine (3 × 3) conditions in which we manipulated expectations about the seller’s reservation price and the buyer’s reservation price factorially.

In the correct-expectations condition, buyers (n = 43) were told that the analyst who provided the best guess estimated that the seller “would be willing to take as little as $34/unit, although the actual limit could be as low as $24/unit and as high as $44/unit.” The sellers (n = 47) were given similar instructions: The buyer “would be willing to pay as much as $46/unit, although the actual limit could be as low as $36/unit and as high as $56/unit.” Thus, the guess given to buyers and sellers was their counterpart’s actual reservation price, although there was considerable uncertainty around that guess.

In the inside-expectations condition (n = 45 for sellers, n = 43 for buyers), the buyer and seller were given best guesses that underestimated the size of the bargaining zone: $42 as a guess for the seller’s reservation price (with a range of $32–$52) and $38 as a guess for the buyer’s reservation price (with a range of $28–$48). Finally, participants in the outside-expectations condition (n = 41 for sellers, n = 47 for buyers) were provided with guesses that overestimated the size of the bargaining zone: $26 as a guess for the seller’s reservation price (with a range of $16–$36) and $54 as a guess for the buyer’s reservation price (with a range of $44–$64). It is important to note that in all cases, the correct reservation prices, $34 for the seller and $46 for the buyers, were contained in the ranges provided.

Participants completed a prenegotiation questionnaire almost identical to that used in Studies 1 and 3. They were asked to provide an assessment of the other party’s reservation price and an assessment of their own confidence.

Participants negotiated for 45 min, after which they completed a postnegotiation questionnaire, in which both buyers and sellers indicated whether there was a settlement, the settlement price in the case of settlement, the seller’s first offer, and the buyer’s first offer. Participants were asked to estimate their opponents’ reservation prices and indicate their confidence level in their estimates, using the same scale as in the prenegotiation questionnaire. We also asked participants to estimate what percentage of pairs reached agreement and the average settlement price for the pairs that reached a deal.

Results

Outcomes. One hundred twenty-eight out of the 133 dyads (96%) reached agreement. The average settlement price across all conditions was $39.89 (SD = 4.00). Three of the settlements were outside of the bargaining zone. We omitted these three dyads and the five impasses from the remaining analysis. Although settlement prices varied as a function of prenegotiation expectations in the expected way (e.g., prices were higher when the buyer had an inside expectation and the seller had an outside expectation), they were not significantly different across the conditions.

As in Study 1, some participants estimated a reservation price for their partner that fell between the participant’s own reservation price and final negotiation price (25 of the 125 sellers who reached agreement and 9 of the 125 buyers who reached agreement). Inclusion of these dyads exaggerates the small-pie and large-slice biases. As in Study 1, we chose to be conservative and omitted the 34 resulting dyads, leaving 91 dyads.

Reservation-price estimates: Seller. As predicted, the negotiation led parties to revise their estimates of the other party’s reservation price differentially by condition. We consider the shift from prenegotiation to postnegotiation estimates of the opponent’s reservation price, beginning with the seller’s estimate of the buyer’s reservation price (Figure 6). The anchoring manipulation was successful in that the prenegotiation estimates were $40.31, $47.09, and $51.40, compared with the anchors of $38, $46, and $54, in the inside, correct, and outside conditions, respectively. All estimates were significantly different from each other between conditions (t(3) > 2, p < .05). As may be seen in Figure 6, sellers in the correct and outside conditions were outside the correct reservation price of $46. These estimates shifted following the completion of the negotiation. The final estimates for the inside, correct, and outside conditions were $40.65, $43.36, and $44.67, respectively, all inside the zone.

Reservation-price estimates: Buyer. We next consider the buyer’s estimate of the seller’s reservation price (Figure 6). The prenegotiation estimates were $27.36, $32.49, and $35.60 in the outside, correct, and inside conditions, respectively, compared with the correct reservation price of $34. As expected, these estimates were close to the respective anchors: $26, $34, and $42. Means were significantly different between conditions (t(3) > 3, p < .01), except for the comparison between the correct and inside conditions (t = 1.74, p = .087). As with the sellers, the buyers’ estimates shifted toward the inside of the bargaining zone following the completion of the negotiation. Estimates for all three conditions were greater than $34 and hence inside the zone: $34.87, $34.87, and $37.18 for the outside, correct, and inside conditions, respectively.

Dyadic analysis of reservation prices. We tested the weak small-pie bias by analyzing the pre- and postnegotiation reservation-price estimates by dyad (Figure 7). As in Study 1, we calculated the degree to which reservation-price estimates were inside or outside the zone and analyzed the means in a Seller Expectation (inside vs. correct vs. outside) × Buyer Expectation (inside vs. correct vs. outside) × Role (buyer vs. seller) × Time (pre vs. post) MANOVA. The last two variables were within-dyad variables.

There was the predicted main effect for time. Initial estimates were outside the zone (M = 1.38), and final estimates were inside
the zone \((M = -2.31)\), \(F(1, 78) = 51.35, p = .001, \eta^2 = .40\). The main effect of time was qualified by significant interactions with the expectation manipulations. There was a Time \(\times\) Seller Expectation interaction, such that initial estimates were outside the zone in the outside \((M = 3.06)\) and correct \((M = 2.77)\) conditions and inside the zone in the inside \((M = -1.71)\) condition, but final estimates were inside the zone in all conditions \((M_s = 1.93, 1.77, 3.24, \text{ respectively})\), \(F(2, 78) = 9.80, p = .001, \eta^2 = .30\). There was a similar Time \(\times\) Buyer Expectation interaction (prenegotiation, \(M_{\text{outside}} = 4.69, M_{\text{correct}} = -0.9, M_{\text{inside}} = -0.48\); postnegotiation, \(M_{\text{outside}} = -2.02, M_{\text{correct}} = -2.44, and M_{\text{inside}} = -2.47\)), \(F(2, 78) = 4.58, p = .013, \eta^2 = .11\). All final estimates in these analyses were significantly less than 0 by a simple-effects test, \(p < .05\). All final estimates in these analyses were significantly less than 0 by a simple-effects test, \(p < .05\).

**Figure 6.** Average estimates by buyers and sellers of the opposing role’s reservation price in Study 2, by condition. Outside, correct, and inside refer to the manipulation of initial expectations. Average prenegotiation and postnegotiation estimates are shown. Asterisks indicate significant differences from the buyer’s correct reservation price of $46 and from the seller’s correct reservation price of $34. *\(p < .05\), ***\(p < .001\).

**Figure 7.** Change in pre- to postnegotiation estimates in Study 2, by dyad. The panels plot the degree to which estimates for the seller and buyer are inside versus outside the actual reservation price \((\text{RP})\) in percentage terms (amount inside or outside divided by size of the bargaining zone). The left panel depicts prenegotiation estimates, and the right panel depicts postnegotiation estimates. The dotted line indicates that the dyad has, on average, correctly estimated the zone size. Dyads to the southwest of the dotted line underestimated the zone size, whereas dyads to the northeast overestimated the zone size.
inside) $\times$ Role (buyer vs. seller) MANOVA, where role was a with-in-dyad measure. The overall average estimate of 65% was significantly greater than 50%, $F(1, 78) = 91.07$, $p < .001$, $\eta^2 = .54$. There were no significant main effects or interactions ($Fs < 2.7$). The effect was equally strong for buyers ($M = 63\%$, $t(90) = 4.78$, $p < .0001$, and for sellers ($M = 68\%$, $t(90) = 6.30$, $p < .0001$).

**Dyadic analysis of confidence.** Confidence was analyzed in a Buyer Expectation (outside vs. correct vs. inside) $\times$ Seller Expectation (outside vs. correct vs. inside) $\times$ Role (buyer vs. seller) $\times$ Time (pre vs. post) MANOVA, with the last two measures tested within dyad. The only significant effect was a main effect for time, $F(1, 77) = 60.63$, $p < .001$, $\eta^2 = .44$. Average confidence increased significantly during the negotiation from 3.32 to 4.26. The increase was equal in magnitude for buyers and sellers ($ts > 5$, $p < .001$).

**First offers.** We also examined self-reported first offers. There was a strong correlation between prenegotiation estimates and first offers; buyers, $r(90) = .56$, $p < .0001$; sellers, $r(90) = .54$, $p < .0001$. An implication of this strong correspondence is that negotiators with preestimates inside the zone should be more likely to make first offers inside the zone. Overall, 22 of the 91 buyers’ first offers and 26 of the 91 sellers’ first offers were inside the bargaining zone. As expected, inside first offers were concentrated among the buyers and sellers with prenegotiation estimates inside the zone. Of the 56 sellers and 38 buyers with prenegotiation estimates inside the zone, 25 (45%) sellers and 15 (37%) buyers made first offers inside the zone. In contrast, only 1 (3%) of the 35 sellers with prenegotiation estimates outside the zone made a first offer inside the zone, and only 7 (14%) of the 50 such buyers did likewise. These rates are statistically significant within each role; sellers, $\chi^2(1) = 18.43$, $p < .001$; buyers, $\chi^2(1) = 6.26$, $p = .01$.

**Settlement-rate and price estimates.** Finally, we asked both buyers and sellers to estimate the settlement rate and average settlement price. The estimated settlement rate was 77% for both sellers and buyers, and it did not vary significantly across conditions but was significantly less than the actual settlement rate of 95.6% for both buyers and sellers ($ts > 10$, $p < .001$). In contrast, estimates of settlement price were not significantly different from the actual settlement price of $39.89; buyers, $M = 39.72$, $t(89) = 0.44$, $p = .66$; sellers, $M = 40.23$, $t(89) = 0.72$, $p = .47$.

**Discussion**

Study 2 replicated the results of the previous studies. Even though dyads overestimated the size of the bargaining zone on average prior to the negotiation, they underestimated the zone size once the negotiation was finished. The vast majority of dyads had total imputed shares that summed to more than 100%.

We manipulated prenegotiation expectations so that some negotiators were more likely to have initial estimates outside the bargaining zone, and some were more likely to have estimates inside the zone. Consistent with asymmetric disconfirmation, negotiators who began with estimates outside the zone tended to be driven inside the zone, whereas those with estimates inside the zone changed their estimates very little. It is interesting that participants in the correct expectations condition began the negotiation with accurate perceptions of the size of the bargaining zone on average and, as predicted, became less accurate as a result of the negotiation dynamic, yet they reported higher confidence in their postnegotiation estimates.

Finally, we asked participants to estimate the settlement rate and average settlement price. Participants systematically overestimated how many dyads would reach an impasse. This could be interpreted as evidence for either self-enhancement (bargainers inflated their performance) or for an inference on the basis of a biased sample of evidence (bargainers found it difficult to settle with their opponents). Evidence to distinguish between these interpretations is provided by estimated settlement price. Both buyers and sellers were remarkably accurate in estimating the average settlement price. We believe this combined pattern is more consistent with the hypothesis testing explanation for the small-pie bias than with the motivational view. The biased sample of information obtained during the negotiation—rejected offers, bluffs about reservation prices, and so on—suggests that opponents are nearly impossible to please. This information fuels both the small-pie bias and the tendency to overestimate the impasse rate but does not distort estimates of average settlement price. Their reasoning, we would argue, is that “if other dyads reached agreement—which would have been difficult—the terms must look similar to mine, because the zone is so small.”

**Study 3: Manipulation of Incentives for Accuracy**

In Study 3, we tested the effect of self-enhancement on the small-pie and large-slice biases by making it more costly. Although we increased accuracy motivation in Studies 1 and 2 through the use of immediate and concrete feedback on the truth, we wanted to heighten the motivation by paying participants for accurate estimates. We ran two conditions: a control condition (comparable to the instructions in Studies 1 and 2) and an incentive condition (in which participants were paid according to the accuracy of their pre- and postnegotiation estimates of their counterparts’ reservation prices). Giving a self-enhancing estimate in the incentive condition would come at a financial cost. Previous research has shown that accuracy motivation improves information processing in negotiation (De Dreu et al., 2000).

**Method**

**Participants.** Participants in Study 3 were 156 MBA students at the University of Chicago’s Graduate School of Business who were enrolled in several sections of an elective negotiation course.

**Procedure.** The basic negotiation was the same as in Studies 1 and 2 with two notable exceptions. We changed the size of the bargaining zone so that the seller’s reservation price was $16 and the buyer’s reservation price was $28 (16, 28). In addition, we ran two conditions: a control condition ($n = 39$) and an incentive condition ($n = 37$), in which participants were paid according to the accuracy of their pre- and postnegotiation estimates of their counterparts’ reservation prices. Participants in the incentive condition were paid $5 if their prenegotiation estimate was among the 20% closest to the actual reservation price (including ties), as measured by the absolute difference between their estimated reservation price and the actual reservation price. They were also paid $5 if their postnegotiation estimate was among the 20% closest estimates (including ties). Thus, participants could earn up to $10.

As in Study 2, participants were given information to help them estimate the other party’s reservation price. Sellers were supplied
with a “best guess” of the maximum the buyer would be willing to pay (i.e., the buyer’s reservation price). Specifically, they were told that the analyst who provided the estimate did “not have much information to base a guess upon” but estimated that the buyer “would be willing to take as little as $13/unit, although the actual limit could be as low as $8/unit and as high as $18/unit.” Similarly, buyers were told that the seller “would be willing to pay as much as $31/unit, although the actual limit could be as low as $26/unit and as high as $36/unit.” Note that these best guesses are both $3 outside the correct reservation price. Sellers and buyers completed pre- and postnegotiation questionnaires as in Studies 1 and 2.

Results

Outcomes. Seventy-five out of the 76 dyads (99%) reached agreement. The one impasse occurred in the incentive condition. The average settlement price across the two conditions was $22.43 (SD = 2.83).

Two dyads were excluded from the remaining analyses; the impasse and one settlement that occurred outside the bargaining zone. As in Studies 1 and 2, some participants estimated reservation prices for their partners that fell between their reservation price and the final negotiated price (6 sellers and 3 buyers). These dyads were omitted, leaving 66 dyads: 33 in the incentive condition and 33 in the control condition.

Reservation-price estimates. Figure 8 shows the pre- and postnegotiation estimates of reservation prices, as well as significance tests versus the actual reservation prices for each mean. The reservation-price estimates for both roles and both conditions showed the predicted pattern: Preestimates were outside the zone, and postestimates were inside the zone. All but one (sellers in the incentive condition) of the means for final estimates were significantly inside the actual reservation price.

Dyadic analyses of reservation-price estimates. Figure 9 shows how reservation prices shifted from pre- to postnegotiation. As in Studies 1 and 2, we calculated a measure of the degree to which estimates were inside or outside the zone. The means were analyzed in an Incentive (incentive vs. control) × Role (buyer vs. seller) × Time (pre vs. post) MANOVA, with the last two variables being within-dyad measures. All effects involving the incentive variable were nonsignificant (Fs < 1), except for an unexpected Incentive × Role interaction, $F(1, 63) = 4.12, p = .047, \eta^2 = .06$. On average, reservation-price estimates were more outside for sellers in the control condition ($M = 1.33$) than in the incentive condition ($M = .21$), whereas the estimates were more outside for buyers in the incentive condition ($M = .89$) than in the control condition ($M = -.44$). This pattern is most easily interpreted by observing that reservation-price estimates in Figure 8 were higher for both roles in the control condition than in the incentive condition. We do not have an explanation for this pattern. We do note that the small-pie bias was more symmetric in the incentive condition—where final inside estimates were of equal magnitude for buyers and sellers and statistically significant for both—than in the control condition.

As predicted, there was a significant main effect for time, such that initial estimates were outside the zone ($M = 2.76$) and final estimates were inside the zone ($M = -1.76$), $F(1, 63) = 115.98, p = .001, \eta^2 = .65$. The time variable did not interact significantly with any other variables, and the pattern of means was similar in
both the control ($M_{\text{pre}} = 2.95$ vs. $M_{\text{post}} = -1.86$) and incentive conditions ($M_{\text{pre}} = 2.55$ vs. $M_{\text{post}} = -1.66$). All means were significantly different from 0 by a simple-effects test, $p < .05$. Only 11% of dyads (7 of 66) exhibited the strong small-pie bias prior to negotiation, whereas 48% (31 of 66) exhibited the bias following the negotiation (Wilcoxon $z = 4.54, p < .0001$). These rates did not differ by condition.

**Dyadic analysis of imputed share.** The bottom panel of Figure 5 plots the imputed shares of buyers and sellers by dyad. A Condition (incentive vs. control) $\times$ Role (buyer vs. seller) MANOVA was conducted with role as a within-dyad variable. The analysis showed that the mean imputed share of 59% was significantly different from 50%, $F(1, 64) = 32.50, p < .001, \eta^2 = .34$. There were no significant main effects or interactions ($Fs < 1.0$). The mean imputed shares for the buyers and sellers were, respectively, 59% and 60% in the incentive condition and 55% and 62% in the control condition. All means were significantly different from 50% ($ts > 2.70, ps < .05$) except for the buyer control condition ($n$s). Seventy-three percent of dyads had imputed shares that summed to greater than 100%.

**Dyadic analysis of confidence.** Change in confidence was analyzed with a Condition (incentive vs. control) $\times$ Role (buyer vs. seller) $\times$ Time (pre vs. post) MANOVA, with role and time as within-dyad variables. The analysis showed a significant increase in confidence from before to after the negotiation ($M_{\text{pre}} = 3.27$ vs. $M_{\text{post}} = 4.24$), $F(1, 64) = 63.10, p < .001, \eta^2 = .50$. There was also an unexpected but interpretable Condition $\times$ Time interaction, $F(1, 64) = 8.51, p < .01, \eta^2 = .12$. Negotiators in the control condition increased in confidence more ($M_{\text{pre}} = 3.20$ vs. $M_{\text{post}} = 4.53$) than did negotiators in the incentive condition ($M_{\text{pre}} = 3.34$ vs. $M_{\text{post}} = 3.95$). It is interesting that incentives led negotiators to express less certainty about their estimates but not to be more accurate.

**Discussion**

The control condition replicated the results of Studies 1 and 2. Even though mean initial estimates of their opponents’ bottom lines were outside the bargaining zone, control-condition participants’ final estimates nevertheless showed a small-pie bias. An incentive condition was added in which participants were paid for the accuracy of their estimates. Accuracy incentives, however, did not alter the magnitude of the small-pie or large-slice biases. This result is particularly noteworthy for two reasons. Paying participants for their reservation-price estimates brought attention to this quantity and informed less-savvy negotiators about the importance of accurately estimating their opponents’ bottom lines. Second, the incentive also gave negotiators reason to pursue deliberate learning strategies that they may not have used otherwise. Neither of these two factors altered the effect we demonstrated in Studies 1 and 2.

**General Discussion**

Three studies demonstrated the small-pie bias—negotiators typically leave the negotiation table believing that the bargaining zone is smaller than it actually is. Negotiators’ final estimates of their opponents’ reservation prices were consistently “inside” the actual reservation price. A consequence of this pattern is the large-slice bias—negotiators typically believe they have captured a larger percentage of the pie than they actually have. In our studies, negotiators left the negotiation table thinking they had captured 56%–72% of the pie on average.

The studies presented here were designed to demonstrate asymmetric disconfirmation processes by systematically inducing initial expectations that were either inside or outside the true zone. The results show that initial inside estimates tended to remain inside during the course of negotiation. Initial outside estimates, however, were disconfirmed during negotiation. It is noteworthy that outside estimates were often driven not just to the true reservation price but inside it. We believe this pattern is due to the fact that negotiators do not adjust sufficiently for the skewed sample of evidence they receive during the course of the negotiation—that is, they are influenced by their opponents’ extreme offers, modest concessions, and bluffs about limits.

We have argued that two principal factors produce these biases: asymmetric disconfirmation and motivated reasoning. We designed our studies to minimize the role of motivated reasoning to highlight the dynamics of asymmetric disconfirmation. Studies 1–3 provided immediate, accurate feedback on final reservation-price estimates, which we believe sharply constrained self-
enhancing estimates. Moreover, Study 3 provided direct incentives to be accurate, with no effect on the magnitude of the small-pie bias.\(^5\)

The remainder of the General Discussion addresses the implications of these results for social perception and for negotiation. The first section tests a formal model of asymmetric disconfirmation. The second section proposes other social inferences that might exhibit asymmetric disconfirmation. The final section considers implications of the small-pie and large-slice biases for negotiation, including how they affect relationships and confidence.

**Tests of Asymmetric Disconfirmation**

In this section, we examine our experimental results in terms of a formal theoretical model of asymmetric disconfirmation. Figure 2 shows the theoretical prediction implied by asymmetric disconfirmation: Initial inside estimates persist intact, whereas initial outside estimates are disconfirmed toward the truth. We test this theoretical prediction formally in two ways. First, we test for an asymmetry in the strength of the relationship between the initial and final estimates conditional on whether initial estimates were inside or outside the zone. Initial inside estimates are rarely challenged by contradictory evidence and thus tend to stay in place, whereas outside estimates are challenged, effectively must move, and therefore are much more noisily related to initial outside estimates. Formally, this process implies that final estimates will be strongly correlated with initial estimates when initial estimates are inside the zone but weakly correlated when initial estimates are outside the zone. This is represented in the right panel of Figure 2 as a region in which pre- and postestimates are linearly related (for inside estimates) and a region in which they are unrelated (for outside estimates).

To test this specific prediction, we ran spline regressions by splitting the initial estimates into inside and outside estimates and fixing a “knot,” or kink, at the actual reservation price. (A spline regression fits a piecewise linear function to the dependent variable, where the function is linear within an interval and continuous at the “knot”; see Marsh & Cormier, 2001.) Separate regressions were run for buyers and sellers. The initial and final estimates were normalized by dividing the amount by which the estimate was inside or outside the zone by the actual zone size. This ratio converts the measures to a percentage of zone size, making the measures comparable across studies. The measure was zero if the estimate matched the actual reservation price, negative for an inside estimate, and positive for an outside estimate. For example, in Study 1’s large-zone condition, an outside estimate of 40 for the buyer’s reservation price received a value of \((40 - 35)/25 = .20\), whereas the value for an inside estimate of 25 was \((25 - 35)/25 = - .40\). Finally, the regression was fixed so that final estimates were equal to initial estimates when initial estimates were accurate (i.e., the intercept was constrained to be zero).

Table 1 shows the results of the regressions for each study and pooled over all studies. The pooled regression provides strong support for the asymmetric-disconfirmation hypothesis. For both buyers and sellers, final estimates were strongly related to initial inside estimates—indicating that estimates did not move much—but were uncorrelated with initial outside estimates. The spline regressions for the individual studies show the same basic pattern. The pooled spline regressions have adjusted \(R^2\)s of 52% and 34%, indicating that they fit the data well and considerably better than regressions that fit a single line, which have adjusted \(R^2\)s of 27% and 15%, respectively.

As a second formal test of asymmetric disconfirmation, we consider a very simple model of asymmetric disconfirmation and apply this model to our studies. Let \(RP_b\) and \(RP_s\) denote the true reservation prices of the buyer and seller, respectively, and \(e_b\) and \(e_s\) denote

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5 In future research, it would be desirable to reduce the role of self-enhancement in other ways. We have begun preliminary studies taking a different tack. Building on the logic of actor–observer research (Jones & Nisbett, 1972; Storms, 1973), we have presented neutral observers with videotapes of negotiations between study participants and measured their perceptions of reservation prices. Specifically, observers were yoked to a role and given the same reservation-price expectations as were the participants themselves. If the small-pie bias is driven by the skewed sample of evidence that arises during a negotiation, then neutral observers should show the same biases as participants themselves do. Our initial findings confirm that observers are as prone to the small-pie bias as are actors.
$e_f$ denote the negotiator’s initial and final estimates about the reservation price. The following model of the learning process captures the asymmetric-disconfirmation process. The seller’s final estimate is assumed to be the smaller of the buyer’s true reservation price and the seller’s initial estimate, $e_f = \min(RP_s, e_i)$, and the buyer’s final estimate is assumed to be the larger of the seller’s true reservation price and the buyer’s initial estimate, $e_f = \max(RP_s, e_i)$. According to this model, final estimates are equal to initial estimates when initial estimates are inside the zone and are equal to the opponent’s actual reservation price when initial estimates are outside the zone. For Study 2, for example, the simple model generates average final reservation-price estimates of $35.91$ and $43.39$, very close to the empirical means of $35.62$ and $42.95$. Table 2 shows the close correspondence of the model with actual empirical means for each of our studies. Paired $t$ tests showed no significant difference between final reservation-price estimates and model predictions for six of the eight tests. In contrast, final reservation-price estimates were significantly different from initial estimates for six of eight tests and from actual reservation prices for seven of eight tests.\footnote{The model fit can also be gauged by calculating the mean absolute difference (MAD) between the mean final reservation-price estimate and (a) the model prediction (MAD = .90), (b) the mean initial reservation-price estimate (MAD = 3.04), and (c) the actual reservation price (MAD = 3.15) for the eight sets of means in the table. The absolute difference between mean final-reservation-price estimate and the model prediction is significantly smaller than the two other differences (MAD = .90 vs. 3.15), $t(7) = 2.66$, $p < .03$; (MAD = .90 vs. 3.04), $t(7) = 3.07$, $p < .02$, which were not significantly different from each other (MAD = 3.15 vs. 3.04), $t(7) = .07$, $p = .94$.}

We close by outlining a more general version of the model we just proposed. It is described formally in the Appendix. The general model differs from the previous analyses in that it lets the true reservation price vary in a population rather than forcing it to be fixed at a single value. This better captures the cross-section of experiences a population of negotiators would have or, alternatively, the longitudinal experience an individual would have over multiple negotiations. The top panel of Figure 10 provides a hypothetical example in which there are a large number of buyers and sellers; there is a uniform distribution of reservation prices across buyers (as shown in the top row); and individual sellers, on average, have expectations that match the true reservation price. If buyers and sellers are randomly paired in a market, sellers will have accurate prenegotiation expectations in some cases (the unshaded areas) and inaccurate expectations in other cases (the shaded areas, where estimates are either initially too high or too low). The simple model of belief revision described above yields the triangular distribution of final perceptions, shown as X’s in the diagram. The result in this case is a systematic underestimation of reservation prices (see the Appendix for a numerical example).

The triangle pattern in the top panel was deliberately designed to resemble the pattern depicted in Kelley and Stahelski’s (1970) famous “triangle hypothesis,” which posited that people who have competitive goals in mixed-motive interactions come to see all opponents as having competitive goals, but people with cooperative goals learn the true distribution of opponents’ goals. The basic mechanism they proposed was a behavioral confirmation process: Competitors, by defecting early in an interaction, elicit competition from others, whereas cooperators elicit the full range of responses from different opponents. In the bottom panel of Figure 10, we offer an interpretation of Kelley and Stahelski’s (1970) triangle hypothesis as a model of learning in prisoner’s-dilemma games (PDGs). That is, we interpret it as a model of how expectations are updated in the specific environment of a PDG (cf. Diekmann et al., 2003; Miller & Holmes, 1975). The top row is the true distribution of tendencies in a population. The left column consists of initial expectations, which are depicted as being accurate on average. And the triangular pattern of X’s reflects the final set of beliefs held after interaction.

The triangular patterns in Figure 10 would be expected after one round of interaction in a population (cross-sectionally), as studied here. We speculate, however, that the pattern might also be observed after many rounds of interaction for one individual (longitudinally). Consider an inexperienced negotiator who has accurate perceptions about the size of the bargaining zone, on average, across a number of negotiations but occasionally errs inside or outside the true zone. The logic of asymmetric disconfirmation suggests that inside estimates are likely to persist, whereas outside estimates are likely to be disconfirmed. Because beliefs are much more likely to be revised inward than outward, our negotiator may “learn” from this experience and generate more conservative estimates in subsequent negotiations. Indeed, a negotiator with initial estimates that are usually inside the bargaining zone (and hence persist through behavioral confirmation) will come to believe that his or her initial estimates are usually accurate. The result is that, in time, negotiators may come to expect all negotiations to be battles over small pies. (Similarly, participants in PDGs who occasionally mispredict their opponents’ goals would “learn” over many interactions with different opponents that they tend to be competitive.) Belief in a small pie and belief in competitive opponents are both “absorbing states” (Feller, 1968). Although speculative, we find this dynamic aspect of the triangle hypothesis for

### Table 2

<table>
<thead>
<tr>
<th>Reservation price</th>
<th>Study 1</th>
<th></th>
<th></th>
<th>Study 2</th>
<th>Study 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small ($n = 48$)</td>
<td>Large ($n = 60$)</td>
<td>Study 2 ($n = 91$)</td>
<td>Study 3 ($n = 66$)</td>
<td></td>
</tr>
<tr>
<td>Estimate of buyer’s RP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final estimate</td>
<td>22.21</td>
<td>25.70</td>
<td>42.95</td>
<td>26.63</td>
<td></td>
</tr>
<tr>
<td>Model prediction</td>
<td>21.91</td>
<td>22.77</td>
<td>43.39</td>
<td>26.94</td>
<td></td>
</tr>
<tr>
<td>Initial estimate</td>
<td>24.02</td>
<td>24.19</td>
<td>46.41</td>
<td>30.58</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>23.00</td>
<td>35.00</td>
<td>46.00</td>
<td>28.00</td>
<td></td>
</tr>
<tr>
<td>Estimate of seller’s RP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final estimate</td>
<td>17.38</td>
<td>16.53</td>
<td>35.62</td>
<td>18.16</td>
<td></td>
</tr>
<tr>
<td>Model prediction</td>
<td>17.53</td>
<td>17.62</td>
<td>35.91</td>
<td>16.45</td>
<td></td>
</tr>
<tr>
<td>Initial estimate</td>
<td>13.72</td>
<td>17.47</td>
<td>31.52</td>
<td>13.26</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>17.00</td>
<td>10.00</td>
<td>34.00</td>
<td>16.00</td>
<td></td>
</tr>
</tbody>
</table>

Note. The model of asymmetric disconfirmation assumes that final reservation-price (RP) estimates are equal to initial RP estimates if initial estimates are inside the zone and are equal to the actual RP if initial estimates are outside the zone. Means with different subscripts are significantly different by paired $t$ test at $p < .05$ when tested within a role and study.
Asymmetric Disconfirmation in Other Social Perceptions

Asymmetric disconfirmation has two essential features. First, judgments that deviate from the truth in one direction encounter disconfirming evidence and are revised toward the truth. Second, judgments that deviate from the truth in the opposite direction rarely encounter disconfirming evidence and therefore are maintained. The absence of disconfirming evidence may be due to a number of factors, including behavioral and perceptual confirmation (Jones, 1986), biased samples of evidence (Zuckerman et al., 1995), and the absence of feedback (Einhorn & Hogarth, 1978).

We have proposed that the small-pie and large-slice biases in distributive negotiation are products of asymmetric disconfirmation. To what extent might other social inferences be subject to this same pattern of forces? We offer two brief examples.

One example is suggested in Miller’s (1999) work on self-interest. Miller and his colleagues (Miller & Ratner, 1996) have proposed that there is a strong assumption in American culture that people are self-interested. They have proposed that the belief is widely held because of cultural injunctions and pluralistic ignorance. This assumption then tends to be self-fulfilling through behavioral confirmation, as perceivers act toward others as if they were greedy and untrustworthy (analogous to the competitors in Kelley & Stahelski, 1970).

A second example is suggested by Einhorn and Hogarth’s (1978) classic analysis of learning from experience. They observed that for many interpersonal decisions, such as job hiring and student admissions, candidates who are predicted to fall below some threshold of aptitude will be rejected, and decision makers will receive little feedback on their actual aptitude. As a result, decision makers will rarely encounter false negatives (i.e., rejected candidates who were actually better than the threshold) and will remain confident in their ability to discern aptitude. (Denrell, 2005, recently made similar theoretical arguments to explain ingroup bias.) An overlooked implication of this feedback environment is that general expectations of talent will become biased downward with experience. The bias occurs because some false positives will be encountered among the accepted candidates, and this feedback will disconfirm overly positive predictions of talent; however, overly negative predictions of talent will not encounter disconfirming feedback and will be maintained. The net result is that people will come to perceive others as less talented than they really are (once again, even if expectations were initially accurate on average).

Implications for Negotiation

The costs of the small-pie/large-slice biases. One implication of these biases is that negotiators over time may become overconfident about their negotiating abilities. If negotiators always think they are claiming 70% of the surplus, they will rarely stop to scrutinize their skills. A second implication is that negotiators concede more of the surplus than they need to. Should they choose, they could press longer in a negotiation to try to claim more value.

A possible recommendation that follows from this research is that negotiators should strive to err in the direction of outside, not
inside, reservation-price estimates and make correspondingly ambitious first offers. The drawbacks of this recommendation are that extremely ambitious offers will lead to more negotiation impasses and may harm the relationship between the negotiators. However, we believe that this cost is more than outweighed by a number of benefits. First, Bottom and Paese (1999) have demonstrated empirically that the costs of inside and outside errors are not symmetric. For a given zone size, negotiators are better off making the mistake of an outside error than an inside error, because there is a range of outside errors that increases the amount of surplus claimed in a fairly linear fashion without increasing the probability of impasse by much. Second, the large-slice bias may be robust to extreme offers. That is, the person on the receiving end of aggressive negotiation tactics may still walk away from the negotiation thinking he or she claimed 60% of the surplus! This was the pattern that held in the small-zone condition of Study 1. The implication is that the small-pie bias may spontaneously salve the relationship wounds caused by aggressive bargaining. An interesting future research question is whether knowledge of the small-pie bias could help negotiators claim more value in distributive negotiations against negotiators who are unaware of the phenomenon and whether this benefit can come with little resulting harm to the relationship.

The benefits of the large-slice bias. Although this article has emphasized inaccuracy in social perceptions, it should be noted that inaccuracy is not always costly. For example, it is often beneficial to relationships if partners have optimistic views of each other (Murray, Holmes, & Griffin, 1996). Similarly, the large-slice bias is likely to be beneficial at a social level. Because the bias will tend to lead both negotiators satisfied with the terms of the deal, it will bode well for upholding the agreement and for the long-term relationship between the parties (Tenbrunsel, Wade-Benzoni, Moag, & Bazerman, 1998; Valley, Neale, & Mannix, 1995). The bias may also be functional at an individual level. A large number of Americans feel apprehensive about negotiating (Small, Gelfand, Babcock, & Gettman, in press), which in part explains the attractiveness of “no-haggle” automobile dealerships like Saturn and CarMax (Firm-price dealers, 1992). One beneficial byproduct of the large-slice bias may be an increase in confidence for otherwise anxious negotiators. Ignorance can be bliss for those less sure of their ability (Larrick, 1993). For novice negotiators, the increased willingness to negotiate and take risks may lead to better personal outcomes.

The large-slice bias in the field. One limitation of the current studies is that they were conducted only in an experimental setting. To address this, we offer preliminary evidence for the large-slice bias from an everyday negotiation. We asked participants in an executive MBA class on negotiation to consider their last car purchase and their last housing purchase. For each purchase, participants reported the sales price, an estimate of the lowest price the seller would have accepted, and the highest price they would have paid. The average imputed share was 63% for cars and 70% for houses, which were both significantly greater than 50%; cars, t(92) = 3.97, p < .0001; houses, t(93) = 6.01, p < .0001. Indeed, 80% of the car buyers and 80% of the house buyers gave imputed shares of 50% or more. The large-slice bias appears to be alive and well in everyday negotiation.

The small-pie bias in multiple-issue negotiation. These studies have focused on inferences in a distributive price negotiation, but not all negotiations involve just a single issue. How does the small-pie bias generalize to negotiations with multiple issues that are valued differently by each side? First, we propose a straightforward extension of the small-pie and large-slice biases to multiple-issue negotiations: Negotiators may believe that they have pushed their counterparts to the limit on each of several individual issues. Second, there may be an additional and related bias among negotiators who understand the logic of finding mutually beneficial (integrative) trades (Raiffa, 1982; Thompson, 2001). We have observed in our classes that students who reach agreement in a multiple-issue negotiation often believe that there are no profitable trades left to be made, even though their agreements often leave value on the table. In some respects, this faulty conclusion may arise from the fixed-pie bias, or the failure to recognize differences in priorities (Thompson & Hastie, 1990). However, we think the bias occurs even for well-trained integrative bargainers because of processes akin to those underlying the small-pie bias. After a great deal of posturing, arguments about limited concessions, and bluffs about priorities, both parties reach the conclusion that the current deal is the best they can do. In fact, it often feels like it is the only possible deal (especially in multiple-party negotiations). In this case, the expanded pie is perceived to be both small—because it was hard to find agreement—and fixed at its current size—there are no beneficial trades left to be made. Thus, each negotiator is likely to believe he or she has claimed not just a large slice of the pie but a large slice of the largest possible pie. We offer this as speculation and believe it would be an interesting research direction to pursue.

Conclusion

Negotiators systematically leave the table believing that they have pushed the settlement price close to their opponent’s limit, thereby claiming a large slice of a small pie. Although small-pie perceptions in everyday negotiations are undoubtedly fueled by self-enhancement needs, we argued that the feedback environment was sufficient for the effect in our studies: Erroneous estimates outside the zone were disconfirmed, whereas erroneous estimates inside the zone were self-fulfilling.

An important implication of asymmetric disconfirmation is that it can lead to population-level biases, even when initial expectations are accurate on average. We have speculated that other social inferences might also be asymmetrically disconfirmed. We hope that the construct of asymmetric disconfirmation contributes to the literature on self-fulfilling prophecies by showing how social beliefs can be subject to systematic bias.

Finally, the issue of learning from feedback has long been an important topic in psychology (Brehmer, 1980; Bush & Mosteller, 1955; Einhorn & Hogarth, 1978; Estes, 1950) but has become of increasing importance to research in other fields (Camerer & Ho, 1999; Denrell & March, 2001; Hoch & Deighton, 1989; Kagel, 1995; March, 1991; Roth & Erev, 1995; Sander, 1995). We hope that the concept of asymmetric disconfirmation will be of value in future research on learning from imperfect feedback.

References

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of Experimental Psychology: Learning, Memory, and Cognition, 17, 734–752.


Appendix

A Model of Asymmetric Disconfirmation With Examples

We formalize asymmetric disconfirmation in the following simple model. Let \( \theta \) denote the true state of the world, and \( e_i \) and \( e_f \) denote the initial and final estimates about \( \theta \), respectively. In distributive negotiation, \( \theta \) is the reservation price of the counterpart, \( e_i \) is the initial estimate about the counterpart’s reservation price, and \( e_f \) is the estimate about the counterpart’s reservation price at the end of the negotiation. In Kelley and Stahelski’s (1970) studies, \( \theta \) represents the prisoners’-dilemma counterpart’s goals, \( e_i \) is the initial estimate about the counterpart’s goals, and \( e_f \) is the final estimate about the counterpart’s goals.

The following model of the learning process captures the essential ideas discussed in this article:

\[
e_f = \min(\theta, e_i)
\]

for the seller

and

\[
e_f = \max(\theta, e_i)
\]

for the buyer. (A1)

In this model, negotiators learn the actual reservation price, unless their initial estimate is “inside” \( \theta \). To show that this model implies the triangle hypothesis, we consider sellers, but the same analysis applies to buyers. Suppose that there are \( n \) equally likely states of the world, \( \theta_1, \ldots, \theta_n \), where \( \theta_i < \theta_{i+1} \). The equal-probability assumption is not essential but is useful for generating quantitative benchmarks. Equation 1 yields the following probability distribution of final estimates:

\[
\Pr(e_f|e_i) = \begin{cases} 
0, & e_f > e_i \\
\frac{n - i}{n}, & e_f = e_i \\
1 & e_f < e_i \end{cases}
\] (A2)

If we apply Equation 2 to the entire range of initial estimates, \( e_i = \theta_1, \ldots, \theta_n \), we get the triangle hypothesis, where elements of the matrix are:

\[
\begin{array}{cccccccc}
\text{\( e_f \)} & \theta_n & \cdots & \theta_i & \cdots & \theta_1 \\
\theta_n & 1 & \cdots & 1 & \cdots & 1 \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\
\theta_i & 0 & \cdots & n+1-i & \cdots & \cdots \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\
\theta_1 & 0 & \cdots & 0 & \cdots & \cdots \\
\end{array}
\]

It is easy to see that the triangle hypothesis results in a small-pie bias. Let \( E(\cdot) \) denote expected value. Then, if initial estimates are on average accurate, \( E(e_i) = \sum_i \theta_i/n \), final estimates will be biased, \( E(e_f) < \sum_i \theta_i/n \), because \( E(e_f) = \sum_i E(e_f|\theta = \theta_i)/n \), \( E(e_f|\theta = \theta_i) < \theta_i \), for all \( i < n \), and \( E(e_f|\theta = \theta_n) = \theta_n \).

We illustrate the model with a numerical example based on Figure 10. Imagine that a market exists in which there are 25 buyers and 25 sellers. The 25 buyers have reservation prices that range between $2,500 and $2,900, and there are an equal number (5) of buyers at each $100 increment. The average reservation price for buyers is $2,700. Sellers have a similar uniform distribution of expectations, and thus sellers’ estimates are imperfect but accurate on average. When buyers and sellers are randomly paired, they create the following joint distribution of dyads, under the simplifying assumption of a uniform joint distribution:

<table>
<thead>
<tr>
<th>Buyers’ actual RP ($)</th>
<th>2,900</th>
<th>2,800</th>
<th>2,700</th>
<th>2,600</th>
<th>2,500</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,900</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2,800</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2,700</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2,600</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2,500</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

The matrix below applies the model and shows the count of sellers with each final reservation-price estimate. Although sellers started with an accurate estimate of $2,700 on average, their final estimate is $2,580, which is the weighted average of 1/25 (2,900) + 3/25 (2,800) + 5/25 (2,700) + 7/25 (2,600) + 9/25 (2,500), thus exhibiting a small-pie bias.

<table>
<thead>
<tr>
<th>Sellers’ initial RP estimate ($)</th>
<th>Sellers’ final RP estimate ($)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,900</td>
<td>2,900</td>
<td>5</td>
</tr>
<tr>
<td>2,800</td>
<td>2,800</td>
<td>5</td>
</tr>
<tr>
<td>2,700</td>
<td>2,700</td>
<td>5</td>
</tr>
<tr>
<td>2,600</td>
<td>2,600</td>
<td>5</td>
</tr>
<tr>
<td>2,500</td>
<td>2,500</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
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Received June 7, 2004
Revision received June 9, 2005
Accepted January 24, 2006